## [HISTORICAL] OBJECTIVES OF SYSTEM TESTS PRIOR TO INITIAL REACTOR FUELING

| SYSTEM TESTS | | TEST OBJECTIVE |
|---|---|---|
| 1. | Electrical System | Ensured continuity, circuit integrity, and the correct and reliable functioning of electrical apparatus required for core loading. Special attention is directed to the following tests:<br><br>(a) Station loss of voltage auto-transfer test.<br>(b) Normal to preferred offsite auxiliary power transfer test. |
| 2. | Voice Communication System | Verified proper communication between all local stations, for interconnection to commercial phone service, and balanced and adjusted amplifiers and speakers. Verified that all temporary communication stations located at the fuel loading status boardsites were functioning. |
| 3. | Essential Service Water System | Verified that service water was available for all component cooling required during core loading. |
| 4. | Fire Protection System | Verified proper operation of the System by ensuring the design intent was met for the fire pumps, and verified that the automatic start functions operated as designed, and verified that the pressure controls met acceptance specifications. |
| 5 | Compressed Air System | Verified leak tightness of the system proper operation of all compressors, the, manual and automatic operation of controls at design setpoints, design air-dryer cycle time and moisture content of discharge air, and proper air pressure to each controller served by the system. |
| 6. | Reactor Coolant System Cleaning | Flushed and cleaned the reactor coolant and related primary systems, obtained the degree of cleanliness required for the intended service. Provisions were made to maintain cleanliness and protection from contaminated sources after system cleaning and acceptance was completed. Coolant was analyzed for chloride content, solids, pH, and conductivity. Oxygen content is analyzed and brought to specifications prior to exceeding 250 °F. |

## [HISTORICAL] OBJECTIVES OF SYSTEM TESTS PRIOR TO INITIAL REACTOR FUELING

| SYSTEM TESTS | | TEST OBJECTIVE |
|---|---|---|
| 7. | Ventilation Systems | Verified the proper operability of fans, controls, and other components of the Containment Ventilation System and Auxiliary Building Ventilation System. |
| 8. | Residual Heat Removal and Component Cooling Water Systems | Verified adequate component cooling flow to the Residual Heat Removal System, and verified proper operation of instrumentation, controllers, and alarms related to the Residual Heat Removal System |
| 9. | Chemical and Volume Control System | Verified prior to critical operation, that the Chemical and Volume Control System functioned as specified in the system description and appropriate manufacturers' technical manuals. More specifically that:<br>(a) All manual and remotely operated valves were operable manually and/or remotely.<br>(b) All pumps performed to specification.<br>(c) All temperature, flow, level, and pressure controllers functioned to control at the required set-point when supplied with appropriate signal(s).<br>(d) All temperature, flow, level, and pressure alarms provided alarms at the required locations when the alarm setpoint was reached and cleared when the reset point was reached.<br>(e) The reactor makeup control regulated blending, dilution and boration as designed.<br>(f) The design seal water flow rates were attainable at each reactor coolant pump.<br>(g) Chemical Addition Subsystem functioned as specified. |

## [HISTORICAL] OBJECTIVES OF SYSTEM TESTS PRIOR TO INITIAL REACTOR FUELING

| SYSTEM TESTS | | TEST OBJECTIVE |
|---|---|---|
| 10. | Fuel Handling Systems [1] | Showed that the system design is capable of providing a safe and effective means of transporting and handling fuel from the time it reaches the station until it is stored in the spent fuel pool. In particular, the tests verified that:<br>(a) The major structures required for refueling, such as the reactor cavity, refueling canal, new fuel and spent fuel storage, and decontamination facilities, were in accordance with the design intent.<br>(b) The major equipment required for refueling such as the manipulator crane, fuel handling tools, and spent fuel transfer system operated in accordance with the design specifications.<br>(c) All auxiliary equipment and instrumentation functioned properly. |
| 11. | Radiation Monitoring Systems | Verified the calibration, operability and alarm setpoints of all radiation monitors, air particulate monitors, gas monitors and liquid monitors which are located in the Containment Building, Auxiliary Building, Spent Fuel Area and Control Room. |

[1] Tests are conducted with a dummy fuel element.

## [HISTORICAL] OBJECTIVES OF SYSTEM TESTS PRIOR TO INITIAL REACTOR FUELING

| | SYSTEM TESTS | TEST OBJECTIVE |
|---|---|---|
| 12. | Nuclear Instrumentation System | To insure that the instrumentation system is capable of monitoring the reactor leakage neutron flux for the source range. In particular, the tests verified that:<br><br>(a) All source range equipment, cabling, and interconnections were properly installed.<br>(b) The source range detector and associated instrumentation respond to neutron level changes and that the source range protection (high flux reactor trip) as well as alarm features, audible count rate, and strip chart recorders operated properly.<br>(c) All auxiliary equipment connected to the source range and temporary core loading detectors operated properly.<br>(d) Source range and temporary core loading detectors were properly calibrated and the associated setpoints and alarms were properly adjusted. |
| 13. | Reactor Plant Sampling System | Verified that a quantity of representative fluid could be obtained safely from each sampling point. In particular, the tests verified that:<br><br>(a) All system piping and components were properly installed.<br>(b) All remotely and manually operated valving operated in accordance with the design specifications.<br>(c) All sample containers and quick-disconnect couplings function properly. |

## [HISTORICAL] OBJECTIVES OF SYSTEM TESTS PRIOR TO INITIAL REACTOR FUELING

| SYSTEM TESTS | | TEST OBJECTIVE |
|---|---|---|
| 14 | Emergency Power System | Demonstrated that the system is capable of providing power for operation of vital equipment under power failure conditions. In particular, the tests verified that:<br><br>(a) All system components were properly installed<br>(b) Each emergency diesel functioned according to the design intent under emergency conditions.<br>(c) The emergency units were capable of supplying the power to vital equipment as required under emergency conditions.<br>(d) All redundant features of the system functioned according to the design intent. |
| 15. | Cold Hydrostatic Tests | Verified the integrity and leak tightness of fluid systems such as the Reactor Coolant System, CVCS, Sampling System, Waste Disposal System and the ECCS by performance of a hydrostatic test at the specified test pressure. |

## [HISTORICAL] OBJECTIVES OF SYSTEM TESTS PRIOR TO INITIAL REACTOR FUELING

| | SYSTEM TESTS | TEST OBJECTIVE |
|---|---|---|
| 16. | Hot Functional Tests | Using pump heat, the Reactor Coolant System is tested to check heatup and cooldown procedures to demonstrate satisfactory performance of components that were exposed to the reactor coolant temperature; verified proper operation of instrumentation, controllers and alarms, and provided design operating conditions for checkout of auxiliary systems.<br><br>The Chemical and Volume Control System was tested to determine that water could be charged at rated flow against normal Reactor Coolant System pressure; to verify letdown flow against design rate for each pressure reduction station; determined the response of the system to changes in pressurizer level; checked procedures and components used in boric boric acid batching and transfer operations; checked operation of the reactor makeup control; checked operation of the excess letdown and seal water flowpath; and verified proper operation of instrumentation controls and alarms.<br><br>The Sampling System was tested to determine that a specified quantity of representative fluid could be obtained safely and at design conditions from each sampling point.<br><br>The Component Cooling Water System was tested to evaluate its ability to remove heat from systems containing radioactive fluid and other special equipment; verified component cooling flow to all components; and verified proper operation of instrumentation controllers and alarms. |
| 17. | Primary System Safety Valve Tests | Tested and set all primary system safety valves ensuring each valve lifted at the specified set pressure. |

## OBJECTIVES OF SYSTEMS TESTS PRIOR TO INITIAL CRITICALITY

| SYSTEM TESTS | | TEST OBJECTIVE |
|---|---|---|
| 1. | Electrical System | Ensured continuity, circuit integrity and the correct and reliable functioning of electrical apparatus. Electrical tests were performed on transformers, switchgear, motors, cables, control circuits, excitation switchgear, d-c systems, annunciator systems, lighting distribution switchboards, communication systems and miscellaneous equipment. Special attention was directed to the following tests:<br><br>(a) High voltage switchgear breaker interlock test<br>(b) Station loss of voltage auto-transfer test<br>(c) Normal to preferred offsite auxiliary power transfer test<br>(d) Tests of protective devices<br>(e) Equipment automatic start tests<br>(f) Exciter check for proper voltage build up<br>(g) Insulation tests |
| 2. | Essential Service Water System | Verified the design head-capacity characteristics of the service water system, i.e., that the system supplied design flow rate through all heat exchangers, and met the specified requirements when operated in the safeguards mode. |
| 3. | Nitrogen Storage System | Verified system integrity, valve operability, regulating and reducing station performance, and the ability to supply nitrogen to interconnecting systems as required. |
| 4. | Condensate and Feedwater System | Verified valve and control operability and setpoints, and inspected for completeness and integrity. Functional testing was performed when the main steam system was available. Flushing and hydrostatic tests were performed where applicable. |

## OBJECTIVES OF SYSTEMS TESTS PRIOR TO INITIAL CRITICALITY

| | | |
|---|---|---|
| 5. | Residual Heat Removal and Component Cooling Water Systems | Verified component cooling flow to all components, and verified the proper operation of instrumentation, controllers, and alarms. Specifically, each of the two systems, i.e., component cooling system and residual heat removal system, was tested ensuring:<br><br>(a) All manual and remotely operated valves were operable.<br>(b) All pumps performed their design functions satisfactorily.<br>(c) All temperature, flow, level and pressure controllers functioned properly at the required set-points when supplied with appropriate signals.<br>(d) All temperature, flow, level and pressure alarms provided alarms at the required locations when the alarm set-point was reached and cleared when the reset point was reached. |
| 6. | Boron Recovery System (CVCS) | Verified valve and control operability and set-points, flushing and hydrostatic testing as applicable, inspection for completeness and integrity. Functional testing was performed when a steam supply was available. |
| 7. | Safety Injection System (ECCS) | Verified correct response to control signals and sequencing of the pumps, valves, and controllers of this system as specified in the system description and the manufacturer's technical manuals. More specifically that:<br><br>(a) All manual and remotely operated valves were operable.<br>(b) Each pair of valves installed for redundant flow paths operated as designed.<br>(c) All pumps performed their design functions satisfactorily.<br>(d) The proper sequencing of valves and pumps occurred on initiation of a safety injection signal.<br>(e) The failed position on a loss of power for each remotely operated valve was as specified.<br>(f) All level and pressure instruments were set at the specified points, alarmed and reset as required. |

## OBJECTIVES OF SYSTEMS TESTS PRIOR TO INITIAL CRITICALITY

| | | |
|---|---|---|
| 8. | Containment Spray System | Verified responses to control signals and sequencing of the pumps, valves and controllers as specified in the system description and the manufacturer's technical manuals; checked that the time required to actuate the system after a containment high-high pressure signal is received was appropriate. |
| 9. | Reactor Control and Protection System | Verified calibration, operability and alarm settings of the reactor control and protection system; tested its operability in conjunction with other systems; e.g., the nuclear instrumentation system as detailed below. |
| 10. | Nuclear Instrumentation System | Ensured that the instrumentation system was capable of monitoring the reactor leakage neutron flux from source range through 120 percent of full power and that protective functions were operating properly. In particular, the tests were designed to verify that:<br><br>(a) All system equipment, cabling and interconnections are properly installed.<br>(b) The source range detector and associated instrumentation responded to neutron level changes, and that the source range protection (high flux level reactor trip) as well as alarm features and audible count rate operated properly.<br>(c) The intermediate range instrumentation operated properly, the reactor protective and control features such as high level reactor trip and high level rod stop signals operated properly, and the permissive for blocking source range trip and source range high voltage-off operated properly. |
| 11. | Pressurizer Level Control System | Ensured that the system was capable of monitoring the full range of pressurizer level alarms and setpoints and that the system, in conjunction with the chemical and volume control system, controls pressurizer level. |
| 12. | Rod Position Indication System | Checked the systems response to test signals verified correct indicating functions. After fuel loading and after the position indication coils were installed, a calibration and complete operational check was performed by operating the individual control rod drive mechanisms. |

## OBJECTIVES OF SYSTEMS TESTS PRIOR TO INITIAL CRITICALITY

| | | |
|---|---|---|
| 13. | Reactor Thermocouple/ RTD Instrumentation | Checked and calibrated the system and compared thermocouple readings with RTD readings up to the maximum allowable temperature at isothermal conditions. |
| 14. | Turbine Auxiliary Cooling System | Established the correct cooling to unit components, demonstrating satisfactory performance of pumps, instruments, alarms, controls and established system integrity. |
| 15. | Primary and Secondary System - Safety and Relief Valves | Verified correct relief and safety valve pressure set-points. |
| 16. | Turbine Steam Seal System | Verified valve and control operability and set-points, flushed and hydrostatically tested where applicable, inspected for completeness and integrity. Functional testing was performed when a steam supply was available. |
| 17. | Turbine and Turning Gear Test | Demonstrated satisfactory operation of these systems. |
| 18. | Chemical Volume and Control System | Verified that the CVCS functioned according to design intent. More specifically that:<br>(a) The reactor makeup control regulated blending, dilution and boration as designed.<br>(b) Chemical addition subsystem functioned as specified. |
| 19. | Emergency Core Cooling System | Verified the performance of the ECCS under full flow conditions. |

## POST CRITICALITY TESTING SUMMARY

| TEST | CONDITIONS | OBJECTIVES |
|---|---|---|
| Control Rod Assembly Drop Tests | (a) Cold Shutdown<br>(b) Hot Shutdown | To measure the drop time of control rod assemblies under full flow and no flow conditions |
| Nuclear Design Check Tests | Normal control group configurations at hot, zero power | To Verify that nuclear design predictions for endpoint boron concentrations, and isothermal temperature coefficient are valid |
| Control Group Calibration | All control rod assembly groups at power | To verify that nuclear design predictions for control rod assembly group differential worths are valid |
| Power Coefficient Measurement | Performed at various per levels | To verify that nuclear design predictions for differential power coefficients are valid |
| Automatic Control Systems Checkout | Approximately 20 percent of rated power | To verify control system response characteristics for the:<br>(a) Steam generator level<br>(b) Control rod assembly automatic control system<br>(c) Turbine control system |

## POST CRITICALITY TESTING SUMMARY

| TEST | CONDITIONS | OBJECTIVES |
|---|---|---|
| Power Range/RTD Instrumentation Calibration | During static and/or transient conditions at the following percentages of rated power:<br><br>30 percent<br>50 percent<br>75 percent<br>90 percent<br>100 percent | To verify all power range instrumentation consisting of power range nuclear channels, and reactor coolant RTD's were responsive to change in reactor power to intercalibrate these systems |
| Load Swing Test | 10 percent step load decrease at 50 and 100 percent power | To verify control systems performance as evidenced by plant parameter variations |
| Turbine Trip | Turbine trip from power | To verify ability of plant to sustain plant trip and bring plant to an orderly hot shutdown |
| Pressurizer Effectiveness Test | Hot, shutdown | To verify that pressurizer pressure is reduced at the required rate by pressurizer spray actuation |
| Minimum Shutdown Verification | Hot, zero power | To measure the minimum shutdown boron concentration with one "stuck" control rod assembly |
| Static Control Rod Assembly Drop Test | 50 percent of rated power | To verify that a single control rod assembly inserted fully or part way below the control bank results in hot channel factors below design values |
| Load Reduction | Reduction from 100 percent to 50 percent of rated power at a ramp rate of 5 percent per minute | To verify control systems performance as evidenced by plant parameter variations |

## POST CRITICALITY TESTING SUMMARY

| TEST | CONDITIONS | OBJECTIVES |
|---|---|---|
| Incore Power Distribution Measurements | 50 percent<br>75 percent<br>100 percent | To verify that nuclear design predicted power distributions are valid for normal control rod patterns and configurations |
| Dynamic Control Rod Assembly DropTest | 50 percent of rated power | To verify automatic detection of dropped control rod assembly, and subsequent automatic rod withdrawal stop and turbine cutback |