STARTUP TEST PROCEDURE 1

CHEMICAL AND RADIOCHEMICAL MEASUREMENTS

1. PURPOSE

A. The principal objectives of the Chemical and Radiochemical Tests are to secure information on the chemistry and radiochemistry of the reactor coolant, and to determine that the sampling equipment, procedures, and analytical techniques are adequate to supply the data required to demonstrate that the chemistry of all parts of the entire reactor system meet specifications and process requirements.

B. Specific objectives of the test program include indirect observations of fuel clad integrity, evaluations of demineralizer operations by direct and indirect methods, measurement of filter performance, confirmation of condenser integrity, measurement and calibration of the off-gas system, and calibration of certain process instrumentation. Data for these purposes is secured for a variety of sources: plant operating records, regular routine coolant analysis, radiochemical measuremens of specific nuclides, and special chemical test on fluids.

2. CRITERIA

Level 1

A. Water quality must be known at all times and must remain within the guidelines of the water Quality Specifications.

B. The activities of gaseous and liquid effluents must be known and must conform to license limitations.

C. Chemical factors defined in the Technical Specifications and Fuel Warranty must be maintained within the limits specified.

3. RESULTS

Test Condition 6

Analysis of radiolytic gas in steam and chemical/radiochemical tests of reactor water, condensate demineralizer inlet and effluent, feedwater, off gas pre-treatment and plant vent were conducted. Measurements of stored water (clean demineralized water storage tank, cycled condensate storage tank, suppression pool, condenser hotwell, and heater drain tank) quality and condensate/feedwater systems filterable iron concentrations were taken. Reactor water quality was monitored during the no reactor water cleanup test.

Although all test results were within the Technical Specification limits, some parameters were outside the GE specified values. GE has evaluated these criteria exceptions and has found plant chemistry to be acceptable.

STARTUP TEST PROCEDURE 2

RADIATION MEASUREMENTS

1. PURPOSE

The purposes of this test are:

A. To determine the background radiation levels in the plant environs prior to operation for use as base data on activity build-up.

B. To monitor radiation at selected power levels to identify potential deficiencies and assure the protection of personnel during plant operation.

C. To provide sufficient data (exposure rate and dose equivalent rates) to allow comparison of the actual dose rates with the design dose equivalent rates outside selected plant shield structures and room entrances for potentially radioactive equipment.

2. CRITERIA

Level 1

A. The radiation doses of plant origin and the occupance times of personnel in radiation zones shall be controlled consistent with the guidelines of the standards for protection against radiation as outlined in 10CFR20, NRC General Design Criteria.

3. RESULTS

This test was performed at test condition 6. The results of the radiation surveys showed that all radiation levels were within the respective criteria.

STARTUP TEST PROCEDURE 5

CONTROL ROD DRIVE SYSTEM

1. PURPOSE

A. The purpose of this test is as follows:

1. To demonstrate that the Control Rod Drive (CRD) system operates properly over the full range of primary coolant temperatues and pressures from ambient to operating.

2. To determine the initial operating characteristics of the entire CRD system.

3. To demonstrate the optimum settings for the CRD flow control loop by analysis of the transients induced in the CRD Hydraulic System by means of CRD flow setpoint changes.

4. To verify that the flow control valve (FCV) closes to a minimum position within 10 to 30 seconds in response to the maximum error signal (scram).

5. To demonstrate that the FCV maintains a constant flow within $\pm$3 gpm as the reactor pressure changes from a shutdown condition to the normal operating pressure.

2. CRITERIA

Level 1.

A. Each CRD must have a normal withdrawal speed less than or equal to 3.6 inches per second indicated by a full 12 foot stroke in greater than or equal to 40 seconds.

B. The mean scram time of all operable CRDs with functioning accumulators must not exceed the following times: (Scram time is measured frm the time the pilot scram valve solenoids are de-energized).

Position Inserted From Fully Withdrawn	Scram Time (Seconds)
45	0.43
39	0.86
25	1.93
05	3.49

C. The mean scram time of the three fastest CRDs in a two by two array must not exceed the following times: (Scram time is measured from the time the pilot scram valve solenoids are deenergized).

Position Inserted From Fully Withdrawn	Scram Time (Seconds)
45	0.45
39	0.92
25	2.05
05	3.70

D. The scram insertion time of each control rod from full out to position 5, based on de-energization of the scram pilot valve solenoids as time zero, shall not exceed 7.0 seconds.

Level 2.

A. Each CRD must have a normal insertion or withdrawal speed of 3.0 $\pm$ 0.6 inches per second indicated by a full 12-foot stroke in 40 to 60 seconds.

B. With respect to the CRD Friction tests, if the differential pressure variation exceeds 15 psid for a continuous drive in, a settling test must be performed, in which case, the differential settling pressure should not be less than 30 psid nor should it vary more than 10 psid over a full stroke. Lower differential pressures are indicative of excessive friction.

3. Results

Test Condition 3

CRD scram timing (section 10.2.J) was performed in conjunction with STP-25, MSIV Full Isolation and STP-27, Generator Load Rejection.

Scram times for 25 drives were obtained in conjunction with STP-25 and their 90% times were within the level 1 acceptance criteria (less than or equal to 7.0 seconds). See Table 1.

Scram times for 23 drives were obtained in conjunction with STP-27 and their 90% times were within the level 1 acceptance criteria (less than or equal to 7.0 seconds). See Table 1.

All CRD testing at test condition 6 was satisfactorily completed.

TABLE 1

TEST CONDITION 6 SCRAM TIMES

Slowest 90% scram time in conjunction with STP-25:	CRD 30-19, 2.564 seconds
Slowest 90% scram time in conjunction with STP-27:	CRD 30-43, 2.556 seconds

STARTUP TEST PROCEDURE 9

WATER LEVEL MEASUREMENT

1. PURPOSE

A. The purpose of this test is as follows:

1. To check the calibration of the various narrow range and wide range indicators.

2. To measure the reference leg temperature and recalibrate the narrow and wide range instruments if the measured temperature is different than the value assumed during the initial calibration.

3. To collect plant data which can be used to investigate the effects of core flow velocity, carry-under, and subcooling on indicated wide range level.

2. CRITERIA

Level 2

A. The narrow range level indicator readings on the instruments used for feedwater level control (1C34-R606A-C) should agree within $\pm$1.5 inches of their average reading.

B. The narrow range level indicator readings on the instruments not used for feedwater level control (1B21-N024A-D, 1B21-N038A-B, 1B21-N100A-B, and 1B21-N101A-B) should agree within $\pm$3.0 inches of their average reading.

C. The wide range level system indicators (1B21-N026A-D, 1B21-N031A-D, 1B21-N036A-D, 1B21-N037A-D, 1B21-R604, 1C61-R010, 1B21-R623A-B should agree within $\pm$6 inches of the average reading.

3. Results

A. Test Condition 6.

1. All narrow and wide range level instruments satisfied their respective level 2 criteria (see Table 1).

Table 1 (TC 6)

INDICATOR	READING *	WR. AVE*	ACCEPTANCE CRITERIA *	ACTUAL DEVIATION FROM AVERAGE *
1B21-NO36C	23	21.1	+ 6.0	+1.9
1B21-NO26B	23	21.1	± 6.0	+1.9
1B21-NO37B	20	21.1	± 6.0	-1.1
1B21-NO36D	22	21.1	± 6.0	+0.9
1B21-NO37D	22	21.1	± 6.0	+0.9
1B21-NO26C	21	21.1	± 6.0	-0.1
1B21-NO31B	20	21.1	± 6.0	-1.1
1B21-NO31D	22	21.1	± 6.0	+0.9
1B21-NO36A	21	21.1	± 6.0	-0.1
1B21-NO37C	17	21.1	± 6.0	-4.1
1B21-NO37A	18	21.1	± 6.0	-3.1
1B21-NO26D	20	21.1	± 6.0	-1.1
1B21-NO36B	20	21.1	± 6.0	-1.1
1B21-NO26A	22.5	21.1	± 6.0	+1.4
1B21-NO31A	23	21.1	± 6.0	+1.9
1B21-NO31C	20	21.1	± 6.0	-1.1

Table 1 (TC 6) (Cont'd)

INDICATOR	READING *	WR. AVE*	ACCEPTANCE CRITERIA *	ACTUAL DEVIATION FROM AVERAGE *
1B21-R884A	24	21.1	± 6.0	+2.9
1B21-R884B	22	21.1	± 6.0	+0.9
1B21-R604	24	21.1	± 6.0	+2.9
1C61-R010	18	21.1	± 6.0	-3.1
1B21-N024A	34.5	34.3	± 3.0	+0.2
1B21-N024B	35	34.3	± 3.0	+0.7
1B21-N024C	35	34.3	± 3.0	+0.7
1B21-N024D	34	34.3	± 3.0	-0.3
1B21-N038A	34	34.3	± 3.0	-0.3
1B21-N038B	33	34.3	± 3.0	-1.3
1B21-N100A	35	34.3	± 3.0	+0.7
1B21-N100B	35	34.3	± 3.0	+0.7
1B21-N101A	33	34.3	± 3.0	-1.3
1B21-N101B	34	34.3	± 3.0	-0.3
1C34-R606A	37	36.3	± 1.5	+0.7
1C34-R606B	36	36.3	± 1.5	-0.3
1C34-R606C	36	36.3	± 1.5	-0.3

* All Data have units in inches

STARTUP TEST PROCEDURE 11

LPRM CALIBRATION

1. PURPOSE

   A. To verify proper response of the Local Power Range Monitoring (LPRM) System to local changes in the reactor power level.

   B. To calibrate the LPRM system.

2. CRITERIA

   Level 2

   A. Each LPRM reading will be within ± 10% of its calculated value.

3. RESULTS

   The LPRM detectors were successfully calibrated to read proportional to the neutron flux at their locations. This was accomplished by using the Traversing Incore Probe (TIP) System.

   The test was satisfactorily completed at test condition 6 and all applicable criteria were met.

STARTUP TEST PROCEDURE 12

APRM CALIBRATION

1. PURPOSE

A. The purpose of this test is to calibrate the Average Power Range Monitor (APRM) system.

2. CRITERIA

A. Level 1

1. The APRM channels must be calibrated to read gerater than or equal to the actual core thermal power. However, recalibration of the APRM system will not be necessary from safety considerations if at least two APRM channels per RPS trip circuit have readings greater than or equal to actual core thermal power.

2. The APRM scram and rod block setpoints shall be set no higher than the limits specified in the Technical Specifications and the fuel warranty document.

3. In the STARTUP mode, all APRM channels must produce a scram at less than or equal to 15% of rated core thermal power.

B. Level 2

1. If the above level 1 criteria are satisfied, then the APRM channels will be considered to be reading accurately if they agree with the heat balance to within $\pm$ 7% of rated core thermal power.

3. RESULTS

Testing at test conditions 6 and Warranty Run were successfully completed, and all applicable criteria were met. The APRM's were adjusted to the results of an OD-3 heat balance, and alarm and trip settings were demonstrated to be less than or equal to their respective limits.

STARTUP TEST PROCEDURE 13

PROCESS COMPUTER

1. PURPOSE

   A. The purpose of this test is to verify the performance of the process computer under plant operating conditions.

2. CRITERIA

   A. Level 2

      1. Programs OD-1, P1 and OD-6 will be considered operational when:

         A. The MCPR calculated by BUCLE and the process computer either:

            1. Are in the same fuel assembly and do not differ in value by more than 2%, or

            2. For the case in which the MCPR calculated by the process computer is in a different assembly than the calculated by BUCLE, for each assembly, the MCPR calculated by the two methods shall agree within 2%.

         B. The maximum LHGR calculated by BUCLE and the process computer either:

            1. Are in the same fuel assembly and do not differ in value by more than 2%, or

            2. For the case in which the maximum LHGR calculated by the process computer is in different assembly than that calculated by BUCLE, for each assembly, the maximum LHGR's calculated by the two methods shall agree within 2%.

         C. The MAPLHGR calculated by BUCLE and the process computer either:

            1. Are in the same fuel assembly and do not differ in value by more than 2%, or

2. For the case in which the MAPLHGR calculated by the process computer is in a different assembly than that calculated by BUCLE, for each assembly, the MAPLHGR's calculated by the two methods shall agree within 2%.

D. The LPRM calibration factor calculated by BUCLE and the process computer agree to within two percent (2%).

E. The remaining programs will be considered operational upon successful completion of the static and dynamic testing.

3. RESULTS

Test Condition 6

Program testing at test condition 6 has been successfully completed. All applicable criteria were satisfied.

Thermal Limit data at 98.6% power:

A. MLHGR Comparison

Method	MFLPD	Location
P1	0.819	11-18-12
BUCLE	0.818	11-18-12

B. MAPLHGR Comparison

Method	MAPLHGR	Location
P1	9.93	11-18-12
BUCLE	9.92	11-18-12

C. MCPR Comparison

Method	MCPR	Location
P1	1.525	13-16
BUCLE	1.527	13-16

STARTUP TEST PROCEDURE 16

SELECTED PROCESS TEMPERATURES

1. PURPOSE

A. The purposes of this test are as follows:

1. To assure that the measured bottom head drain temperature corresponds to bottom head coolant temperature during normal operations.

2. To identify any reactor operating modes that could cause temperature stratification.

3. To determine the proper setting of the low flow control valve limiter for the recirculation pumps to avoid coolant temperature stratification in the reactor pressure vessel bottom head region.

4. To familiarize plant personnel with the temperatue differential limitations of the reactor system.

2. CRITERIA

A. Level 1.

1. The reactor recirculation pumps shall not be started nor flow increased unless the coolant temperatures between the steam dome and bottom head drain are within 145^{O}F (81^{O}C).

2. The recirculation pump in an idle loop must not be started unless the loop suction temperature is within 50^{O}F (28^{O}C) of the active loop suction temperature if one pump is idle or the steam dome temperature if two pumps are idle.

B. Level 2.

1. During two pump operation at rated core flow, the bottom head coolant temperature, as measured by the bottom drain line thermocouple, should be within 30^{O}F (17^{O}C) of the recirculation loop temperatures.

3. RESULTS

Test Condition 6

Analysis of the test data showed no evidence of thermal stratification in the event of single recirculation pump trips. The following maximum delta temperatures were observed during testing.

One Pump Trip:	Steam Dome - Bottom Head	32.8°F
	Idle Loop - Active Loop	7°F
Two Pump Operation:	Bottom Head - Recirc Loop	5°F

STARTUP TEST PROCEDURE 17

SYSTEM EXPANSION

1. PURPOSE

A. Verify that the reactor drywell piping system is free and unrestrained with regard to thermal expansion.

B. Verify that suspension components are functioning in the specified manner.

2. CRITERIA

A. Level 1

1. There shall be no evidence of blocking of the displacements of any system component caused by thermal expansion of the system.

2. Electrical cables shall not be fully stretched.

3. Hangers shall not be bottomed our or have the spring fully stretched.

4. Snubbers shall be in the operating range about the midpoint of the total travel range at operating temperature.

5. The measured steady state displacement of the recirculation and main steam systems shall not exceed the allowable values.

B. Level 2.

1. At a steady-state condition, the displacements of instrumented points with displacement measuring devices shall not vary from the calculated values. If measured displacements do not meet these criteria, the piping design engineer must be contacted to analyze the data with regard to design stresses.

2. During the heatup cycle, the trace of instrumented points on the main steam and recirculation systems shall fall within a range of 150 percent of the calculated value from the initial cold position in the direction of the calculated value and 50 percent of the calculated value from the initial position in the opposite direction of the calculated value.

3. Hangers will be in their operating range between the hot and cold settings.

3. RESULTS

Test Condition 6

Displacements of instrumented points were recorded at steady state power. Displacements for certain points exceeded Level 2 criteria but analyses by General Electric and Sargent and Lundy have shown these exceptions to be acceptable with actual displacements yielding acceptable stress levels.

STARTUP TEST PROCEDURE 18

CORE POWER DISTRIBUTION

1. PURPOSE

A. The purposes of this test are:

1. To determine the core power distribution in three dimensions.

2. To determine the reproducibility of the Traversing In-Core Probe (TIP) system readings.

2. ACCEPTANCE CRITERIA

A. Level 2

1. The total TIP uncertainty (including random noise and geometric uncertainties) obtained by averaging the uncertainties for all data sets must be less than 6.0%.

NOTE

A minimum of two and a maximum of six data sets may be used to meet the above criterion.

3. RESULTS

Test Condition 6

Tip data taken at this test condition was evaluated along with that taken at test condition 3. The total TIP uncertainty for both data sets was found to be 2.47%.

STARTUP TEST PROCEDURE 19

CORE PERFORMANCE

1. PURPOSE

A. The purpose of this test is to evaluate the following core performance parameters at Test Conditions 1 through 6:

1. Maximum Linear Heat Generation Rate (MLHGR).

2. Minimum Critical Power Ration (MCPR).

3. Maximum Average Planar Linear Heat Generation Rate (MAPLHGR).

4. Core Thermal Power (CTP).

2. CRITERIA

A. Level 1.

1. The Maximum Linear Heat Generation Rate (MLHGR) of any rod during steady state conditions shall not exceed 13.4 Kw/ft.

2. The steady state Minimum Critical Power Ratio (MCPR) shall not exceed the limits specified in the plant technical specifications.

3. The Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) shall not exceed the limits shown specified in the plant technical specifications.

4. Steady State reactor power shall be limited to 3323 MWt and values on or below the analyzed flow control line.

3. RESULTS

The core performance parameters were demonstrated to be within the range required by the Technical Specifications for Test Condition 6 and Warranty Run (Table 1).

Table 1

Core Performance Data

Core Parameter	Value TC 6	Value W.Run	Level 1 Criteria Limit
CTP (MWt)	3237		3268
		3256	3270
MLHGR	11.38	11.0	13.4
MCPR	1.52		1.24
		1.513	1.242
MAPLHGR	10.2		12.05
		9.95	12.06

STARTUP TEST PROCEDURE 20

STEAM PRODUCTION

1. PURPOSE

   A. To demonstrate that the nuclear steam supply system is providing steam sufficient to satisfy all appropriate warranties as defined in the contract.

2. CRITERIA

   A. Level 1.

      1. The NSSS parameters as determined by using normal operating procedures shall be within the appropriate license restrictions.

3. RESULTS

The steam production verification initially scheduled to be performed during 100 hours of continuous operation at near rated power was actually performed in two parts. The first two of three scheduled data sets were taken during a 67 hour period of continuous operation at rated power. The plant was then forced to reduce power due to a non-NSSS problem. By mutual agreement with GE, the third data set was taken after the plant was able to return to rated power and stabilize.

All applicable criteria were met during the test period.

STARTUP TEST PROCEDURE 22

PRESSURE REGULATOR

1. PURPOSE

A. To determine the optimum settings for the pressure control loop by analysis of the transients induced in the reactor pressure control system by means of the pressure regulators.

B. To demonstrate the takeover capability of the backup pressure regulator via simulated failure of the controlling pressure regulator and to set the regulator setpoint difference between the two regulators to an appropriate value.

C. To demonstrate smooth pressure control transition between the turbine control valves and bypass valves when the reactor steam generation exceeds the steam flow used by the turbine.

2. CRITERIA

A. Level 1.

1. The transient response of any EHC system-related variable to any test input must not diverge.

B. Level 2.

1. System-related variables may contain oscillatory modes of response. In these cases, the decay ratio for each controlled mode of response must be less than or equal to 0.25.

2. The response time from pressure setpoint unput until the pressure peak of the pressure peak of the pressure regulator inlet pressure must be less than or equal to 10 seconds, with the Recirculation Flow Control System in the Position Command Mode only.

3. Pressure control system deadband, delay, etc., shall be small enough that steady state limit cycles (if any) shall produce steam flow variations no larger than $\pm$ 0.5 percent of rated steam flow.

4. The normal difference between regulator setpoints must be small enough that the peak neutron flux and peak vessel pressure remain below the scram settings by 7.5 percent and 10 psi respectively, for the Regulator Failure Test performed at Test Condition 6.

3. RESULTS

A. Test Condition 6

Pressure regulator system testing was performed with the turbine-generator load selector set so the pressure transients were controlled by 1) the turbine control valves, 2) turbine control valves and the turbine bypass valves, or 3) the turbine bypass valves. For each of these operating conditions, pressure setpoint step changes and simulated regulator failure tests were performed.

All applicable test results were acceptable and applicable criteria were satisfied.

STARTUP TEST PROCEDURE 23A

FEEDWATER CONTROL SYSTEM

1. PURPOSE

A. The purpose of this test is as follows:

1. To demonstrate satisfactory reactor water level and feedwater flow rate control. Measurements of feedwater system stability and performance are analyzed for this determination.

2. ACCEPTANCE CRITERIA

A. Level 1

1. In the automatic mode, the response of any level system controlled variable to any test input change or disturbance must not diverge.

B. Level 2

1. Level control system-related variables may contain oscillatory modes of response. In thes cases, the decay ratio for each controlled mode of response. In these cases, the decay ratio for each controlled mode of response must be less than or equal to 0.25.

2. The average rate of response of the feedwater turbines to large (greater than 20%) step disturbance shall be between 10 percent to 25 percent of pump rated flow/second This average response rate will be assessed by determining the time required to pass linearly through the 10% and 90% response points of the flow transient.

3. The dynamic flow response of each feedwater actuator (turbine or valve) to small (less than 10%) step distrubances in the manual mode shall be:

a. Dead Time ≤1.0 sec

b. Maximum time to 10%* ≤1.1 sec.

c. Maximum time from 10% to 90%* ≤1.9 sec.

d. Settling time to within ±5%* of the final value ≤14.0 sec.

e. Peak overshoot* ≤15%

* % of input step disturbance.

3. RESULTS

At test condition 6, level setpoint steps with both turbine driven reactor feed pumps in 3-element were successfully completed. All applicable criteria were satisfied.

STARTUP TEST PROCEDURE 23-B

FEEDWATER SYSTEM, LOSS OF FEEDWATER HEATER

1. PURPOSE

A. To demonstrate adequate response to feedwater heater loss.

2. CRITERIA

A. Level 1

i. The maximum feedwater temperature decrease due to a single failure case must be less than or equal to 100°F. The resultant MCPR must be greater than the fuel thermal safety limit.

2. The increase in simulated heat flux cannot exceed the predicted level 2 value by more than 2%. The predicted value will be based on the actual test values of feedwater temperature change and power level.

A. Level 2.

1. The increase in simulated heat flux cannot exceed the predicted value referenced to the actual feedwater temperature change and power level.

3. RESULTS

Testing was satisfactorily completed at test condition 6. The feedwater temperature change and minimum MCPR observed when extraction steam to both high pressure heaters was isolated were 56.9°F and 1.727 respectively. The observed delta heat flux of 7.9% was well within the predicted value of 8.73%.

STARTUP TEST PROCEDURE 23C

FEEDWATER SYSTEM, FEEDWATER PUMP TRIP

1. PURPOSE

A. To demonstrate the capability of the automatic core flow runback feature to prevent low water level scram following the trip of one feedwater pump.

B. To demonstrate the ability of the standby motor driven feedwater pump to maintain water level if the turbine driven system is totally lost.

2. CRITERIA

Level 2

A. A scram must not occur from low water level following a trip of one of the operating feedwater pumps. There should be greater than 3 inch water level margin to scram for a feedwater pump trip initiated at 100% power conditions.

3. RESULTS

Testing was successfully completed at test condition 6 and all applicable criteria were satisfied.

Test results determined a 9.9" margin to a low level scram at 100% core thermal power.

Analysis of transient recorder data determined that the level controller behaved as predicted in the Control Systems Design Report (CSDR) in response to the reactor water level drop induced by the feedwater pump trip.

STARTUP TEST PROCEDURE 23D

FEEDWATER SYSTEM, MAXIMUM FEEDWATER RUNOUT CAPABILITY.

1. PURPOSE

The purpose of this teste is to determine the maximum feedwater runout capability.

2. CRITERIA

Level 1

A. The feedwater flow runout capability must not exceed the assumed value in the FSAR.

3. RESULTS

A. Test Condition 6

Turbine driven feed pump performance data was taken during the power ascension to Test Condition 6. Then, each turbine driven feed pump was run up to it's high speed stop to verify that it's capacity was less than that assumed in the FSAR for a runout condition. The test results are as follows:

Measured Runout Flow = 18.77 Mlb/hr

FSAR Assumed Runout Flow = 19.22 Mlb/hr

STARTUP TEST PROCEDURE 24

TURBINE VALVE SURVEILLANCE

1. PURPOSE

A. The purpose of this test are as follows:

1. To demonstrate acceptable procedures and maximum power levels for surveillance testing of the main turbine control, stop, and bypass valves withot producing a reactor scram.

2. To establish baseline data for evaluating test condition acceptability with respect to PCIOMR during future startup tests.

2. ACCEPTANCE CRITERIA

A. Level 1

1. The decay ratio of an oscillatory response must be less than 1.0.

B. Level 2

1. The peak neutron flux must be at least 7.5 percent below the scram trip setting. The peak heat flux must remain at least 5 percent below its scram trip setting. The peak vessel pressure must remain at least 10 psi below the high pressure scram setting.

2. The peak steam flow in each line must remain 10 percent below the high steam flow isolation trip setting.

3. The decay ratio of any oscillatory response must be less than 0.25, when operating above the minimum core flow for the recirculation master manual mode.

3. RESULTS

Testing was completed during the ascension to test condition 6 at 70% and 90% core thermal power (CTP) and again at test condition 6 with power at 95% of rated.

Testing yielded satisfactory results with the following margins to scram:

Neutron Flux	12%
Heat Flux	14.4%
Vessel Pressure	54.5 psi

Some oscillatory behavior was noted during the induced pressure transient but specific startup tests on the applicable systems have shown the control systems to be stable.

STARTUP TEST PROCEDURE 25

MAIN STEAM ISOLATION VALVES

1. PURPOSE

A. The purpose of this test is as follows:

1. To functionally check the main steam line isolation valves (MSIV's) for peroper operation at selected power level.

2. To determine isolation valve closure times.

3. To determine the maximum power at which full closures of a single valve can be performed without a scram.

4. To determine the reactor transient behavior resulting from the simultaneous full closure of all MSIV's.

2. CRITERIA

A. Level 1

1. MSIV closure time, excluding electrical delay shall be no faster than 3.0 seconds and including electrical delay shall no slower than 5.0 seconds (each valve, not averaged).

2. The positive change in vessel dome pressure occurring within 30 seconds after the full MSIV closure from greater than 95% of rated power must not exceed the Level 2 criteria, 6.2.D, by more than 25 psi. The positive change in simulated heat flux shall not exceed the Level 2 criteria, 6.2.D, by more than 2% of rated value.

3. Feedwater control systems settings must prevent flooding of the steam lines.

B. Level 2.

1. During full closure of individual valves:

a. Peak vessel pressure must be 10 psi (0.7 Kg/cm) below scram.

b. Peak neutron flux must be 7.5% below scram.

c. Steam flow in individual lines must be 10% below the isolation trip setting.

d. Peak heat flux must be 5% less than its trip point.

2. Initial action of RCIC and HPCS shall be automatic if the level 2 setpoint is reached, and system performance shall be within specification.

3. The relief valves must reclose properly (without leakage) following the pressure transient.

4. For the full MSIV closure from greater than 95% power, predicted analytical resulst based on beginning of cycle design basis analysis, assuming no equipment failures and applying appropriate parametric corrections, will be used as the basis to which the actual transient is compared. The following table specifies the upper limits of these criteria during the first 30 seconds following initiation of the indicated conditions:

Initial Conditions		Criteria	
Power (%)	Dome Pressure (psia)	Increse In Heat Flux (%)	Increase In Dome Pressure (psi)
100	1020	0	*

* To be determined based upon actual plant conditions at the time the test is performed.

3. RESULTS

The MSIV's were functionally tested at this test condition. Individual valve closure was performed on the fastest MSIV and the maximum power at which the full closure of a single valve can be performed was determined to be 90%. A simultaneous full closure of all MSIV's was initiated at 96% of rated power and reactor transient behavior observed. Individual valve closure times were determined. This test was successfully completed with all applicable acceptance criteria being satisfied for test condition 6.

STARTUP TEST PROCEDURE 26

RELIEF VALVES

1. PURPOSE

A. The purpose of this test is as follows:

1. To verify the proper operation of the primary system relief valves.

2. To determine each relief valve's capacity.

3. To verify that the discharge piping is not blocked.

4. To verify that each relief valve reseats following operation.

5. To obtain a transient recorder signature of each relief valve operation for subsequent comparisons.

6. To confirm proper overall functioning of the Low-Low Set Pressure Relief Logic.

7. To verify proper safety/relief valve discharge line backpressure.

2. CRITERIA

Level 1.

A. There should be positive indication of steam discharge during the manual actuation of each valve.

B. The sum total of the percentage corrected flow rates must be greater than 111.5% of the Nuclear Boiler warranted steam flow at 103% of the spring setpoint pressure of 1165 psig.

C. The Low-Low Set Pressure Relief logic shall function to preclude subsequent simultaneous SRV actuations following the initial SRV actuation due to the original pressurization transient.

Level 2.

A. No observable leakage shall exists following closure.

B. The pressure regulator must satisfactorily control the reactor transient and close the control and/or bypass valves by an amount equivalent to the relief valve steam flow.

C. The transient recorder signatures for each valve must be analyzed for a relative system response comparison. The dalay time (between trip and motion) shall be less than or equal to 0.1 seconds, and the response time (main disk stroke time) shall be less than or equal to 0.15 seconds.

D. No individual relief valve may have a flow rate (corrected to the setpoint pressure) that, considering measurement uncertainties, is less than 90%, or greate than 122.5%, of its expected flow rate of 862,400 lbs/hr at 103% of the spring setpoint pressure of 1146 psig

E. No more than 25% of the installed relief valves may have an individual corrected flow rate that is between 90% - 100% of their expected flow rates.

F. The total flow capacity of the safety relief valves used in the Automatic Depressurization System must be equal to or greater than 4.8×10^6 lbs/hr. at 1125 psig when the valve heaving the highest measured capacity is assumed to be out of service.

G. The selected MSRV with the highest nominal safety spring setting must indicate full open when manually actuated with its accumulator air supply isolated and vented.

H. Discharge line backpressure shall be comparable with information presented on the Nuclear Boiler Process Diagram.

I. When the Low-Low Pressure Relief logic functions, the open/close actions of the SRV's shall occur within $\pm$13 psi and $\pm$20 psi of their design points respectively.

3. RESULTS

Relief valve testing was performed in conjunction with the MSIV Closure and Generator Load Reject Tests at greater than 95% of rated power. During both tests, the Low-Low Pressure Relief Logic performed according to design. All other applicable criteria were also satisfied.

STARTUP TEST PROCEDURE 27

GENERATOR LOAD REJECTION

1. PURPOSE

A. The purpose of this test is to demonstrate the response of the reactor and its control system to protective trip in the turbine and the generator.

2. CRITERIA

Level 1

A. For Turbine and Generator trips there should be a delay of less than 0.1 seconds following the beginning of control or stop valve closure before the beginning of bypass valve opening. The bypas valves should be opened to a point corresponding to approximately 80 percent of their capacity within an additional 0.2 seconds, or 0.3 seconds total, from the beginning of control or stop valve closure motion.

B. Feedwater system settings must prevent flooding of the steam lines following these transients.

C. The two recirculation pump drive flow coastdown transient during the first three seconds must be equal to or faster than that specified in this procedure.

D. The positive change in vessel dome pressure occurring within 30 seconds after either generator or turbine trip must not exceed the Level 2 criteria by more than 25 psi.

E. The positive change in simulated heat flux shall not exceed the Level 2 criteria by more than 2% of rated value.

F. Turbine sped does not reach the point where a mechanical overspeed turbine trip would occur.

Level 2

A. There shall be no MSIV closure in the first three minutes of the transient and operator action shall not be required in that period to avoid the MSIV trip.

B. The positive change in vessel doem pressure and in simulated heat flux which occurs within the first 30 seconds after the initiation of either generator or turbine trip must not exceed the predicted values.

C. Electrical load transfers occur as designed.

D. The reactor shall not scram for initial thermal power at less than or equal to 25% of rated.

E. If the Level 1 criterion (6.1.c of this procedure) for the two recirculation pump drive flow coast down transient is passed, the data shall be analyzed within 3 weeks for compatibility with the safety analysis.

3. RESULTS

A generator load reject from 95.4% of rated power was successfully performed at test condition 6. All applicable test criteria were satisfied.

STARTUP TEST PROCEDURE 29

RECIRCULATION FLOW CONTROL SYSTEM

1. PURPOSE

The purposes of this test are:

A. To demonstrate the core flow system's control capability over the entire flow control range, including valve position, core flow, neutron flux, and load following modes of operation.

B. To determine that all electrical compensators and controllers are set for desired system performance and stability.

2. CRITERIA

Level 1

A. Position Loop Criteria

1. The position loop response to test inputs shall not diverge.

B. Flow Loop Criteria.

1. The flow loop response to test inputs shall not diverge.

C. Flux Loop Criteria.

1. The flux loop response to test inputs shall not diverge.

D. Load Following Loop Criteria.

1. The load following loop response to test inpouts shall not diverge.

E. Scram AVoidance and General Criteria.

1. None.

F. Flow Control Valve Duty Test Criteria.

1. None.

Level 2

A. Position Loop Criteria.

Gains and limiters shall be set to obtain the following response:

1. Maximum steady state reate of change of valve position shall be between 9 & 11% per second for a 100% position demand input. (Initial valve velocity may exceed this limit for a short time).

2. Gains shall be set to give as fast a response as possible for small position damand input within the overshoot criterion and without additional valve duty cycle. (See FCV duty criterion for valve duty cycle requirement.)

3. The decay ratio of any oscillatory controlled variable must be less than or equal to 0.25, when operating above the minimum core flow for Recirculation Master Manual mode. Below this minimum core flow, the decay ratio must be less than or equal to 0.50 with the recommendation that each control system be adjusted to meet less than or equal to 0.25 unless there is an identifiable perormance loss involved at higher power levels.

B. Flow Loop Criteria.

1. The decay ratio of any oscillatory controlled vairable must be less than or equal to 0.25, when operating above the minimum core flow for Recirculation Master Manual mode. Below this minimum core flow, the decay ratio must be less than or euqal to 0.50, with the recommendation that each control system be adjusted to meet less than or equal to 0.25 unless there is an identifiable operformance loss involved at higher power levels.

2. The flow loops provide equal flows in the two loops during steady state operation. Flow loop gains should be set to correct 90% of a flow imbalance in 20 $\pm$ 5 sec.

C. Flux Loop Criteria.

1. The decay ratio of any oscillatory controlled variable must be less than or equal to 0.25, when operating above the minimum core flow for Recirculation Master Manual mode (loops A and B receive command from a common point).. Below this minimum core flow, the decay ratio must be less than or equal to 0.50, with the recommendation that each control system be adjusted to meet less than or equal to 0.25 unless there is an identifiable performance loss involved at higher power levels.

2. For small flux command step changes of between 1%-5%, at near rated power, the following apply:

   a. Deadband, percent rated flux demand: less than or equal to 0.5.

   b. Delay time for flux demand steps, sec.: less than or equal to 0.8.

   c. Reponse time for flux demand steps, sec.: less than or equal to 2.5.

   d. Maximum allowable flux overshoot, for step demand of less than or equal to 20% of rated is, in percent: 2.

   e. Flux settling time, sec.: less than or equal to 15.

3. Switching between estimated and actual flow should not exceed 5 times/5 minutes at steady state

4. During flux step transient there should be no switching to actual flux or if switching does not occur, it should switch back to estimated flux within 20 seconds of the start of the transient.

5. The deadband of the flux controller for a flux demand step shall be less than or equal to .5% of rated flux demand.

D. Load Following Loop Criteria.

1. The decay ratio of any oscillatory controlled variable must be less than or equal to 0.25, when oeprating above te minimum core flow for Recirculation Master Manual mode. Bleow this minimum core flow, the decay ratio must be less than or equal to 0.50, with the recommendation that each control system be adjusted to meet less than or equal to 0.25 unless there is an identifiable performance involved at higher power levels.

2. The response to a step input of lss than 10% in load demand shall be such that the load demand error is within 10% fo the magnitude of the step within 10 seconds.

3. When a load demand step of greatr than 10% is applied (N%), the load demand error must be within 10% of the magnitude of the step within N seconds.

4. For large Auto Load following Recirculation sytem maneuvers along the 100 percent rod line, 90 percent of the commanded step power change (P) must be completed within (t) seconds:

   a. For 10 percent change, 9 percent within 10 seconds.

   b. For 20 percent change, 18 percent within 20 seconds.

   c. For 35 percent change, 31.5 percent within 35 seconds.

5. The Automatic Load following range along the 100 percent (Flow Control) rod line shall be at least 35 percent power (i.e., between 65 percent - 100 percent power).

E. Scram Avoidance and General Criteria. For anyone of the above loops' test maneuvers, the trip avoidance margins must be at least the following:

1. For APRM greater than or equal to 7.5%.

2. For simulated heat flux gerater than or equal to 5.0%.

3. The system response in any mode response shall produce steady steam flow limit cucle variations no larger than 0.5% of rated steam flow.

F. Flow Control Valve Duty Test Criteria.

1. The lfow control valve duty cycle in any operating mode shall not exceed 0.2% -Hz. Flow control valve duty cycle is defined as:

$$\frac{\text{Total valve travel (\%)}}{\text{2x time span in sec.}} \qquad (\% - Hz)$$

3. RESULTS

All applicable level 1 criteria were satisfied while testng at test condition 6.

Level 2 time response criteria were not met at this test condition. Testing determined that relatively slow controller settings were necessary in order to obtain minimum overshoot. These control system settings resulted in stable responses to the test inputs while maintaining acceptable response times.

STP-29 was satisfactorily completed at test conditon 6 and all applicable criteria were satisfied except as stated above.

STARTUP TEST PROCEDURE 30

RECIRCULATION SYSTEM

1. PURPOSE

A. Obtain recirculation system preformance data under different operational conditions, such as pump trip, flow coastdown, pump restart, and flow induced vibration.

B. To verify that no recirculation system cavitation will occur in the operating region of the power-flow map.

C. To verify that during the trip of one recirculation pump, the feedwater contrl system can satisfactorily control water level without a resulting turbine trip and/or scram.

D. To record and verify acceptable performance of the recirculation two pump circuit trip system.

2. CRITERIA

Level 1

A. The two pump drive flow coastdown transient during the first 3 seconds must be equal to or faster than that specified on Figure 14.2-7 of the FSAR.

Level 2

A. The water level, APRM and transients of simulated heat flux, pressure, drive and core flow for the one pump trip shall not exceed the predicted values.

B. The reactor water level margin to avoid a high level trip shall be greate than or equal to 3.0 inches during the one pump trip.

C. The simulated heat flux (TPM) margin to avoid a scram shall be greater than or equal to 5.0 percent during the one pump trip.

D. The recirculation system cavitation runback feature shall be adjusted such that a flow runback (transfer of recirc. pump power supplies from 60 Hz to 15 Hz) occurs prior to any observable cavitation in the Recirculation System.

E. During recirculation pump restart(s) the scram trip avoidance margins must be at least the following:

1. For APRM, greater than or equal to 7.5%.

2. For simulated heat flux, greater then or equal to 5.0%.

F. If the level 1 criteria for the two pump trip coastdown transient is met, the data shall be analyzed within two weeks to ensure compatibility with the safety analysis.

3. RESULTS

A. The following tests were successfully completed at test condition 6:

- system performance data acquisition,

- recirculation one pump trip and restart,

- single loop flow drop data acquisition,

- balanced flow data acquisition.

All testing satisfied the acceptance criteria.

STARTUP TEST PROCEDURE 33

DRYWELL PIPING VIBRATION

1. PURPOSE

A. The purpose of this test is to verify that the main steam, reactor recirculation, and feedwater piping have acceptable vibration.

2. CRITERIA

Level 1.

A. The mesured amplitude for vibration of the recirculation system during recirculation pump trips and subsequent coast down shall not exceed the allowable values.

B. The measured amplitude for vibration of the main steam lines during relief valve operation shall not exceed allowable values.

C. The measured amplitude for steady state vibration of the recirculation and main steam sysatems shall not exceed allowable values.

D. The measured amplitude for vibration of the main steam lines due to turbine stop valve trip and relief valve operation shall not exceed allowable values.

Level 2.

A. The mesured amplitude of vibration of the main steam system following relief valve operation and turbine stop valve trip should nt exceed the expected values.

B. The measured amplitude of vibration of the main team and recirculation systems during steady state operation should not exeed the expected values.

C. The measured vibrational stresses induced in the feedwater system following trip of one and both turbine driven feed pumps and during steady stat operations should not exceed the expected stresses.

3. RESULTS

At Test Condition 6, steady state vibration measurements were made and found to be acceptable. Transient vibration measurements were also made at this test condition. Main steam line vibration due to a generator trip (STP-27) was found to be acceptable. Main Steam line vibration induced by a full MSIV isolation (STP-25) was within criteria limits. Recirculation system vibration induced by RHR shutdown cooling operation (STP-71) and by recirculation pump trip and restart (STP-30) were within criteria limits.

During the course of test it was determined by General Electric that four (4) of the installed sensors were inoperative. The loss of this instrumentation had no impact on the test because the measurements from the functioning instrumentation indicated values which were well within acceptance criteria limits.

STARTUP TEST PROCEDURE 34

REACTOR INTERNALS VIBRATION

1. PURPOSE

A. The purpose of this test is to obtain vibration measurements on the jet pumps to confirm the mechanical integrity of the system with respect to flow induced vibration and to verify the accuracy of the analytical vibration model. This test is in conformance with Regulatory Guide 1.20 requirements for Non-Prototype. Category II Plants (similar to prototype but some component differences).

2. CRITERIA

Level 1.

A. The peak stress intensity may exceed 10,000 psi (single amplitude) when the component is deformed in a manner corresponding to one of its normal or natural modes but the fatigue usage factor must not exceed 1.0.

Level 2.

A. The peak stress intensity shall not exceed 10,000 psi (single amplitude) when the component is deformed in a manner corresponding to one of its normal or natural modes. This is the low stress limit which is suitable for sustained vibration in the reactor environment for the design life of the reactor components.

3. RESULTS

Vibration measurements were taken during the Recirculation Pump Trip and the Generator Load Reject Transient Tests and during steady state operation at various points on the power vs flow operating map.

Although the Level 2 vibration criteria at certain points was exceeded during the high active loop flow operation which exists immediately after a recirc pump trip, this is a transient condition and is therefore not expected to cause any operational problems. All criteria were met in the normal single loop and two loop operating regions of the power vs flow map as well as the extended core flow operating region.

STARTUP TEST PROCEDURE 35

RECIRCULATION SYSEM FLOW CALIBRATION

1. PURPOSE

A. The purpose of this test is to perform a complete calibration of the installed recirculation system flow instrumentation.

2. ACCEPTANCE CRITERIA

A. Level 2.

1. Jet pump intrumentation shall be adjusted such that the jet pump total flow recorder will provide a correct core flow indication at rated conditions.

2. The APRM/RBM flow bias instrumentation shall be adjusted to function properly at rated conditions.

3. RESULTS

The recirculation system flow calibration was successfully performed at test condition 6. The core flow instrumentation was adjusted to provide accurate flow indication based on jet pump flows.

No adjustments were performed on the loop drive flow instrumentation since these flows were already conservatively adjusted per normal plant surveillance procedures.

All applicable criteria were satisfied at this condition.

STARTUP TEST PROCEDURE 71
RESIDUAL HEAT REMOVAL SYSTEM

1. PURPOSE

A. To demonstrate the ability of the Residual Heat Removal (RHR) System to remove residual and decay heat from the nuclear system so that refueling and nuclear servicing may be performed. This will be demonstrated from both the control room and the remote shutdown panel.

B. To demonstrate the ability of the RHR system, in conjunction with the Reactor Core Isolation Cooling (RCIC) System, to condense steam.

2. CRITERIA

Level 2

A. The RHR System shall be capable of operating in tahe steam condensing (with both 1 and 2 heat exchangers), suppression pool cooling, and shutdown cooling moes (with either heat exchanger operating) at the flow rates and temperature differentials indicated on the process diagrams.

B. In the steam condensing mode, for small disturbances, each variable must have a decay ratio less than 0.25 throughout each controller's expected operating range.

C. The time to place the RHR heat exchangers in the steam condensing mode with the RCIC using the heat exchanger condensate flow for suction shall be one-half hour or less.

D. The RHR System performance in the shutdown cooling mode shall not be less than that indicated on the process diagram.

3. RESULTS

Test Condition 6

The ability of the shutdown cooling mode of RHR to establish a cooldown rate was demonstrated at Test Condition 6. The heat removal rate was large enough that bypass flow around the RHR heat exchanger was required to avoid exceeding the Tech Spec cooldown limit of 100^{o}F/hour. With the bypass open, it was not possible to obtain a set of performance data which could be compared to the process diagram, though performance was estimated from previous test conditions. The failure to make an exact comparison, though a Level 2 criteria violation, is not of major concern because the estimated preformance was close to that expected and the demonstration of system performance greatly exceeded the cooldown required at the test condition.

STARTUP TEST PROCEDURE 74

OFF-GAS SYSTEM

1. PURPOSE

A. The purpose of this test is as follows:

1. To verify the proper operation of the Off-Gas System over its expected operating parameters.

2. To determine the performance of the activated carbon absorber.

2. CRITERIA

A. Level 1

1. The release of radioactive gaseous and partaiculate effluents must not exceed the limits specified in the site Technical Specifications.

2. There shall be no loss of flow of dilution steam to the non-condensing stage when the steam jet air ejectors are pumping.

B. Level 2

1. The system flow, pressure temperatue, and relative humidity shall comply with the design specifications.

2. The catalytic recombiner, the hydrogen analyzer, the activated carbon beds, and the filters shall be oerating properly during operation, i.e., there shall be no gross malfunction of these components.

3. RESULTS

The release of radioactive gaseous and particulate effluents was demonstrated to be within the limits specified in the LTechnical Specifications during test condition 6.

There was no loss of dilution steam to the uncondensing stage when the SJAE's are pumping during test condition 6.

The following level 2 design specification criteria were not satisfied during Test Condition 6:

a. Off-Gas Flow to After Filter (Normal Mode)

b. Off-Gas Condenser Outlet Temperature (Normal Mode)

c. Gas Reheater Outlet Dewpoint (Normal Mode)

d. Adsorber Vault Temperature (Normal Mode)

e. Adsorber vessel (1N62-D014) Temperature (Normal Mode).

The Off-Gas Condenser Outlet Temperature was indicating upscale. The level 2 criteria is less than 154°F, and the design limit is 50° - 160°F. The indicator only reads to 150°F. This fact, in conjunction with the fact that other system parameters downstream of the condenser were within limits, is good indication of no gross malfunctioning of equipment (level 2).

The Gas Reheater Outlet Dewpoint instrumentation and the Adsorber Vault Temperature instrumentation were not operable at the time of the test. The Moisture Separator Outlet Temperature indication assured the system dewpoint was not a significant problem. Local indication of the vault temperature was within specifications. A station work request has been initiated to correct the instrumentation problems.

The Off-Gas Flow to After Filters was 30 scfm above its criteria in test condition 3. A station work request addressed this problem and a leak in the condenser boot was found and repaired. The flow is presently 6-7 scfm above its level 2 criteria. This does not represent any gross malfunctioning of the system (level 2).

The temperature of the Adsorber Vessel was slightly below its level 2 criteria limit. All other vessel temperatures were well within specifications, thereby not representing an operating problem nor malfunctioning of equipment.

This test was successfully completed for test condition 6. All applicable criteria were satisfied except as stated above.

Table 1

Design Specification Deviation (Test Condition 6)

PARAMETER	ACTUAL VALUE	CRITERIA VALUE
Off Gas Condenser Outlet Temp.	Upscale	Less than 154°F
Gas Reheater Outlet Dewpoint	Not Operable	34-45°F
Adsorber Vault Temperature	Not Operable	75-79°F
Off Gas Flow to After filter	37 scfm	6-30 scfm
Adsorber Vessel 1N62-D014 Temp.	71.5°F	75-79°F