Westinghouse Electric Corporation

Energy Systems

Box 355
Pittsburgh Pennsylvania 15230-0355

NSD-NRC-97-4965
DCP/NRC0721
Docket No.: STN-52-003

January 31, 1997

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: T. R. QUAY

SUBJECT: RESPONSES TO DECEMBER 19, 1996 NRC COMMENTS ON AP600 INITIAL TEST PROGRAM

REFERENCE: NRC Letter dated December 19, 1996, "Followon Questions and Discussion Items on the AP600 Initial Test Program (ITP)"

Dear Mr. Quay:

Attached are written responses and proposed SSAR revisions to address the discussion items in the December 19, 1996 letter. We request that the NRC review these responses and that comments on the attached responses be discussed in an upcoming teleconference. This will assist us in the preparation of a response to the related Request for Additional Information (RAI 260.90). A teleconference is tentatively planned for February 6, 1997.

Please contact Gene Piplica on (412) 374-5310 if you have any questions concerning this transmittal.

C.L. Haag for BAM

B. A. McIntyre, Manager
Advanced Plant Safety and Licensing

/jml

Attachments

cc: T. Kenyon, NRC (w/o Attachments)
J. Sebrosky, NRC
J. Peralta, NRC
A. Levin, NRC
N. J. Liparulo, Westinghouse (w/o Attachments)

E004

Attachment 1

AP600 ITP Discussion Items received from NRC on Dec. 19, 1996

14.2.9.1.3, Passive Core Cooling System Testing

1. The abstracts for the passive core cooling system testing will be revised to contain more specific initial test conditions, as appropriate. In addition, the types of data required to be collected will be more clearly specified, as requested in Item 3 below. These modifications will provide sufficient information to guide the development of detailed test procedures for these tests.

2. The AP600 test abstracts which state that temporary test instrumentation will or may be used, will be revised to specify that such instrumentation is to be calibrated and to more clearly indicate when this instrumentation is required to be used.

3. As stated in Item 1 above, the types of data required to be collected will be more clearly stated in the test abstracts.

4. The passive core cooling system core makeup tank and accumulator water chemistry is monitored using the primary sampling system (PSS), and these components will be specifically noted in the PSS testing abstract. The in-containment refueling water storage tank water chemistry is tested by sampling via the spent fuel pool cooling system sampling point.

   The AP600 sampling system does not function to determine the debris content in the passive core cooling system components and piping. However these components are tested for the presence of blockage as part of the ITP, in that proper flow rates and pressure losses are demonstrated. Also during the operation of the plant, the proper operation of the passive safety system valves and proper flow rates from the accumulators, core makeup tanks, and the IRWST are verified during each plant cooldown/refueling. In addition, the containment sump screens, which prevent debris from entering/affecting the long term cooling flow path from the containment to the reactor, are verified to be free of debris by inspections during construction, installation, and prior to each plant startup. Note that these screens are located on vertical walls in a rector coolant system loop compartment and therefore are not susceptible to the accumulation of debris since they are located well above the bottom of containment, and they can be easily verified to be clear of any debris.

5. The heat removal capability of the PRHR heat exchanger can be adequately tested during hot functional testing portion of the ITP (with no additional heat from the reactor core). This testing utilizes the heat capacity of the AP600 reactor coolant system, which is sufficient to demonstrate the natural circulation operation of the PRHR heat exchanger at initially high inlet temperature, followed by a controlled cooldown of the reactor coolant system. Thus, the heat exchanger performance over a wide range of operating conditions can be demonstrated.

   The hot functional test would be initiated with the reactor coolant system at ~540°F and would be expected to function as described below. The heat exchanger operation would be started after the reactor coolant pumps had been shut-off and had coasted down. Thus, the heat exchanger natural circulation flow would start and increase solely due to the temperature difference (density difference) between the water in the supply side piping and the water in the heat exchanger and return piping. The heat exchanger inlet temperature would initially remain relatively constant as the hot water from the reactor vessel is replaced with cooled water. Following this period of constant temperature operation, the heat exchanger inlet temperature would decrease.

Based on an overall energy balance, the reactor coolant system would be cooled from ~540° to 450°F in ~45 minutes, with natural circulation flow decreasing from 295000 to 242000 lbs./hr. Cooldown to 350°F would be expected after approximately 2 hours of operation, with natural circulation flow decreasing to 172000 lbs./hr. Thus, this test during the hot functional testing period (prior to fuel load) provides sufficient operating time to confirm the PRHR heat exchanger heat removal capability at high temperature and over a wide range of operating conditions.

6. The "first plant only" CMT recirculation testing (Item j in subsection 14.2.9.1.3) is performed after the resistances of the CMT cold leg balance and injection lines have been measured and verified to be correct (Items h and k, respectively). These resistances, combined with the actual elevations of the CMT tanks and reactor vessel, solely determine the CMT recirculation flow rate. The subsequent test of the actual recirculation function is performed as a demonstration in the first plant. Repetition of this demonstration for every plant is not considered necessary, since it provides no additional technical information.

   Similarly, the "first plant only" ADS Stage 1/2/3 blowdown test (Item r) is performed after the resistances of all the ADS Stage 1/2/3 piping path combination resistances have been measured and verified to be correct (Item o). These resistances, combined with the manufacturing quality control and operational testing of the ADS Stage 1/2/3 valves which is performed for all plants, establish the venting capability of the ADS Stage 1/2/3. No additional technical information will be provided by repetition of this demonstration in subsequent plants.

7. The ADS actuation function of the CMT level instrumentation is tested during the draindown testing of the CMT's, specified in Item k.

8. The inspection to assure that the baskets containing trisodium phosphate are located in their proper location and contain the proper amount of TSP will be deleted from the ITP, since no tests are associated with the TSP baskets. This inspection is included as an AP600 ITAAC. The ability of the TSP to perform its long term pH control function is verified by analysis.

9. The ITP will be revised to specify that the proper function of the containment sump instrumentation shall be verified by actually simulating the containment flood-up water levels using tygon tubing or temporary piping, as appropriate.

10. The interactions between the passive safety injection system functions and the defense-in-depth systems have been determined by analysis and tested as part of the SPES-2 and OSU integral system, design certification tests. The results of this extensive effort to identify interactions will be incorporated into the plant simulators used to train the operators.

    Note that is impractical to perform testing in the AP600 of all safety system functions, with and without DID systems operating, and demonstrate comparative performance in the plant as part of the ITP. However, the actual plant system performance observed in the ITP will be used to update the plant simulations and used for operator training. For example, the interaction between the normal RHR system and core makeup tank draindown can be verified by measuring the pressure at the upstream side of the orifice in the CMT/RNS injection line, during operation of the RNS pumps. This pressure determines the CMT water level at which CMT injection will be stopped by the RNS pumps and verifies that the 4th stage of ADS will not be actuated if the RNS pumps are injecting sufficient water. This data requirement will be added to the RNS test abstract (subsection 14.2.9.2.4).

14.2.9.1.1 Reactor Coolant System Testing

1. The AP600 ITP is organized on a system and level of importance basis which has improved the overall understandability and inter-relationship of individual test abstracts to the overall testing program. In order to retain this organization, the abstracts for the pressurizer, reactor coolant pumps, and pressurizer safety valves should not be individually grouped.

2. The test abstract for the reactor coolant pumps will be modified to specify that the proper operation of both the reactor coolant pumps and motors is verified.

3. The proper operation of the pressurizer heaters, pressure control, and level control functions is currently tested and verified in Items o, p, and q of subsection 14.2.9.1.1. Please provide additional clarification of this comment.

Comments on Test Description Format

1. The combination of the test method and acceptance criteria is similar to the format used in General Electric Corporation's ABWR ITP which was previously reviewed and approved by the NRC. Separation of the acceptance criteria from [illegible] test, in many cases, would result in the loss of the purpose for each individual test; or would require the unnecessary repetition of the same statements in each individual section.

2. The test abstracts will be revised to add pertinent plant or system conditions where applicable. However, it is not the purpose of Chapter 14 to compile all the relevant information of all the plant systems and components needed to write the actual test procedures and to perform the actual test. References to the appropriate SSAR sections, and the system and component design specifications are necessary, and must be consulted by the COL when specifying the actual plant tests.

Attachment #2

Draft Responses to NRC

14.2.9.1 Preoperational Tests of Systems with Safety-Related Functions

14.2.9.1.1 Reactor Coolant System Testing

Purpose

The purpose of the reactor coolant system testing is to verify that the as-installed reactor coolant system properly performs the following safety-related functions:

- Provide reactor coolant system pressure boundary integrity as described in Section 5.2
- Provide core cooling and boration in conjunction with the passive core cooling system as described in Sections 5.1 and 6.3
- Measure process parameters required for safety-related actuations as described in Sections 7.2, 7.3 and 7.4
- Measure selected process parameters required for post-accident monitoring as described in Section 7.5
- Vent the reactor vessel head as discussed in subsection 5.4.12

Testing is also performed to verify that the system properly performs the following defense-in-depth functions described in Section 5.2:

- Provide forced circulation cooling of the reactor core in conjunction with heat removal by the steam generator(s) as described in Section 5.1
- Provide core cooling by natural circulation of coolant in conjunction with heat removal by the steam generator(s) as described in Section 5.1
- In conjunction with the steam generator(s) and normal residual heat removal system, provide the capability to remove core decay heat and cool the reactor coolant to permit the reactor to be refueled and started up in a controlled manner
- Provide pressurizer pressure control during normal operation
- Provide pressurizer level control in conjunction with the chemical and volume control system
- Provide pressurizer spray

Prerequisites

The construction testing of the reactor coolant system has been successfully completed. The pre-operational testing of the component cooling water system, service water system, chemical and volume control system, main ac power electrical power system, and required interfacing systems is completed to the extent sufficient to support the specified testing. The reactor coolant system is filled, vented, and pressurized above the minimum required pressure for reactor coolant pump operation, and component cooling water flow to the reactor coolant pumps is initiated prior to starting the pumps.

In preparation for the hydrostatic test of the reactor coolant system, the reactor vessel lower and upper internals and the closure head are installed. The closure head studs are properly tensioned for the hydrostatic test pressure. The pressurizer safety valves and instrumentation within the test boundary are either removed, recalibrated or verified to be able to withstand the hydrostatic test pressure. Welds within the test boundaries are verified as ready for hydrostatic testing. A hydrostatic test pump is available for the pressure boundary integrity testing.

General Test Method and Acceptance Criteria

Reactor coolant system performance is observed and recorded during a series of individual component and system tests. The following testing demonstrates that the reactor coolant system can perform the functions described above and in appropriate design specifications:

a) The integrity and leaktightness of the reactor coolant system and the high-pressure portions of associated systems is verified by performing a cold hydrostatic pressure test in conformance with Section III of the American Society of Mechanical Engineers (ASME) Code. The reactor coolant system is pressurized in stages by operation of the temporary hydrostatic test pump, while monitoring system welds, piping, and components for leaks at each stage. The hydrostatic test verifies that there are no leaks at welds or piping within the test boundaries during the final inspection. Leaks at valves, flanges, or mechanical fittings are acceptable during the hydrostatic test, but they are repaired prior to the final inspection, or the leak may be isolated, repaired, and retested at a later date.

b) Proper operation of the safety-related reactor coolant system and reactor coolant pressure boundary valves is verified by the performance of baseline in-service tests as described in subsection 3.9.6.

c) The operability of the pressurizer safety valves is demonstrated by a bench test at temperature and pressure with steam as the pressurizing fluid or with a suitable in-situ test. This testing verifies that each pressurizer safety valve actuates at the required set pressure, with appropriate tolerance as specified in the Technical Specifications. The safety valve rated capacity, as recorded on the valve vendor code plates, is verified to be greater than or equal to that described in Section 5.4.

d) During hot functional testing, reactor coolant system leakage is verified to be within the limits specified in the Technical Specifications. The pressurizer water level is set to the no-load level, the chemical and volume control system makeup pumps and letdown line do not operate, and no primary system samples are taken. During this test, the identified and unidentified reactor coolant system leakage rates are determined by monitoring the reactor coolant system water inventory over a specified period of time.

e) The leakage across individual valves between high pressure and low pressure systems, as specified in the Technical Specifications, is verified to be less than design requirements.

f) The as-installed safety valve discharge chamber rupture disks are inspected to verify the manufacturer's stamped set pressure is within the limits specified in the appropriate design specifications.

g) Proper calibration and operation of safety-related instrumentation, controls, actuation signals and interlocks are verified. This testing includes the following:

- Hot leg and cold leg resistance temperature detectors
- Cold leg flow instrumentation
- Reactor coolant system wide range pressure transmitters
- Hot leg level instruments
- Pressurizer pressure and level instruments
- Reactor coolant pump bearing water temperature detectors
- Reactor coolant pump speed sensor instruments
- Reactor vessel head vent valve controls

This testing includes demonstration of proper actuation of safety-related functions from the main control room.

h) Automatic trip of the reactor coolant pumps following appropriate safety-related actuation signals is demonstrated.

i) Proper operation of the reactor vessel head vent valves is verified with the reactor coolant system pressurized.

The following testing demonstrates that the system properly performs the defense-in-depth functions described above and in appropriate design specifications:

j) The pressurizer spray valves are verified to operate properly over the range of reactor coolant system operating temperatures and with the reactor coolant pumps operating.

k) Proper calibration and operation of defense-in-depth related instrumentation, controls, actuation signals and interlocks are verified. This testing includes actuation of the pressurizer spray valves on receipt of appropriate signals, as well as actuation from the main control room.

l) Reactor coolant pump and motor performance and operating characteristics are initially verified with the reactor coolant system at cold conditions. This testing includes verification of the proper flow through the reactor coolant system when all four reactor coolant pumps are operated in various combinations as specified in the appropriate design specifications and operating procedures. In addition, the proper operation of the pump motor instrumentation, alarms, and interlocks is verified including:

- Motor current
- Motor power
- Pump vibration
- Motor Stator temperature

m) The reactor coolant system is heated from cold conditions to hot standby conditions by operating the reactor coolant pumps and the pressurizer heaters. The reactor coolant system is operated at full flow conditions for at least 240 hours prior to core loading. The reactor coolant temperature is maintained at or above 515°F for at least one-half of this operating time. In addition to facilitating the reactor coolant system tests that are required to be performed hot and pressurized, these hot functional testing conditions allow the plant operators to control the plant using the plant operating procedures for the reactor coolant system, secondary side systems, and auxiliary systems.

Other preoperational tests that require these hot and/or dynamic conditions are conducted during this hot functional testing period.

n) During hot functional testing, the reactor coolant pump and motor operating characteristics are measured and recorded at various temperature plateaus during reactor coolant system heatup to verify proper operation over their operating temperature range. This testing includes verification of the proper pump flow; proper motor current, power, and stator temperature; and pump vibration levels.

o) The pressurizer spray continuous flow rate is established, and the proper spray line temperature is verified for each pressurizer spray line.

p) The proper operation of the pressurizer heaters, pressurizer spray, and pressure control functions and alarms is verified during the heatup, operation at hot functional test conditions, and cooldown of the reactor coolant system.

q) The proper operation of the pressurizer level control functions and alarms is verified during the heatup, operation at hot functional test conditions, and cooldown of the reactor coolant system.

Tests associated with the automatic depressurization functions of reactor coolant system components are described in subsection 14.2.9.1.3.

14.2.9.1.3 Passive Core Cooling System Testing

Purpose

The purpose of the passive core cooling system testing is to verify that the as-installed components and their associated piping and valves properly perform the following safety functions, described in Section 6.3:

- Emergency core decay heat removal
- Reactor coolant system emergency makeup and boration
- Safety injection
- Containment pH control

Prerequisites

The construction testing of the passive core cooling system, or of a specific portion of the system to be tested, is successfully completed. The preoperational testing of the reactor coolant system, normal residual heat removal system, chemical and volume control system, the refueling cavity, the Class 1E dc and uninterruptable power supply, the ac electrical power and distribution systems, and other interfacing systems required for operation of the above systems is completed as needed to support the specified testing and system configurations. A source of water, of a quality acceptable for filling the passive core cooling system components and the reactor coolant system, is available.

General Test Method and Acceptance Criteria

The performance of the passive core cooling system is observed and recorded during a series of individual component testing and testing with the reactor coolant system. The following testing demonstrates that the passive core cooling system operates as described in Section 6.3 and appropriate design specifications.

a) Proper operation of safety-related valves is verified by the performance of baseline in-service tests as described in subsection 3.9.6. Also, the proper operation of non-safety-related valves is verified including manual valve locking devices This testing does not include actuation of the squib valves, which is discussed in Item t, below.

b) Proper calibration and operation of safety-related instrumentation, controls, actuation signals, and interlocks is verified. This testing includes the following:

  - Passive residual heat removal heat exchanger flow
  - Core makeup tank level
  - In-containment refueling water storage tank level
  - Containment floodup level
  - Core makeup tank inlet/outlet valve controls
  - Passive residual heat removal heat exchanger inlet/outlet valve controls

- In-containment refueling water storage tank outlet valve controls
- Containment recirculation valve controls
- Automatic depressurization valve controls

This testing includes demonstration of proper actuation of safety-related functions from the main control room.

c) Proper calibration and operation of instrumentation, controls, and interlocks required to demonstrate readiness of a safety-related component is verified. This testing includes the following:

- Accumulator pressure and level and alarms
- Passive residual heat removal heat exchanger ~~pressure and~~ temperatures
- Passive residual heat removal heat exchanger high point vent level
- Core makeup tank inlet line temperatures
- Core makeup tank inlet line high point levels
- Direct vessel injection line temperatures
- In-containment refueling water storage tank level and temperatures

d) Proper calibration and operation of temporary instrumentation and data recording devices used in this testing is verified. This testing includes the following:

- CMT level
- CMT flow and balance line temperatures
- PRHR supply line temperatures
- Accumulator wide range level
- In-containment refueling water storage tank and sump-recirculation flow
- ADS piping differential pressure

The passive core cooling system emergency core decay heat removal function is verified by the following testing of the passive residual heat removal heat exchanger.

~~d~~e) During hot functional testing of the reactor coolant system, the heat exchanger supply and return line piping water temperatures are ~~verified~~ recorded to verify that natural circulation flow initiates.

~~e~~f) The heat transfer capability of the passive residual heat removal heat exchanger ~~with~~ is verified by measuring natural circulation flow rate and the heat exchanger inlet and outlet temperatures while the reactor coolant system is cooled to $\leq$ 400°F ~~is verified~~. This testing is performed during ~~reactor coolant system~~ hot functional testing with the reactor coolant system initial temperature $\geq$ 540°F and the reactor coolant pumps not running.

~~f~~g) The proper operation of the passive residual heat removal heat exchanger and its heat transfer capability with forced flow is verified by initiating and operating the heat exchanger with all four reactor coolant pumps running. This testing is performed during

~~reactor coolant system~~ hot functional testing with the reactor coolant system at an elevated initial temperature between 250 and 400°F. The heat exchanger heat transfer is determined by measuring the heat exchanger flow rate and its inlet and outlet temperatures while the reactor coolant system is cooled down.

gh) The heatup characteristics of the in-containment refueling water storage tank water are verified by measuring the vertical water temperature gradient that occurs in the in-containment refueling water storage tank water at the passive residual heat removal heat exchanger tube bundle and at several distances from the tube bundle, during testing in Item e), above. **Note that this verification is required only for the first plant.**

The passive core cooling system emergency makeup and boration function is verified by the following testing of the core makeup tanks.

hi) The resistance of the core makeup tank cold leg balance lines is determined by filling the core makeup tanks with flow from the cold legs. This testing is performed by filling the cold, depressurized reactor coolant system using a constant, measured discharge flow from the normal residual heat removal pumps. The reactor coolant system is maintained at a constant level above the top of the cold leg balance line(s). The normal residual heat removal system flow rate and the differential pressure across the cold leg balance lines are used to determine the resistance of the balance lines.

i j) During hot functional testing of the reactor coolant system, the core makeup tank cold leg balance line piping water temperature at various locations is ~~verified~~ recorded to verify that the water in this line is sufficiently heated to initiate recirculation flow through the CMTs.

jk) Proper operation of the core makeup tanks to perform their reactor water makeup and boration function is verified by initiating recirculation flow through the tanks during ~~reactor coolant system~~ hot functional testing with the reactor coolant system at ≥ 530°F. This testing is initiated by simulating a safety signal which opens the tank discharge isolation valves, and stops reactor coolant pumps after the appropriate time delay. The proper tank recirculation flow after the pumps have coasted down is verified. Based on the cold leg temperature, **CMT discharge temperature,** and temporary CMT flow instrumentation, the net mass injection rate into the reactor is verified. **Note that this verification is required only for the first plant.**

The passive core cooling system safety injection function is verified by the following testing of the core makeup tanks, accumulators, in-containment refueling water storage tank, containment sump, automatic depressurization, and their associated piping and valves.

kl) Proper flow resistance of each of the core makeup tank injection lines is verified by gravity draining each tank filled with cold water through the empty direct vessel injection flow path, while measuring the CMT level (driving head) and discharge flow rate. Air enters the top of the draining tank from the reactor coolant system cold leg via the cold leg

balance line. If necessary, the flow **limiting** orifice in the core makeup tank discharge line is to be resized, and the core makeup tank retested to obtain the required line resistance.

~~l~~m) The proper flow resistance of each of the accumulator injection lines is verified by performing a blowdown from a partially pressurized accumulator **through the empty direct vessel injection flow path, while measuring the change in accumulator level and pressure**. If necessary, the flow orifice in the accumulator discharge line is to be resized and the accumulator retested to obtain the required discharge line resistance.

~~m~~n) The proper flow resistance of each of the in-containment refueling water storage tank injection lines is verified by gravity draining water from the tank **through the empty direct vessel injection flow path, while measuring the water level (driving head) and discharge flow rate using temporary instrumentation**. If necessary, the flow orifice in the in-containment refueling water storage tank injection line is resized and retested, until the required line resistance is achieved.

~~n~~o) The flow resistance of each of the flow paths from the in-containment refueling water storage tank to each containment sump, and from each containment sump to the reactor is verified by a series of tests. These tests gravity drain water from the in-containment refueling water storage tank to the containment sump, and from the sump ~~to the empty reactor coolant system~~ **through the empty direct vessel injection flow path, while measuring the storage tank water level (driving head) and injection flow rate using temporary instrumentation**. This testing is performed using temporary piping to prevent flooding of the containment. A spool piece with prototypical resistance may be used to simulate the squib valves in the flow paths tested.

~~o~~p) The resistance of each automatic depressurization stage 1, 2, and 3 flowpath and flowpath combination is verified by pumping cold water from the in-containment refueling water storage tank into the cold, depressurized, water-filled reactor coolant system; and back to the in-containment refueling water storage tank using the normal residual heat removal pump(s). **The resistances are determined by measuring the residual heat removal pump flow rate and** ~~Temporary instrumentation may be used to measure~~ the pressure drop across the flow paths tested **using temporary instrumentation**.

~~p~~q) The resistance of each automatic depressurization stage 4 flowpath and their flowpath combinations is verified by pumping cold water from the in-containment refueling water storage tank into the cold, depressurized, water-filled reactor coolant system using the normal residual heat removal pump(s). **The resistances are determined by measuring the residual heat removal pump flow rate**~~Temporary instrumentation may be used to measure~~ **and** the pressure drop across the flow paths tested **using temporary instrumentation**. The automatic depressurization stage 4 squib valves are not required to be included in this test.

~~q~~r) The proper operation of the vacuum breakers in the automatic depressurization discharge lines is verified.

rs) During hot functional testing of the reactor coolant system, proper operation of automatic depressurization is verified by blowing down the reactor coolant system. This testing verifies proper operation of the stage 1, 2, and 3 components including the ability of the spargers to limit loads imposed on the in-containment refueling water storage tank by the blowdown. Proper operation of the stage 1, 2 and 3 valves is demonstrated during blowdown conditions. **Note that this verification is required only for the first plant.**

st) The proper operation of at least one of each squib valve size and type including a containment recirculation, in-containment refueling water storage tank injection, and a stage 4 automatic depressurization squib valve is demonstrated. The squib valve performance and the flow resistance of the actuated squib valves is compared to the squib valve qualification testing results.

tu) ~~The passive core cooling system containment pH control function is verified by inspections of the storage baskets.~~ **The proper operation of the containment sump instrumentation is demonstrated by simulating the containment flood-up water levels.**

v) **The proper operation of the CMT level instrumentation is demonstrated during the draindown testing of the CMTs, specified in Item l) above.**

14.2.9.1.4 Passive Containment Cooling System Testing

Purpose

The purpose of the passive containment cooling system testing is to verify that the as-installed components perform properly to accomplish their safety-related functions to transfer heat from inside the containment to the environment, as described in Section 6.2. The passive containment cooling water storage tank also provides a seismically qualified source of water for the fire protection system. Testing of this function is discussed in subsection 14.2.9.2.8.

Prerequisites

The construction testing of the passive containment cooling system is successfully completed. The preoperational testing of the Class 1E dc electrical power and uninterruptable power supply systems, the non-Class 1E electrical power supply system, the compressed and instrument air system, and other interfacing systems required for operation of the above systems is available as needed to support the specified testing and system configurations. Additionally, a sufficient quantity of acceptable quality water for filling the passive containment cooling water storage tank and draining onto the containment is available, and a means of filling the tank is available.

General Test Acceptance Criteria and Methods

Passive containment cooling system performance is observed and recorded during a series of individual component testing that characterizes passive containment cooling system operation. The

- Automatic alignment of the boric acid tank
- Pressurizer auxiliary spray initiation and termination

This testing includes actuation of defense-in-depth pumps and remotely-operated valves from the main control room. Pressurizer level control testing is described in subsection 14.2.9.1.1.

c) The capability of the makeup pumps to operate when performing their normal makeup and pressurizer spray functions is verified with the reactor coolant system at normal operating pressure.

d) The capability of the makeup pumps to operate at miniflow and the operation of the miniflow heat exchanger is verified.

14.2.9.2.4 Normal Residual Heat Removal System Testing

Purpose

The purpose of the normal residual heat removal system testing is to verify that the as-installed components and associated piping, valves, and instrumentation properly perform the following defense-in-depth functions, as discussed in Section 5.4:

- Remove reactor core decay heat and cool the reactor coolant system during shutdown operations at low pressure and temperature

- Remove reactor core decay heat from the reactor coolant system during reduced reactor coolant inventory operations in Modes 5 and 6

- Following actuation of the automatic depressurization system, provide makeup to the reactor coolant system at low pressure

- Circulate and cool water from the containment after draindown of the in-containment water storage tank

- Provide low temperature overpressure protection for the reactor coolant system

Prerequisites

The construction testing of the normal residual heat removal system is completed. The required preoperational testing of the in-containment refueling water storage tank, reactor coolant system, passive core cooling system, component cooling water system, service water system, ac electrical power and distribution systems, and other interfacing systems required for operation of the above systems and data collection is available as needed to support the specified testing and system configurations. The reactor coolant system and the in-containment refueling water storage tank have an adequate water inventory to support testing.

General Test Acceptance Criteria and Methods

Normal residual heat removal system performance is observed and recorded during a series of individual component and system testing, that characterizes system operation. The following testing verifies that the normal residual heat removal system performs its defense-in-depth functions as described in subsection 5.4.7 and appropriate design specifications:

a) Operation of valves to open, to close, or to control flow as required to perform the above defense-in-depth functions is verified.

b) Operation of system controls, alarms, instrumentation, and interlocks associated with performing the above defense-in-depth functions is verified.

c) The normal residual heat removal system pumps testing includes verification that the pump flow rate corresponds to the expected system alignment, proper pump miniflow operation, and verification that adequate net positive suction head is available for the configurations tested. The following system configurations are tested with each pump operating individually and with two pumps operating:

- Recirculation from and to the reactor coolant system with the reactor coolant system at mid-loop hot leg water level and atmospheric pressure

- Makeup to the reactor from the in-containment refueling water storage tank with approximately 4 feet of water in the tank

d) During the verifications of normal residual heat removal system flow to the reactor coolant system, verify that the pumped flow provides sufficient back pressure to maintain a water level in the CMT.

de) The capability of the normal residual heat removal heat exchangers to provide the required heat removal rate from the reactor coolant system is verified by testing performed with flow from and to the heated reactor coolant system, with each normal residual heat removal pump/heat exchanger operating individually.

ef) Operation of the normal residual heat removal system relief valve which provides low temperature overpressure protection for the reactor coolant system is verified by the performance of baseline in-service testing, as specified in subsection 3.9.6.

fg) Operation of the system to facilitate draining the reactor coolant system water level to near the centerline of the hot leg for reduced inventory operations is verified. This test is performed in conjunction with the chemical and volume control system, and is used to demonstrate the performance of the reactor coolant system hot leg level instruments as discussed in subsection 14.2.9.1.1.

14.2.9.2.5 Component Cooling Water System Testing

14.2.9.2.20 Primary Sampling System Testing

Purpose

The purpose of the primary sampling system testing is to verify that the as installed components properly perform the following nonsafety-related defense-in-depth functions described in subsection 9.3.3:

- Provide the capability to obtain samples of the reactor coolant, **passive core cooling system**, containment sump water, and containment atmosphere

Prerequisites

Construction testing of the primary sampling system has been completed. Component cooling water is being provided to the sample cooler when samples are taken from the reactor coolant system when it is at elevated temperature. The systems/components to be sampled are filled and at their normal pressure and temperature. The liquid radwaste system is available to receive discharged sample fluid. Electrical power is available for operation of the system components and a source of compressed gas is available for operation of the gas sample eductor.

General Test Method and Acceptance Criteria

The performance of the primary sampling system is observed and recorded during a series of individual component tests and testing in conjunction with the reactor coolant system and passive core cooling system operation. The following testing demonstrates that the primary sampling system performs its defense-in-depth functions as described in subsection 9.3.3 and appropriate design specifications.

a) Proper operation of the system's remotely-operated valves and eductor supply pump is verified.

b) Proper calibration and operation of instrumentation, controls, actuation signals, and interlocks are verified.

c) Verify the capability to obtain samples from the reactor coolant **system, core makeup tanks, accumulators,** containment sump, and containment atmosphere.

d) Verify the ability to return the sample stream fluid to the containment sump or liquid radwaste system, as appropriate.

e) Verify the capability to route sample streams to the laboratory.