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POWER SYSTEMS

STN 50-470F

October 16, 1984
LD-84-060

Mr. Darrell G. Eisenhut, Director
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: CESSAR Startup Testing

Dear Mr. Eisenhut:

During preparation for startup of the first System 80™ plant, C-E has noted minor modifications which could be made to CESSAR Chapter 14 to facilitate an improved testing procedure. These changes affect only tests performed after fuel loading and do not in any way affect CESSAR's compliance with NRC requirements. These changes, along with a description of each change, are provided in the attachment for NRC review. These changes will be incorporated in a subsequent amendment to CESSAR.

If you have any questions or comments, feel free to call me or Mr. T. J. Collier of my staff at (203) 285-5215.

Very truly yours,

COMBUSTION ENGINEERING, INC.

A. E. Scherer
Director
Nuclear Licensing

AES:las
Attach.
cc: K. Eccleston (USNRC Project Manager)

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14.2.7.1.1: RG 1.68, Appendix A, Section B.1.c (page 14.2-5)

Deleting the cold (260°F) partial flow CEA drops is consistent with experience in previous startups, which showed that the hot, full-flow drops were more limiting. Low temperature criticality is allowed only on first-of-a-kind plants, and then only for short periods of time under close supervision. CEA insertability at cold conditions is still demonstrated during post-core hot functional testing, providing assurance that the CEAs can be tripped, if necessary.

14.2.10.1: Initial Fuel Loading (page 14.2-7a)

The containment evacuation alarm described in the deleted material will not be provided, nor is there any requirement for such a device. Should a situation exist requiring evacuation, the operator could (in the case of Palo Verde is required to) utilize the site public address system and the plant evacuation alarm. As stated in this section, audible count rate indicators will be provided in containment.

14.2.12.3.1: PCHFT Controlling Document (page 14.2-69)

Item 2.1 reflects the possibility that some of the pre-core tests may be postponed to, or rerun during, the post-core hot functional testing. The other changes reflect how the instrumentation is to be calibrated.

14.2.12.3.4: Post-Core CEDM Performance (page 14.2-72)

The test method is updated to reflect the fact that no cold drops are to be performed. Verification of position indication and alarms is not temperature or schedule dependent and can be accomplished at any time, as the change reflects. The change to the required data reflects the fact that the RCS conditions are only a concern for this test during the rod drops.

14.2.12.4.2: CEA Symmetry and Coupling Test (pages 14.2-77a, 14.2-78)

The CEA coupling test is deleted because of a difference in the System 80 design and previous C-E designs. In previous C-E designs, CEAs and extension shafts were uncoupled during each refueling outage (CEAs remained in the core). In the System 80 design, CEAs and extension shafts are not uncoupled (CEAs are withdrawn into the upper guide structure).

14.2.12.4.4: Shutdown and Regulating CEA Group Worth Tests (page 14.2-79)

Testing on the first-of-a-kind plant has been modified to perform the net shutdown measurement at low temperature (approximately 320°F) rather than at HZP conditions. This change is advantageous for the following reasons:

(1) The measurement provides direct verification of the net shutdown worth at relatively cold conditions (shutdown margin following a cooldown). This measurement can be readily done on the first-of-a-kind unit where a low temperature test program is performed.

(2) Less RCS boron dilution is required.

(3) Potential cooldown events during testing while in a highly rodded configuration would have less of a consequence.

The remaining information, e.g., CEA group worths, obtained with the revised measurement approach is essentially equivalent to that obtained with the original test approach. For follow-on plants, the net shutdown measurement is to be performed at 565°F, since low temperature testing is not performed.

14.2.12.4.7: Pseudo Dropped and Ejected CEA Worth Test (page 14.2-83)

The wording is changed to provide flexibility in the testing methodology. The measurements of CEA worths via dilution (CEA insertion), boration (CEA withdrawal) or CEA compensation provide equivalent information. The test method is reworded to clarify the conditions at which testing will be performed.

14.2.12.5.3: Unit Load Transient Test (page 14.2-87)

The test method is updated to reflect the conditions under which the test will be conducted, including the limiting factors.

14.2.12.5.4: Control Systems Checkout Test (pages 14.2-87, 14.2-88)

The test method is reworded to clarify the conditions at whiich testing will be performed. Feedwater temperature is added to the list of monitored parameters (4.1.7). The acceptance criteria are reworded to clarify the criteria to be used for evaluating steady state performance and transient responses.

14.2.12.5.6: Turbine Trip (pages 14.2-89, 14.2-89a)

The Turbine Trip Test and the Unit Load Rejection Test lead to essentially the same plant response. Rather than perform redundant tests, the turbine trip test will be performed with the Reactor Power Cutback System (RPCS) not in-service while the unit load rejection test is performed with the RPCS in-service. The Data Required section is reworded to specify the parameters to be evaluated against acceptance criteria. Additional key parameters are to be monitored to provide supplemental information but are not evaluated against specific acceptance criteria. The Acceptance Criteria section is reworded to specify the method to be used for evaluating the parameters against which acceptance criteria are applied. Since non-safety parameters monitored during the test are not evaluated against specific acceptance criteria, the second sentence is eliminated.

14.2.12.5.7: Unit Load Rejection Test (pages 14.2-90, 14.2-90a, 14.2-91)

This test will be performed with the RPCS in operation. The summary is reworded in a manner similar to the Turbine Trip Test.

14.2.12.5.11: Xenon Oscillation Control (PLCEA) Test (pages 14.2-93, 14.2-94)

The initial conditions for the test are revised to allow this test to be performed at or above 50% power. The prerequisite that testing at the 80% plateau be completed is not required. The acceptance criteria is reworded to eliminate the phrase "throughout core life", since this requirement cannot be demonstrated directly from the test results. The test data, in conjunction with design analyses, demonstrates that xenon oscillations are readily controllable throughout life.

14.2.12.5.12: "Ejected" CEA Test (page 14.2-95)
14.2.15.5.13 "Dropped" CEA Test (page 14.2-96)

The rewording of the acceptance criteria clarifies the procedure to be used for evaluating the test results. The rewording does not change the intended acceptance criteria.

14.2.12.5.14: Steady State Core Performance Test (pages 14.2-96, 14.2-97)

The objective is reworded to coincide with the primary reason for performing the test. Objective 1.1 is deleted since specific acceptance criteria are not applied for this purpose. The Test Method and Data Required sections are reworded to more clearly specify the way the test will be performed. Acceptance Criteria 5.1 is not required as the COLSS and CPC systems adequately monitor DNBR and LPD limits during power escalation. Acceptance Criteria 5.2 is reworded to specify that core peaking factors are also evaluated against specific acceptance criteria.

14.2.12.5.15: Intercomparison of PPS, CPC and PMS Inputs (page 14.2-99)

The rewording reflects the proper terminology for this parameter, i.e., the temperature shadowing factor. This measurement is planned for both first-of-a-kind and follow-on units, so the asterisked footnote is deleted.

14.2.12.5.17: Main and Emergency Feedwater Systems Test (page 14.2-99a)

This page was missing from Amendment 9, February 27, 1984.

14.2.12.5.18: CPC Verification (page 14.2-101)

Incore detector maps (Section 4.5) are not required for this test so this requirement is deleted. The Acceptance Criteria section is reworded to clarify the procedure for applying the criteria.

14.2.12.5.19: Steam Bypass Valve Capacity Test (pages 14.2-101, 14.2-102)

The test description is altered to reflect capacity testing of each ADV and SBCS valve individually. Individual valve capacities are required to show that the valve capacities assumed in Chapter 15 (Safety Analysis) are conservative. Prerequisites are changed to delete the requirement for automatic SBCS operation, because individual valve modulation (open and close) is not possible in automatic control.

Table 14.2-1: Low Power Physics Tests

The table is modified to be consistent with the revised test summaries (described above).

Table 14.2-2: Power Ascension Test

The table is modified to be consistent with the test summaries and to reflect the planned testing approach. The footnote on the coefficient measurements is added to clarify that the test is performed with CEA movement and must be performed at a power level which allows the required CEA motion based on margin considerations.

Table 14.2-7: Physics (Steady State) Test Acceptance Criteria

The acceptance criteria for net shutdown worth, and dropped and ejected CEA worths, were inadvertently omitted. These are added in this amendment. Dropped and ejected CEA worths, and power distribution comparisons, are not required on follow-on units. This change makes Table 14.2-7 consistent with Tables 14.2-1 and 14.2-2. Other addtions are added for clarification and do not affect the established acceptance criteria.

MODIFICATIONS

TO CHAPTER 14

OF CESSAR-F

14.2.5 REVIEW, EVALUATION, AND APPROVAL OF TEST RESULTS

The development of administrative procedures for review, evaluation and approval of test results is the responsibility of the Applicant. Advice and consultation will be provided by Combustion Engineering as appropriate.

Test results shall be recorded as permanent plant records.

14.2.6 TEST RECORDS

An official copy of each completed test procedure, including all required supplemental data, exceptions, conclusions and approval signatures shall be maintained in accordance with the Applicant'· administrative controls.

14.2.7 CONFORMANCE OF INITIAL TEST PROGRAMS WITH REGULATORY GUIDES AND INDUSTRY STANDARDS

The intent of the following Regulatory Guides will be followed with the noted differences.

14.2.7.1 Reg. Guide 1.68 Initial Test Programs for Water-Cooled Reactor Power Plants (Revision 0, 11/73).

The following exceptions and/or clarifications address only significant differences between the System 80 test program and the applicable regulatory position. Minor terminology differences, testing not applicable to the plant design, and testing that is part of required surveillance tests will not be addressed. Reference is made to the applicable portion of Regulatory Guide 1.68 (Revision 0, 11/73).

14.2.7.1.1 Reference Appendix A, Section B.1.c.

This section suggests that rod drop times be measured for all control element assemblies (CEAs) at hot and cold full-flow and no-flow conditions.

The CESSAR CEA drop-time testing is consistent with the recommendations of the regulatory guide; however, tests which do not provide meaningful data will be deleted. As outlined in test summary 14.2.12.3.4, the CEA drop time testing will consist of:

a.) One drop of each CEA ~~at cold, maximum permissible flow conditions (2 or 3 reactor coolant pumps) and~~ at hot, full-flow conditions.*

b.) Those CEAs falling outside the two-sigma limit for similar CEAs will be dropped three additional times.

c.) Hot no flow scram insertion rod drops will not be performed for System 80 reactors. C-E has demonstrated that rod drop times under full-flow conditions are more limiting than the drop times under conditions of no-flow.

d.) The CEA drop time test at 260°F Plateau was eliminated since ~~Only "first-of-a-kind" plants are allowed to be critical at reduced temperature. Thus, if plant operating procedures preclude pulling CEA's prior to achieving HOT ZERO POWER conditions, the cold drops will be expected.~~ the hot, full-flow conditions are more bounding and since criticality is not allowed below 500°F except for a short period of time during low power physics testing.

one temporary channel and one permanent channel will be equipped with audible count rate indicators in two locations, temporary in the containment and permanent in the main control room. ~~A containment evacuation alarm is coupled to the permanent wide-range nuclear channels with a setpoint at five times the latest equilibrium count rate to provide automatic indication of high count rate during the fuel loading operation~~.

Continuous area radiation monitoring will be provided during fuel handling and fuel loading operations. Permanently installed radiation monitors display radiation levels in the main control room and will be monitored by licensed operators.

Fuel assemblies, together with inserted components, will be placed in the reactor vessel one at a time according to a previously established and approved sequence which was developed to provide reliable core monitoring with minimum possibility of core mechanical damage. The initial fuel loading procedure will include detailed instructions which will prescribe successive movements of each fuel assembly from its initial position in the storage racks to its final position in the core. The procedures will establish a system and a requirement for verification of each fuel assembly movement prior to proceeding with the next assembly. Multiple checks will be made for fuel assembly and inserted component serial numbers at successive transfer points to guard against possible inadvertent exchanges or substitutions.

At least two fuel assemblies containing neutron sources will be placed into the core at appropriate specified points in the initial fuel loading procedure to ensure a neutron population large enough for adequate monitoring of the core. As each fuel assembly is loaded, at least two separate inverse count rate plots will be maintained to ensure that the extrapolated inverse count rate ratio behaves as would be expected. In addition, nuclear instrumentation will be monitored to ensure that the "just loaded" fuel assembly does not excessively increase the count rate. The results of each loading step will be reviewed and evaluated before the next prescribed step is started.

14.2.10.1.1 Safe Loading Criteria

Criteria for the safe loading of fuel require that loading operations stop immediately if:

a.) The neutron count rate from either temporary nuclear channel unexpectedly doubles during any single loading step, excluding anticipated change due to detector and/or source movement or spatial effects (i.e., fuel assembly coupling source with a detector), or

b.) The neutron count rate on any individual nuclear channel increases by a factor of five during any single loading step, excluding anticipated changes due to detector and/or source movement or spatial effects (i.e., fuel assembly coupling source with a detector).

14.2.12.3 Postcore Hot Functional Tests

14.2.12.3.1 Postcore Hot Functional Test Controlling Document

1.0 OBJECTIVE

To demonstrate the proper integrated operation of plant primary, secondary, and auxiliary systems with fuel loaded in the core.

2.0 PREREQUISITES

2.1 All precore hot functional testing has been completed, as required.

2.2 Fuel loading has been completed.

2.3 All permanently installed instrumentation on systems to be tested is available and calibrated, in accordance with technical specifications and test procedures.

2.4 All necessary test instrumentation is available and calibrated, in accordance with technical specifications and test procedures.

2.5 All cabling between the CEDM's and the CEDM control system is connected.

2.6 Steam generators are in wet layup in accordance with the NSSS chemistry manual.

2.7 RCS has been borated to the proper concentration.

3.0 TEST METHOD

3.1 Specify plant conditions and coordinate the execution of the related postcore hot functional test appendices.

4.0 DATA REQUIRED

4.1 As specified by the individual postcore hot functional test appendices.

5.0 ACCEPTANCE CRITERIA

5.1 Integrated operation of the primary, secondary, and related auxiliary systems is in accordance with the CESSAR descriptions.

5.2 As specified by the individual postcore hot functional test appendices.

14.2.12.3.4 Postcore Control Element Drive Mechanism Performance

1.0 OBJECTIVE

1.1 To demonstrate the proper operation of the CEDM's and CEA's under HOT SHUTDOWN and Hot, Zero Power conditions.

1.2 To verify proper operation of the CEA position indicating system and alarms.

1.3 To measure CEA drop times.

2.0 PREREQUISITES

2.1 The CEDMCS precore performance test has been completed.

2.2 All test instrumentation is available and calibrated.

2.3 Plant Monitoring System is operational.

2.4 The CEDM cooling system is operational.

2.5 CEDM coil resistances have been measured.

3.0 TEST METHOD

3.1 Perform the following at HOT SHUTDOWN conditions:

3.1.1 Withdraw and insert each CEA ~~while recording position indications and alarms.~~ to verify proper operation of CEDM.

~~3.1.2 Measure and record drop time for each CEA.~~

~~3.1.3 Perform three additional measurements of drop time for each of those CEA's falling outside the two-sigma limit for similar CEA's~~.

3.2 Perform the following at hot, zero power conditions:

3.2.1 Withdraw and insert each CEA ~~while recording position indications and alarms.~~ to verify proper operation of CEDM.

3.2.2 Measure and record drop time for each CEA.

3.2.3 Perform three measurements of drop time for each of those CEA's falling outside the two-sigma limit for similar CEA's.

3.3 Perform the following at any time:

3.3.1 Withdraw and insert each CEA while recording position indications and alarms.

4.0 DATA REQUIRED

4.1 CEA drop time.

4.2 RCS temperature and pressure to be taken during measurement and recording of drop time for each CEA.

4.3 CEA position and alarm indications.

14.2.12.4.2 CEA Symmetry ~~and Coupling~~ Test**

1.0 OBJECTIVE

1.1 To demonstrate that no loading or fabrication errors that result in measurable CEA worth asymmetries have occurred.

~~1.2 To demonstrate proper coupling of each CEA to its drive mechanism.~~

~~**For the "first of of a kind" unit the coupling checks will be performed at HOT SHUTDOWN conditions and the symmetry checks will be performed at 565°F. For "follow-on" units only the symmetry check at 565°F is performed.~~

2.0 PREREQUISITES

2.1 The reactivity computer is in operation.

2.2 The reactor is critical at the desired conditions with the controlling CEA group partially inserted and in manual control.

3.0 TEST METHOD

~~3.1 CEA Coupling Check (HOT SHUTDOWN - "first-of-a-kind")~~

~~3.1.1 A selected CEA is inserted sufficiently to produce a small negative reactivity insertion and then is withdrawn.~~

~~3.1.2 Step 3.1.1 is repeated for the remainder of the CEAs.~~

3.~~2~~1 CEA Symmetry Test (hot, zero power conditions - 565°F, 2250 psia)

3.~~2~~1.1 The first CEA of a symmetric group is fully inserted with all remaining CEAs withdrawn except the controlling group, which is positioned for zero reactivity.

3.~~2~~1.2 The inserted CEA is withdrawn while another CEA in the symmetric group is inserted and the differences in worth (net reactivity) of the CEAs is determined from the reactivity computer.

3.~~2~~1.3 The remainder of the CEAs in the symmetric group are sequentially swapped until the relative worths of each CEA in the symmetric group has been determined.

3.~~2~~1.4 Repeat steps 3.~~2~~1.1 - 3.~~2~~1.3 for the remainder of the groups.

4.0 DATA REQUIRED

4.1 Conditions of the measurement.

4.1.1 RCS temperature.

4.1.2 Pressurizer pressure.

4.1.3 Boron concentration.

4.2 Time dependent data.

4.2.1 CEA position.

4.2.2 Reactivity computer traces.

5.0 ACCEPTANCE CRITERIA

5.1 The relative worth of symmetric CEAs are within the acceptance criteria specified in Table 14.2-7.

~~5.2 All CEAs are demonstrated to be coupled.~~

14.2.12.4.4 Shutdown and Regulating CEA Group Worth Test

1.0 OBJECTIVE

1.1 To determine regulating ~~(including PLCEA's)~~ and shutdown CEA group worths necessary to demonstrate shutdown margin (i.e., worth of all CEA's less the highest worth CEA).

1.2 To demonstrate that the shutdown margin is adequate.

2.0 PREREQUISITES

2.1 The reactor is critical.

2.2 The reactivity computer is operating.

3.0 TEST METHOD

3.1 ~~HOT SHUTDOWN CONDITIONS~~ 320°F measurement of regulating AND SHUTDOWN CEA groups down to the ~~zero power dependent insertion limit (HZPDIL)~~ NET SHUTDOWN CONFIGURATION (for "first-of-a-kind" plant only).*

3.1.1 The CEA group worths will be measured by dilution/boration of the RCS.

3.2 Hot, zero power measurement of regulating ~~and shutdown~~ CEA groups.*

3.2.1 The CEA group worths will be measured by dilution/boration of the RCS.

3.2.2 Where dilution/boration is not feasible, worths may be determined by CEA drop and/or by use of alternate CEA configurations.

4.0 DATA REQUIRED

4.1 Conditions of the measurement.

4.1.1 RCS temperature.

4.1.2 Pressurizer pressure.

4.1.3 CEA configuration.

4.1.4 Boron concentration.

4.2 Time dependant information.

4.2.1 Reactivity variation (strip chart).

4.2.2 CEA positions.

* ON "FOLLOW-ON" UNITS THE NET SHUTDOWN MEASUREMENT IS MADE AT 565°F.

14.2.12.4.7 Pseudo Dropped and Ejected CEA Worth Test*

1.0 OBJECTIVE

1.1 To measure the worth of the "dropped" CEA.

1.2 To measure the worth of the "ejected" CEA from the zero power dependent insertion limit (ZPDIL).

2.0 PREREQUISITES

2.1 Reactor critical at hot, zero power conditions with appropriate CEA configurations.

2.2 The reactivity computer is in operation.

3.0 TEST METHOD

3.1 Pseudo worst "dropped" CEA measurement

3.1.1 The pseudo worst and next worst "dropped" CEA worths are established on the basis of predictions and verified during the symmetry check.

3.1.2 The worths of the worst and next worst dropped CEAs are then measured by ~~boron~~ dilution/boration and/or CEA compensation.

3.2 Pseudo worst "dropped" PLCEA and worst "dropped" PLCEA subgroup measurement.

3.2.1 The pseudo worst "dropped" PLCEA and worst "dropped" PLCEA subgroups are established by prediction.

3.2.2 The worths of the worst single PLCEA and PLCEA subgroup are measured by boron dilution/boration and/or CEA compensation.

3.3 Pseudo worst "ejected" CEA measurement

3.3.1 The worth of the pseudo worst "ejected" CEA is established by means of a prediction.

3.3.2 The worths of the worst and next worst "ejected" CEAs are measured by boration ~~for the ZPDIL CEA configuration.~~ /dilution and/or CEA compensation from the ZPIL CEA configuration.

4.0 DATA REQUIRED

4.1 Conditions of the measurement

4.1.1 RCS temperature

*This test will be performed only on the "first-of-a-kind" plant.

2.2 The RRS, FWCS, SBCS, RPCS, and the pressurizer level and pressure control systems are in automatic operation.

3.0 TEST METHOD

3.1 Load increases and decreases (steps and ramps) in accordance with the C-E Fuel Pre-conditioning Guidelines and as allowed by the RRS will be performed at power levels in the ~~90~~ 75 to ~~100%~~ 95 range ~~and with swings in the 50 to 25 to 50% power level~~ and in the 25 to 50% power range.

4.0 DATA REQUIRED

4.1 Time dependent data.

4.1.1 Pressurizer level and pressure.

4.1.2 RCS temperatures.

4.1.3 CEA position.

4.1.4 Power level and demand.

4.1.5 Steam generator levels and pressures.

4.1.6 Feedwater and steam flow.

4.1.7 Feedwater temperature.

5.0 ACCEPTANCE CRITERIA

5.1 The step and ramp transients demonstrate that the plant performs load changes allowed by C-E's Fuel Pre-conditioning Guidelines and data has been taken that will demonstrate the plant's ability to meet unit load swing design transients.

14.2.12.5.4 Control Systems Checkout Test

1.0 OBJECTIVE

1.1 To demonstrate that the automatic control systems operate satisfactorily during steady-state and transient conditions.

2.0 PREREQUISITES

2.1 The reactor is operating at the desired conditions.

2.2 The RRS, FWCS, SBCS, RPCS, and the pressurizer level and pressure controls are in automatic operation.

3.0 TEST METHOD

3.1 The performance of the control systems during ~~normal operation, and transients and trips~~ steady state and transient conditions will be monitored to demonstrate that the systems are operating satisfactorily.

4.0 DATA REQUIRED

4.1 Time dependent data.

4.1.1 Pressurizer level and pressure.

4.1.2 RCS temperatures.

4.1.3 CEA position.

4.1.4 Power level and demand.

4.1.5 Steam generator levels and pressures.

4.1.6 Feedwater and steam flow.

4.1.7 Feedwater temperature.

5.0 ACCEPTANCE CRITERIA

5.1 The control systems maintain the reactor power, RCS temperature, pressurizer pressure and level, and steam generator levels and pressures within their control bands during ~~both~~ steady state ~~and transient operation~~ operation and are capable of returning these parameters to within their control bands in response to transient operation.

14.2.12.5.5 Reactor Coolant and Secondary Chemistry and Radiochemistry Test

1.0 OBJECTIVE

1.1 To conduct chemistry tests at various power levels with the intent of gathering corrosion data and determining activity buildup.

1.2 To verify proper operation of the process radiation monitor.

1.3 To verify the adequacy of sampling and analysis procedures.

2.0 PREREQUISITES

2.1 The reactor is stable at the desired power level.

2.2 Sampling systems for the RCS and CVCS are operable.

3.0 TEST METHOD

3.1 Samples will be collected from the RCS and secondary system at various power levels and analyzed in the laboratory using applicable sampling and analysis procedures.

3.2 Samples will be collected at the process radiation monitor at various power levels, analyzed in the laboratory, and compared with the process radiation monitor to verify proper operation.

4.0 DATA REQUIRED

4.1 Conditions of the measurement.

4.1.1 Power.

4.1.2 RCS temperature.

4.1.3 Boron concentration.

4.1.4 Core average burnup.

4.2 Samples for measurement of gross activities and/or isotopic activities.

5.0 ACCEPTANCE CRITERIA

5.1 Measured activity levels are within their limits.

5.2 The process radiation monitors agree with the laboratory analyses within measurement uncertainties.

5.3 Procedures for sample collection and analysis are verified.

14.2.12.5.6 Turbine Trip Test

1.0 OBJECTIVE

1.1 To demonstrate that the plant responds and is controlled as designed following a 100% turbine trip without RPCS in Service.

2.0 PREREQUISITES

2.1 The reactor is operating above 95% power.

2.2 The SBCS, FWCS, RRS, ~~RPCS~~ and pressurizer pressure and level control systems are in automatic operation.

2.3 The RPCS is in Auto Actuate Out of Service.

3.0 TEST METHOD

3.1 The turbine is tripped.

3.2 The plant behavior is monitored to assure that the RRS, SBCS, FWCS, ~~RPCS~~, and pressurizer pressure and level control systems maintain the NSSS within operating limits.

4.0 DATA REQUIRED

4.1 Power level prior to trip.

4.2 The following acceptance criteria parameters are monitored prior to and throughout the transient.

4.2.1 Pressurizer pressure, and level. ~~and spray flow~~

4.2.2 RCS Hot Leg temperature. ~~and pressure~~

4.2.3 SG pressures. ~~and level.~~

~~4.2.4 SBC steam flow and header pressure.~~

~~4.2.5 Feedwater systems (main and auxiliary) feed flow and enthalpy.~~

~~4.2.6 Core power.~~

~~4.2.7 Charging and letdown flows.~~

~~4.2.8 RPS performance and CEA position.~~

4.3 Additional key plant parameters will be monitored for base line data.

5.0 ACCEPTANCE CRITERIA

5.1 The test will be evaluated against single valued acceptance limits for those safety parameters which approach a safety limit. ~~In addition, the time dependent RCS temperatures and pressure as well as SG levels and pressures will be compared to expected values~~.

14.2.12.5.7 Unit Load Rejection Test

1.0 OBJECTIVE

1.1 To demonstrate that the ~~NSSS can sustain a 100% load rejection.~~ *plant responds and is controlled as designed following a 100% load rejection with RPCS in service.*

2.0 PREREQUISITES

2.1 The reactor is operating above 95% power.

2.2 The SBCS, FWCS, RRS, *CEDMCS,* RPCS, and pressurizer pressure and level control are in automatic operation.

3.0 TEST METHOD

3.1 A breaker(s) is tripped so as to subject the turbine to the maximum credible overspeed condition.

3.2 The plant behavior is monitored to assure that the RRS, *CEDMCS,* SBCS, RPCS, FWCS, and pressurizer pressure and level control systems maintain the monitored parameters.

4.0 DATA REQUIRED

4.1 Plant condition prior to trip.

4.2 The following *acceptance criteria* parameters are monitored *prior to and* throughout the transient.

4.2.1 Pressurizer pressure, *and* level ~~and spray flow.~~

4.2.2 RCS *Hot Leg* temperatures~~, and pressure.~~

4.2.3 SG pressure*s* ~~and level.~~

~~4.2.4 SBC steam flow and header pressure.~~

4.3 Additional key plant parameters will be monitored for baseline data.

~~4.2.5 Feedwater systems (main and auxiliary) feed flow and enthalpy.~~

~~4.2.6 Core power.~~

~~4.2.7 Charging and letdown flows.~~

~~4.2.8 RPS performance and CEA position.~~

5.0 ACCEPTANCE CRITERIA

5.1 The test will be evaluated against single valued acceptance limits for those safety parameters which approach a safety limit. ~~In addition, the time dependent RCS temperature and pressure as well as SG levels and pressures will be compared to expected values.~~

14.2.12.5.8 Shutdown from Outside the Control Room Test

1.0 OBJECTIVE

1.1 To demonstrate that the plant can be maintained in HOT STANDBY from outside the control room following a reactor trip.

2.0 PREREQUISITES

2.1 The reactor is operating at $\geq$ 10% of rated power.

2.2 The capability to cooldown on the shutdown cooling systems has been demonstrated during pre and post core hot functional tests.

2.3 The remote shutdown panel instrumentation is operating properly.

2.4 The communication systems between the control room and remote shutdown location has been demonstrated to be operational.

2.5 The remote shutdown instrumentation controls and systems have been preoperationally tested.

3.0 TEST METHOD

3.1 The operating crew evacuates the control room (standby crew remains in the control room).

3.2 The reactor is tripped from outside the control room.

3.3 The reactor is brought to HOT STANDBY by the operating crew from outside the control room and is maintained in this condition for at least 30 minutes.

4.0 DATA REQUIRED

4.1 Time dependent data.

2.2 Results of the radiation surveys performed at zero power conditions are available.

3.0 TEST METHOD

3.1 Measure gamma and neutron dose rates at 20, 50, 80 and 100% power levels.

4.0 DATA REQUIRED

4.1 Power level.

4.2 Gamma dose rates in the accessible locations.

4.3 Neutron dose rates in the accessible locations.

5.0 ACCEPTANCE CRITERIA

5.1 Accessible areas and occupancy times during power operation have been defined.

14.2.12.5.11 Xenon Oscillation Control (PLCEA) Test*

1.0 OBJECTIVE

1.1 To demonstrate a technique for damping xenon oscillations.

2.0 PREREQUISITES

~~2.1 Testing at 80% power has been completed.~~

2.~~2~~ 1 The reactor is ~~at approximately 65% power with equilibrium xenon and the PLCEAs inserted.~~ greater than or equal to 50% power.

2.~~3~~ 2 The COLSS and the incore detector system are in operation.

3.0 TEST METHOD

3.1 A free oscillation is establised.

3.2 The PLCEA's/or CEA's are used to dampen the oscillation.

4.0 DATA REQUIRED

4.1 Reactor conditions.

4.1.1 Power level.

4.1.2 Boron concentration.

*This test will be performed only on the "first-of-a-kind" plant.

4.1.3 RCS temperatures.

4.1.4 Burnup.

4.1.5 CEA position.

4.2 Time dependent data.

4.2.1 Incore detector maps.

4.2.2 Excore detector information.

4.2.3 PLCEA's and CEA position.

5.0 ACCEPTANCE CRITERIA

5.1 The technique necessary to damp xenon oscillations ~~throughout core life~~ using the PLCEAs and/or CEA's has been demonstrated.

14.2.12.5.12 "Ejected" CEA Test*

1.0 OBJECTIVE

1.1 To determine the power distribution associated with the pseudo CEA ejection from the full power dependent insertion limit (FPDIL) CEA configuration.

2.0 PREREQUISITES

2.1 Testing at 80% power has been completed.

2.2 The reactor is at approximately 50% power with equilibrium conditions and with the CEAs at the FPDIL.

2.3 The incore detector system is in operation.

3.0 TEST METHOD

3.1 The "worst" case CEA (selected by calculation) is fully withdrawn.

3.2 Incore detector maps are taken before and after withdrawal of the static "ejected" CEA.

3.3 The next worst "ejected" CEA is withdrawn while inserting the previous CEA.

3.4 An incore detector map is taken.

3.5 The CEAs are returned to normal configuration.

*This test will be performed only on the "first-of-a-kind" plant.

4.0 DATA REQUIRED

4.1 Conditions of the measurement.

4.1.1 Boron concentration.

4.1.2 Burnup.

4.2 Time dependent data.

4.2.1 Power.

4.2.2 Incore and excore detector readings.

4.2.3 RCS temperature.

4.2.4 CEA position.

5.0 ACCEPTANCE CRITERIA

5.1 The difference between the measured and predicted ratios of the post-ejected CEA to pre-ejected CEA power distributions are ~~The normalized incore detector signals are~~ within the acceptance band specified in Table 14.2-7. ~~of those for similarly normalized predicted values.~~

14.2.12.5.13 Dropped CEA Test*

1.0 OBJECTIVE

1.1 To determine the power distribution resulting from a "dropped" CEA.

2.0 PREREQUISITES

2.1 Testing at 80% power has been completed.

2.2 The reactor is at approximately 50% power with equilibrium conditions for the desired CEA configuration.

2.3 The incore detector system is in operation.

3.0 TEST METHOD

3.1 A full length CEA is selected, based on calculations, which will best verify the dropped rod assumptions used in the safety analyses.

3.1.1 The selected CEA is rapidly inserted to the full-in position.

3.1.2 The CEA remains inserted for a preselected time.

3.1.3 Excore and incore instrument signals are recorded before and after the CEA insertion.

*This test will be performed only on the "first-of-a-kind" plant.

3.2 PLCEA

3.2.1 The PLCEA, selected as prescribed in 3.1.1, is rapidly inserted to the full-in position.

3.2.2 The PLCEA remains inserted for a preselected time.

3.2.3 Excore and incore instrument signals are recored before and after the CEA insertion.

4.0 <u>DATA REQUIRED</u>

4.1 Conditions of the measurement.

4.1.1 Boron concentration.

4.1.2 Burnup.

4.2 Time dependent data.

4.2.1 Power.

4.2.2 Incore and excore detector readings.

4.2.3 RCS temperatures.

4.2.4 CEA position.

5.0 <u>ACCEPTANCE CRITERIA</u>

5.1 The difference between the measured and predicted ratios of the post-dropped CEA to pre-dropped CEA power distributions are ~~The measured normalized power distributions agree with predictions~~ within the acceptance ~~criteria~~ band specified in Table 14.2-7.

14.2.12.5.14 Steady State Core Performance Test

1.0 <u>OBJECTIVE</u>

~~1.1 To monitor NSSS and overall plant performance and establish a data base for future use.~~

1.~~2~~1 To determine core power distributions using incore instrumentation.

2.0 <u>PREREQUISITES</u>

2.1 The reactor is operating at the desired power level and CEA configuration with equilibrium Xe.

2.2 The incore instrumentation system is in operation.

3.0 TEST METHOD

3.1 Selected plant computer outputs and CPC outputs are recorded. ~~and console instrument readings are recorded.~~

3.2 Reactor power is determined by performing a heat balance.

3.3 The core power distribution is obtained using the incore detectors.

4.0 DATA REQUIRED

4.1 Conditions of the test.

4.1.1 Reactor power.

4.1.2 CEA positions.

4.1.3 Boron concentration.

4.1.4 Core average burnup.

4.1.5 Selected plant computer outputs and CPC outputs.

~~4.1.6 Selected console instrument readings.~~

4.1.~~7~~6 Incore detector maps.

5.0 ACCEPTANCE CRITERIA

~~5.1 A data base has been established at the plateau and reviewed to determine that DNBR and LPD limits will not be exceeded during escalation to the next power plateau.~~

5.~~2~~1 Agreement between the predicted and measured power distributions and core peaking factors are within the acceptance criteria specified in Table 14.2-7.

14.2.12.5.15 Intercomparison of PPS, Core Protection Calculator (CPC), and PMS Inputs

1.0 OBJECTIVE

1.1 To verify that process variable inputs/outputs of the PPS, the CPCs, the PMS, and the console instruments are consistent.

2.0 PREREQUISITES

2.1 The plant is operating at the desired conditions.

2.2 All CPCs and CEACs, and the PMS are operable.

3.0 TEST METHOD

3.1 Planar radial peaking factors are verified for various CEA configurations by comparison of the CPC values with values measured with the incore detector system.

3.2 The CEA shadowing factors are verified by comparing excore detector responses for various CEA configurations with the unrodded excore responses.

3.3 The shape annealing factors are measured by comparing incore power distributions and excore detector responses during a free Xe oscillation.

3.4 The temperature ~~annealing~~ shadowing factors are verified by comparing core power and excore detector responses for various RCS temperatures.

4.0 DATA REQUIRED

4.1 Conditions of the measurement.

4.1.1 Power.

4.1.2 Burnup.

4.2 Time dependent data.

4.2.1 Incore and excore detector readings.

4.2.2 CEA position.

4.2.3 RCS temperatures.

5.0 ACCEPTANCE CRITERIA

5.1 Measured radial peaking factors determined from incore flux maps are no higher than the corresponding values used in the CPCs.

5.2 The CEA shadowing factors, and temperature ~~annealing~~ shadowing factors used in the CPCs agree within the acceptance criteria specified in the CPC test requirements.**

5.3 The shape annealing matrix have been measured and the boundary point power correlation constants used in the CPCs are within the limits specified by the test requirements.**

~~*This test will be performed only on the "first-of-a-kind" plant.~~

**As specified in the appropriate revisions or supplements of ~~CEN-63A~~ CEN-235(V).

14.2.12.5.17 Main and Emergency Feedwater Systems Test

1.0 OBJECTIVE

1.1 To demonstrate that the operation of the main feedwater and emergency feedwater systems during Hot Standby, Startup and other normal operations, transients, and plant trips is satisfactory. 7

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(missing page from Amendment 9, February 27, 1984)

4.0 DATA REQUIRED

4.1 Reactor power.

4.2 CEA positions.

4.3 Boron concentration.

4.4 Specified CPC inputs, outputs, and constants.

~~4.5 Incore detector maps.~~

5.0 ACCEPTANCE CRITERIA

5.1 The values of DNBR and LPD ~~obtained from~~ calculated by the CPCs are ~~within the acceptance criteria as delineated in CEN 63 A and its updates.~~ consistent with the values calculated by the CPC Fortran code.

14.2.12.5.19 Steam Bypass Valve Capacity Test

1.0 OBJECTIVE

1.1 To demonstrate that the maximum steam flow capacity of ~~a single~~ each atmospheric steam dump valve upstream of the main steam isolation valves is less than that assumed for the safety analysis.

1.2 To measure the capacity of ~~the low capacity~~ each steam bypass valve ~~and one of the high~~ individually to determine that the capacity ~~turbine by-pass valves.~~ of each steam bypass valve is less than the value used in the safety analysis.

2.0 PREREQUISITES

2.1 The reactor power is ≥ 15% full power.

~~2.2 The SBCS is in automatic operation and is bypassing steam to the condenser.~~

2.~~3~~2 Control systems are in automatic where applicable.

2.~~4~~3 The operation of the atmospheric steam ~~drum~~ dump, turbine by-pass and shutdown cooling system have been demonstrated as part of the HOT FUNCTIONAL testing.

3.0 TEST METHOD

3.1 The individual steam flows through each of the atmospheric dump valves upsteam of the MSIVs are measured.

3.2 The capaci~~ties~~ty of ~~selected~~ each steam bypass valve~~s~~ ~~are~~ is measured.

4.0 DATA REQUIRED

4.1 Reactor power.

4.2 RCS temperatures.

4.3 Pressurizer pressure.

4.4 Steam generator levels and pressure.

4.5 Steam dump and bypass valve positions.

5.0 ACCEPTANCE CRITERIA

5.1 The capacities of the individual steam dump valves are less than the values used in the safety analysis but greater than the values required for a safe cooldown.

5.2 The capacit~~ies~~y of ~~selected~~ each steam bypass valve~~s~~ h~~ave~~as been measured, and the capacity of each steam bypass valve is less than the value used in the safety analysis.

14.2.12.5.20 Incore Detector Test

1.0 OBJECTIVE

1.1 To verify conversion of the fixed incore detector signals to voltages for input to the plant computer.

1.2 To collect baseline performance data for the movable incore detector system.

2.0 PREREQUISITES

2.1 The reactor is at the specified power level and conditions.

2.2 The plant computer is operable.

2.3 The incore detector system is operable.

3.0 TEST METHOD

3.1 Fixed incore detector signal verification.

3.1.1 Amplifier output signals are measured based on test input signals.

3.1.2 Group symmetric instrument signals are measured.

3.2 Data is recorded from the movable incore detectors during core traverses.

4.0 DATA REQUIRED

4.1 Reactor power.

4.2 CEA position.

TABLE 14.2-1

LOW POWER PHYSICS TESTS

Test Title	First-of-a-kind*	Follow-On Units***
Low Power Biological Shield Survey Test	320°F/565°F	565°F
[redacted]CEA [redacted]Symmetry Test	[redacted]565°F	565°F
Isothermal Temperature Coefficient Test	320°F-565°F	565°F
Regulating CEA Group Worth Test	320°F & 565°F	565°F
Shutdown CEA Group Worth Test	320°F ~~565°F~~	565°F
Differential Boron Worth Test	320°F & 565°F	565°F
Critical Boron Concentration Test	320°F-565°	565°F
Pseudo Dropped and Ejected CEA Worth Test	565°F	N/A

* An expanded test program is conducted for the "first-of-a-kind" in order to validate the design, the design methods, and the safety analysis assumptions.

~~** On the "first-of-a-kind" plant the CEA coupling check is performed at 320°F, and the CEA symmetry test is performed at 565°F.~~

*** Reduced testing is contingent upon the demonstration that "Follow-On" plants behave in an identical manner at (as) the First-Of-A-Kind plant through conformance with the Acceptance Criteria given in Table 14.2-7.

TABLE 14.2-2

(Sheet 1 of 2)

POWER ASCENSION TEST

Test Title	First-of-a-Kind*	Follow-On Units**
Natural Circulation Test	*** ≥ 80%	N/A
Variable Tavg (Isothermal Temperature**** Coefficient & Power Coefficient) Test	20, 50, 80, 100%	50 & 100%
Unit Load Transient Test	50, 100% ~~Post 100%~~	50, 100% ~~Post 100%~~
Control Systems Checkout Test	20, 50, 80[redacted], 100%	50, 80%
RCS and Secondary Chemistry and Radiochemistry Test	20, 50, 80, 100%	20, 50, 80, 100%
Turbine Trip Test	100%	100%
Unit Load Rejection Test	[redacted] 100%	[redacted]-100%
Shutdown from Outside the Control Room Test	≥ 10%	≥ 10%
Loss of Offsite Power Test	≥ 10%	≥ 10%
Biological Shield Survey Test	20, 50, 80, 100%	20, 50, 80, 100%
Xenon Oscillation Control Test	[redacted] ≥50%	N/A
Dropped CEA TEST	Post 80 [redacted]%	N/A
"Ejected" CEA Test	Post 80 [redacted]%	N/A
Steady-State Core Performance Test	20, 50, 80, 100%	20, 50, 80, 100%
Intercomparison of PPS, CPC and Process Computer Inputs	20, 50, 80, 100%	20, 50, 80, 100%
Verification of CPC Power Distribution Related Constants	20, 50% [redacted]	20, 50% [redacted]

* An Expanded test program is conducted for the "first-of-a-kind" in order to validate the design, the design methods, and the safety analysis assumptions.

** Reduced testing is contingent upon the demonstration that "Follow-On" plants behave in an identical manner as the "First-of-a-Kind" plant through conformance with the acceptance criteria given in Table 14.2-7.

*** Initial Power Level

**** The temperature and power coefficient measurements are done as close as possible to 100% power at a level where CEA motion is practical accounting for margin considerations.

Table 14.2-7

PHYSICS (STEADY STATE) TEST ACCEPTANCE CRITERIA TOLERANCES

Parameter	First-of-a-kind	Follow-on Plant
LPTT		
Symmetry Test	± 1 1/2 ¢	± 1 1/2 ¢
CEA Group Worths	± 15% or .1% Δρ whichever is greater	± 10% or .05% Δρ whichever is greater
Total Worth (Net Shutdown)	±10%	±10%
Temperature Coefficient	± .5 x 10^{-4} Δρ/°F	± .3 x 10^{-4} Δρ/°F
Critical Boron Concentration	± 100 ppm	± 50 ppm
Boron Worth	± 15 ppm/% Δρ	± 10 ppm/% Δρ
Dropped and Ejected CEA WORTHS	±25% or .1% Δρ whichever is greater	N/A
PAPT		
Power Distribution (Radial and Axial)	**RMS ≤ 5%	**RMS ≤ 3%*
Peaking Factors (Fxy, FR, Fz1, Fq)	± 10%	± 7.5%*
Temperature Coefficient	± .5 x 10^{-4} Δρ/°F	± .3 x 10^{-4} Δρ/°F
Power Coefficient	± .2 x 10^{-4} Δρ/% power	± .2 x 10^{-4} Δρ/% power
Pseudo Ejected CEA RATIO (2D Power Density Ratio Comparison)	± 20%	~~± 20%~~ N/A
Dropped CEA RATIO (2D Power Density Ratio Comparison)	± .2	~~± .2~~ N/A

* at 50% power and above

~~** ± .2 or 20% of the average pin power on a normalized distribution~~

** $$RMS = \sqrt{\frac{\sum_{1}^{N} (RPD^{PRED} - RPD^{MEAS})^2}{N}}$$

where n = 1, 2, 3 - - - N (Total number of fuel assemblies in core or number of axial planes, as appropriate).