Commonwealth Edison
One First National Plaza, Chicago, Illinois
Address Reply to: Post Office Box 767
Chicago, Illinois 60690

December 23, 1981

RECEIVED
JAN 15 1982
U.S. NUCLEAR REGULATORY COMMISSION
DOCUMENT MANAGEMENT BR
TIDC

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Byron Station Units 1 and 2
Braidwood Station Units 1 and 2
Responses to FSAR Questions
NRC Docket Nos. 50-454, 50-455,
50-456 and 50-457

Dear Mr. Denton:

This is to provide advance copies of information which will be included in the Byron/Braidwood FSAR in the next amendment. Attachment A to this letter lists the enclosures which contain new or revised FSAR information.

One (1) signed original and fifty-nine (59) copies of this letter are provided. Fifteen (15) copies of the enclosures are included for your review and approval.

Please address further questions to this office.

Very truly yours,

T. R. Tramm

T. R. Tramm
Nuclear Licensing Administrator

Enclosures

lm

B001
s
1/1

3073N

8201180383 811223
PDR ADOCK 05000454
A PDR

ATTACHMENT A

LIST OF ENCLOSED INFORMATION

I. Responses to FSAR Questions

040.139	022.39
040.140	022.42
040.158	022.46
251.2	022.47
022.28	022.52
022.36	022.53
022.77	022.54
022.9	022.55
022.19	022.58
022.69	022.65
022.13	022.66
022.	022.78
022.12	022.80
022.29	022.81
022.34	022.35
022.38	022.71
022.14	022.62
022.64	022.72
130.43	031.35

II. FSAR TEXT CHANGES

E.31 (II.F.2)

III. MISCELLANEOUS ITEMS:

Notes of ICSB Meeting, December 9 & 10, 1981

ICSB Open Item 2

CPB Open Item 5

Handouts from 12/22/81 meeting on 241.1 and 241.4

Unresolved Safety Issue A-12

5.4.7.2.6 Manual Actions

In order to prepare the plant to go onto the RHRS, the following manual actions are required outside the control room:

a. Rack in power to the accumulator isolation valves so they can be closed from the control room.

b. Rack out power to the SI pumps.

c. Sample the boron concentration in the RHRS.

The RHRS is designed to be fully operable from the control room for normal operation. Manual operations required of the operator are: closing the suction valves to the RWST, opening the suction isolation valves, positioning the flow control valves downstream of the RHRS heat exchangers, and starting the RHR pumps.

Manual actions required outside the control room, under conditions of single failure, are discussed in Subsection 5.4.7.2.5.

5.4.7.2.7 System Operation

Reactor Startup

Generally, while at cold shutdown condition, decay heat from the reactor core is being removed by the RHRS. The number of pumps and heat exchangers in service depends upon the heat load at the time.

At initiation of the plant startup, the RCS is completely filled, and the pressurizer heaters are energized. The RHRS is operating and is connected to the CVCS via the low-pressure letdown line to control reactor coolant pressure. During this time, the RHRS acts as an alternate letdown path. The manual valves downstream of the residual heat exchangers leading to the letdown line of the CVCS are opened. The control valve in the line from the RHRS to the letdown of the CVCS is then manually adjusted in the control room to permit letdown flow.

After the reactor coolant pumps are started, the residual heat removal pumps are stopped but pressure control via the RHRS and the low-pressure letdown line is continued until the pressurizer steam bubble is formed. Indication of steam bubble formation is provided in the control room by the damping out of the RCS pressure fluctuations, and by pressurizer level indication. The RHRS is then isolated from the RCS and the system pressure is controlled by normal letdown and the pressurizer spray and pressurizer heaters.

Power Generation and Hot Standby Operation

During power generation and hot standby operation, the RHRS is not in service but is aligned for operation as part of the ECCS.

Reactor Cooldown

Reactor cooldown is defined as the operation which brings the reactor from no-load temperature and pressure to cold conditions.

The initial phase of reactor cooldown is accomplished by transferring heat from the RCS to the steam and power conversion system through the use of the steam generators.

9.3 PROCESS AUXILIARIES

9.3.1 Compressed Air Systems

9.3.1.1 Design Basis

Two compressed air systems are employed for the Station, the service air system and the instrument air system. The service air system provides oil-free compressed air for general plant use and maintenance use. The instrument air system provides dry, oil-free compressed air for both nonessential and essential components and instruments. Both systems are designated Safety Category II, Quality Group D with the exception of containment penetrations, inasmuch as there are no safety-related systems that require compressed air to perform their safety-related functions under post-accident or emergency cooldown conditions.

The instrument air system is supplied with service air which is dried to a dewpoint of -40° F or less. Oil and dust are removed by a pre-filter and an after-filter fitted to the air dryer. The pre-filter removes 100% of the particles 0.6 microns and larger and 98% of the particles 0.04 microns and larger. The after-filter removes 100% of the particles .9 microns and larger and 98% of the particles 0.07 microns and larger.

To ensure that the quality of the instrument air is equivalent or exceeds that recommended by ANSI MC 11.1-1975, air samples will be taken at every refueling outage and the air analyzed for moisture, oil, and particulate content.

9.3.1.2 System Description

Service air and instrument air for both units are supplied by three motor-driven centrifugal air compressors located in the turbine building. The compressors are sized such that each compressor can supply the air requirements of one unit (2190 scfm at 115 psig) with the third compressor serving as a common standby. The air intake to each compressor is taken from outdoors and is filtered. The compressed air is intercooled between stages, utilizing service water in heat exchangers. The discharge of each compressor passes through a service water cooled aftercooler and moisture separator before entering the receivers, each of which has provisions for draining moisture. There is a station air receiver for each compressor.

Each station air receiver has two discharge connections, one to the service air system and the second to the instrument air system. The three discharges to the instrument air system are cross tied to a header which feeds three instrument air dryer units located in the turbine building. Each air dryer unit consists of a prefilter - dryer - afterfilter train. The three air dryer discharges are cross-tied to a header which supplies instrument air to three instrument air receivers located in the

turbine building. The air receivers supply instrument air to the turbine buildings, auxiliary building, fuel handling building, and containment buildings. Additional instrument air receivers are located throughout the station to provide additional surge capacity in areas of heavy air usage.

Each air dryer is of the twin tower, dry dessicant type which uses activated alumina as the adsorption material. While one tower is in service, the other is being regenerated. The "in-service" tower receives up to 1755 scfm of air saturated at 115 psig and 120° F, and discharges the air at a dewpoint temperature of -40° F. Dry air from the discharge of the "in-service" tower is backflowed at the rate of 232 scfm through the other tower, which gives up its moisture to the dry air purge flow. The tower

i. multiple makeup lines, one for each hotwell compartment.

There is a motor-operated butterfly valve in each circulating water riser pipe immediately above the basement slab therefore each of the four cooling sections may be isolated for inspection and maintenance while the turbine generator remains in operation at reduced load. Administrative controls ensure that the motor-operated valves are closed before removing water box manways. In the unlikely event of flooding, the main steam and feedwater valve rooms adjacent to the containments could be affected, depending upon the rate and duration of leakage before it is discovered. However, the auxiliary feedwater tunnels have watertight hatches, and operation of this safety-related system will not be impaired. No other safety-related systems will be affected.

In the event of primary to secondary leakage, radioactive gaseous isotopes will be transported to the condenser. Some isotopes in soluble and particulate form will also be carried over with the 0.25% entrained moisture in the steam. The gaseous isotopes will be evacuated and discharged via the Off-Gas System. Refer to Section 10.12 for control functions.

In the event of primary to secondary leakage at the design rate of one gallon per minute concurrent with cladding defects in fuel rods, generating 1% of rated power, the equilibrium isotopic activity level in the condenser hotwell is approximately as shown in Table 10.4-2.

10.4.2 Main Condenser Evacuation Systems

Each condenser is equipped with two 100% two-stage steam jet air ejectors with inter- and aftercondensers that will utilize condensate for liquefying entrained vapor. The steam jet air ejectors meet or exceed the minimum capacities recommended by the Heat Exchanger Institute "Standards for Steam Surface Condensers." In addition, each condenser has a high-capacity mechanical vacuum pump which is used for initial evacuation during startup. A leakage meter is provided for each condenser so that the leakage rate of noncondensibles into the condenser may be determined at any time.

Each steam jet air ejector is rated 32 cfm of dry air at 3 in. Hg abs in an air-vapor mixture.

The mechanical vacuum pump is required to evacuate the turbine, reheat piping, extraction piping, and the main condenser with the turbine glands sealed, from atmospheric pressure down to 5 in. Hg abs within 3.5 hours.

To monitor potential contamination of main steam by a steam generator tube leak, radiation monitoring of the noncondensible gases present in the steam jet air ejector exhaust header is maintained as explained in Chapter 11.0. Provisions for grab-sampling the noncondensibles is made in order to confirm an alarm should one occur.

10.4.6 Condensate Cleanup System

10.4.6.1 Design Bases

The condensate cleanup systems at Byron and Braidwood will be utilized primarily during plant startup to flush the condensate, condensate booster, and feedwater systems. This system will not be operated continuously. The equipment is designed to treat one-third of the condensate system flowrate supplied from the discharge header of the condensate pumps. The treated water returns to the condensate booster pumps suction header.

The condensate cleanup system is designed to produce an effluent at the design flowrate within the following limits:

a.	Sodium	< 1 ppb
b.	Conductivity	< 0.1 μmho/cm
c.	SO_4	< 1 ppb
d.	Iron	< 10 ppb

All pressurized vessels in the system are designed and constructed in accordance with the ASME code for Unfired Pressure Vessels of ASME Division 1, Section VIII.

No part of the system is safety-related, thus it is designated Safety Category II.

10.4.6.2 System Description

10.4.6.2.1 General Description and System Operation

The condensate cleanup system for each station consists of four mixed bed polishers each designed for a capacity of 3750 gpm. Two vessels are normally assigned to each unit, however, the valving arrangement permits operation of the vessels with either unit. Normally the flowrate from each unit is equally divided among two vessels.

The external resin regeneration system, common to all four mixed bed polishers, consists of one resin mixing and storage tank, one resin separation and cation regeneration tank, and one anion regeneration tank. Resin is sluiced from a mixed bed polisher to the resin separation and cation regeneration tank. The anion and cation resin are separated and the anion resin in transferred to the anion regeneration tank. The cation resin is regenerated with sulfuric acid, and the anion resin is regenerated with sodium hydroxide. After regeneration is complete, the resins are transferred to the resin mixing and storage tank.

When placed in service, the operation of this system is controlled and maintained by a solid state controller. The control system will prevent the initiation of any automatic or sequence of operations that would conflict with any operation already in progress, whether such operation is under automatic or manual control. The operation status of each polisher and each regeneration vessel, including which automatic sequence is in progress, is indicated by means of lights on the polisher control panel.

Improper operation of the regeneration system and components will cause an alarm to sound and the system will be shut down. Improper regeneration solution strength will sound an alarm and the system will shut down if the situation is not corrected within five minutes.

10.4.6.2.2 Component Description

10.4.6.2.2.1 Mixed Bed Polisher

Each of the four mixed bed polishers are 114 inches in diameter with a 60-inch side seam and are sized for a flowrate of 3750 gpm. The polisher tanks are fabricated of carbon steel and lined with 3/16-inch gum rubber. All internals are 304 stainless steel construction. Each vessel contains approximately 5 kg/ft^3 of anion resin and [illegible] kg/ft^3 of cation resin. The vessels are equipped with viewports on the side shell and an illumination port in the upper head. The mixed bed polishers are designed to Section VIII of the ASME Boiler and Pressure Vessel Code, and are rated at 300 psig. A high pressure resin trap in each polisher effluent line is designed to retain particles larger than 50 mesh.

10.4.6.2.2.2 Resin Separation and Cation Regeneration Tank

The resin separation and cation regeneration tank is 84 inches in diameter with a 174-inch side shell and equipped with four viewports in the side shell and an illumination port in the top head for illumination. This tank is fabricated of carbon steel and is lined with 3/16-inch gum rubber. All internals are of 316 stainless steel construction. The design pressure of the tank is 100 psig. The resin is backwashed to separate the anion and cation resins. The anion resin is drawn off before the cation resin is regenerated.

A 3-foot diameter by 5-foot side shell resin hopper is located above the resin separation and cation storage tank to make up for any lost resin.

10.4.6.2.2.3 Anion Regeneration Tank

Anion resin is transferred to this tank to be regenerated with caustic. The anion regeneration tank is 78 inches in diameter with a 120-inch side shell. The vessel is fabricated from carbon steel and is lined with 3/16-inch gum rubber. All internals are manufactured with 304 stainless steel. The tank is equipped with two view ports in the side shell and one illumination port in the top head. The design pressure is 100 psig.

10.4.6.2.2.4 Resin Mix and Storage Tank

The resin mix and storage tank is 96 inches in diameter with a 102-inch side seam and the design pressure is 100 psig. The carbon steel tank is lined with 3/16-inch gum rubber. All internals are 304 stainless steel. Three viewports are located in the side shell and one illumination port is located in the top head. The tank is sized to contain a complete change of resin for one mixed bed polisher. The anion and cation resin is sluiced from their respective regeneration tanks to this storage tank. The resins are mixed and stored until being transferred to a mixed bed polisher.

10.4.6.2.2.5 Regeneration Equipment

The acid regeneration skid consists of a 200-gallon acid storage tank, two metering pumps, and a dilution station. The storage tank is sized for two regenerations. The caustic regeneration skid consists of a 700-gallon caustic tank, two metering pumps, and a dilution station. A hot water tank provides dilution water for regeneration of the anion resin. Both regeneration systems are equipped with the necessary instrumentation and controls to automatically provide regeneration chemicals in the required amount, temperature, and concentration to the respective regeneration tanks. All of the regeneration equipment is manufactured of material suitable for the respective chemicals.

10.4.6.2.2.6 Sluice Water Pumps

Two 400-gpm, 100-psig pumps are used to supply water from the condensate storage tank for sluicing the resin between the various tanks. The pumps also supply the required dilution water to the acid and caustic regeneration systems. The sluice water pumps are constructed of carbon steel.

10.4.6.3 Safety Evaluation

The condensate cleanup system is a non-safety-related system and is not required for safe shutdown of the plant.

10.4.6.4 Testing and Inspection

All pressurized tanks are designed in accordance with the ASME Code for Unfired Pressure Vessels of ASME Division 1, Section VIII. All equipment is factory inspected and tested in accordance with the applicable equipment specifications and codes. Preoperational tests will be performed on this system. The equipment manufacturer's recommendations and station pactices are considered in determining required maintenance.

10.4.7 Condensate and Feedwater System

The purpose of the Condensate and Feedwater System is to provide feedwater from the condenser to the steam generators. This subsection discusses the Condensate and Feedwater System from the condenser to the connection with the steam generators.

10.4.7.1 Design Bases

10.4.7.1.1 Safety Design Bases

The only part of the Condensate and Feedwater System classified as safety-related (i.e., required for safe shutdown or in the event of postulated accidents) is the main feedwater piping from the preheater section of the steam generators to, and including, the outermost containment isolation and check valves; the tempering feedwater lines between the steam generator preheater bypass connections and the outermost check and isolation valves; the interconnecting piping between the tempering lines and the auxiliary feedwater system, and the chemical feed piping from the interface into the tempering piping to, and including, the shutoff valves. These parts of the system are designated as Safety Category I, Quality Group B.

10.4.7.2 System Description

The Condensate and Feedwater System consists of the piping, valves, pumps, heat exchangers, controls, instrumentation, and the associated equipment and subsystems that supply the steam generators with heated feedwater in a closed steam cycle using regenerative feedwater heating. The system is shown in Figure 10.4-1, Sheets 1 and 2.

There are four 1/3-capacity centrifugal condensate pumps per unit with motor drives and common suction and common discharge headers, and four 1/3-capacity condensate booster pumps per unit with common suction and discharge headers. Each condensate and condensate booster pump set is driven by a single motor. Three sets of pumps are normally in operation. The fourth set of pumps will automatically start on low pressure at the feedwater pump suction to assure adequate flow to the feedwater pumps.

The Feedwater System is of the closed type, with deaerating accomplished in the condenser. The condensate pumps take suction from the condenser hotwell and pump condensate through the air ejector condensers and the gland steam condensers to the suction of the condensate booster pumps. These pump the condensate through six stages of low-pressure feedwater heating to the feedwater pumps. The water discharge from the feedwater pumps

14.2 SPECIFIC INFORMATION TO BE INCLUDED IN FSAR

14.2.1 Summary of Test Program and Objectives

Commonwealth Edison will conduct a comprehensive initial test program at the Byron/Braidwood Stations to demonstrate that structures, systems, and components will perform satisfactorily in service. The principle objectives of this program are to provide assurance that:

a. the plant has been properly designed and constructed and is ready to operate in a manner that will not endanger the health and safety of the public:

b. the procedures for operating the plant safely have been verified by trial use to be adequate; and

c. the plant operating personnel and technial staffs are knowledgeable about the plant and procedures and are fully prepared to operate the facility in a safe manner.

The initial test program will include preoperational and initial startup testing. Preoperational testing will consist of system performance tests performed prior to core load on essentially completed systems. These tests will demonstrate the capability of structures, systems, and components to meet safety-related performance requirements.

Initial startup testing will consist of those single and multisystem tests that occur after fuel loading and which are intended to demonstrate overall plant performance. This will include such activities as precritical tests, low-power tests (including critical tests), and power ascension tests. This testing will confirm the design bases and demonstrate, where possible, that the plant is capable of withstanding the anticipated transients and postulated accidents.

14.2.2 Organization and Staffing

The Byron/Braidwood Stations' operating and technical staffs will manage and execute the initial test program in accordance with the Quality Assurance Program as outlined in the QA Topical Report referenced in Chapter 14.0. The Assistant Superintendent, Administration and Support Services is the senior participant of the Onsite Review Group, Other assistant superintendents are appointed as alternates on a case basis. The senior participant will choose the necessary participants for a particular review from designated individuals qualified in the disciplines listed in Technical Specification G.1.G.1.f. The station technical staffs are responsible for writing and conducting the initial test program. The Onsite Review Group is responsible for the review and approval of the test procedures

and test results. The Commonwealth Edison Station Nuclear Engineering, Operational Analysis, and Station Construction Departments will provide technical support or participate in the test program as required. The Station Nuclear Engineering Department (SNED) has overall responsibility for the successful review and completion of the intitial test program. SNED conducts its review in accordance with an approved procedure (SNED Procedure Q.19). SNED also

provides the interface between the test personnel at the stations and the architect-ingineer and the Nuclear Steam Supply Vendor. The Nuclear Steam Supply System vendor (Westinghouse) and the architect-engineer (Sargent & Lundy) will provide technical assistance during testing of systems. The authority and responsibility of each organizational unit involved in the initial test program is further specified in the Quality Assurance Program, Quality Assurance Pocedures Manual, Section 11.

The station organizational structure that will implement the test program is discussed in Section 13.1. Personnel conducting the testing will be qualified by experience and training as described in Chapter 13.0.

14.2.3 Test Procedures

The initial test program will be conducted using detailed written procedures for each individual test. Tests of Safety-Related Systems and specially designated non-safety-related systems (for purposes of initial plant startup only) are called Preoperational or Startup Tests. The Quality Assurance Program for the Commonwealth Edison Company (referred to in Chapter 17.0) describes the procedures for administration of Preoperational and Startup Tests. All other tests will be called System Demonstrations or Operational Demonstrations. Preoperational Tests and System Demonstrations will be performed during the "preoperational test phase". Startup Tests and Operational Demonstrations will be performed during the "startup test phase."

Sargent & Lundy or Westinghouse, as appropriate, and as directed by Commonwealth Edison, will prepare rough draft test procedures. The station staff will prepare final draft test procedures based on the rough draft and on comments received from appropriate Commonwealth Edison departments. Sargent & Lundy and Westinghouse will review the final draft procedures. The final draft of Preoperational Test and Startup Test procedures will be reviewed and approved by the Station Nuclear Engineering Department. Revisions to Preoperational Tests or Startup Tests will be prepared by the station staff and submitted to the Station Nuclear Engineering Department for review and approval.

System Demonstration and Operational Demonstration test procedures will be written, reviewed, and approved by the station staff in accordance with station procedures.

Individual test procedures will specify prerequisites, data to be obtained, and requirements and acceptance criteria to be fulfilled. Table 14.2-1 identifies the information typically provided in the individual test procedures.

14.2.4 Conduct of Test Program

The initial preoperational and startup test programs will be conducted using detailed written procedures that include provisions for assuring that

prerequisites have been completed. Test personnel will be instructed to initial and date the prerequisites included in each test procedure. Data will be examined as each test proceeds and out-of-tolerance conditions will be recorded and described in adequate detail to permit post-test analysis. Test data that is unsuccessful will be recorded, evaluated during post-test review, and resolved within the Quality Assurance program.

14.2.5 Review, Evaluation, and Approval of Test Results

Initial startup tests that fall within the scope of the Quality Assurance program will be subject to two stages of evaluation. First, a detailed and comprehensive review by station personnel will be made. The Station Nuclear Engineering Department project personnel will perform a second and final review and evaluation. Modifications or rework of systems or equipment required to resolve deficiencies will be accomplished in accordance with controlled procedures. Retesting, if required because of modification or rework, will be documented and filed with the initial test record.

The initial core loading procedure will specify the startup tests that must be completed prior to commencement of fuel load. All testing identified as falling within the pre-operational test phase will be completed and the results evaluated prior to core load.

The power ascension procedure will specify those startup tests or portions of startup tests that must be completed as a prerequisite for commencing each phase. The data obtained at each power test plateau will be evaluated and approved before increasing power level.

14.2.6 Test Records

The initial startup test procedures and test data will be retained and maintained in accordance with the Quality Assurance program described in Chapter 17.0. The original test records will be reviewed for completeness, identified, and indexed to establish them as part of a permanent record to be retained. These records will include data sheets completed during the test.

14.2.7 Conformance of Test Program with Regulatory Guides

Appendix A to the FSAR identifies those Regulatory Guides applicable to Byron/Braidwood and describes the anticipated degree of conformance to each.

14.2.8 Utilization of Reactor Operating and Testing Experience in Development of Test Program

The initial test program at Byron/Braidwood is similar to the programs conducted at the Quad-Cities, Dresden, Zion, and La Salle Stations.

Preoperational testing will proceed concurrently with construction testing as various systems reach completion and are turned over to the station staff. The principal milestones during this phase are expected to be the reactor coolant system hydrostatic test and the integrated hot functional test. The former test is expected to be accomplished approximately 10 months prior to fuel load. Hot functional testing is expected to begin about 3 months before fuel load. Tests of other systems will be scheduled as appropriate to support these tests. A schedule for testing is provided in Figure 14.2-1.

Individual preoperational tests will be conducted as early in the test program as practical and at no time will the safety of the plant be totally dependent on the performance of untested systems, components and features. Core load will occur only after the satisfactory completion and approval of all preoperational tests.

Individual startup tests will be conducted after core load and test data obtained at each power test plateau will be evaluated and approved prior to increasing power load.

Any initial test schedule overlap at the Byron and Braidwood Stations will not result in significant divisions of responsibility or dilutions in the staff provided to implement the test program.

TABLE 14.2-2

EXCORE NUCLEAR INSTRUMENTATION

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core loading and initial criticality.

Test Objective

To verify instrument alignment and source range detector response to a neutron source.

Test Summary

Prior to core loading the nuclear instruments will be aligned. All channels will be checked to verify high level trip functions, alarm setpoints, audible count rates where applicable, and operation of strip chart recorders and any auxiliary equipment.

Acceptance Criteria

The nuclear instruments are aligned and respond to a source of neutrons and trip, alarm and indicate in accordance with Technical Specification 2.2.1 and Sections 7.5 and 7.7.

TABLE 14.2-3

INCORE THERMOCOUPLE SYSTEM

(Preoperational Test)

Plant Condition or Prerequisite

During heatup and at temperature.

Test Objective

To calibrate the incore thermocouples to the average Reactor Coolant System temperature.

Test Summary

During heatup and at temperature, the incore thermocouples will be calibrated to the average of the Reactor Coolant System resistance temperature detectors. All readout and temperature compensating equipment will be checked during calibration and isothermal corrections for the thermocouples determined.

Acceptance Criteria

The incore thermocouples are in calibration in accordance with Subsections 7.7.1.9, 7.7.1.9.1, and 7.2.2.3.2.

TABLE 14.2-4

AUXILIARY STARTUP INSTRUMENTATION

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To verify response of each temporary startup source range channel to a neutron source prior to core loading.

Test Summary

Two separate temporary source range detectors will be installed in the core during core loading operations. An additional channel will serve as a spare to the other two channels. During the core loading operations these detectors will be relocated at specific loading steps to provide the most meaningful neutron count rate. The response of each channel to a neutron source will be verified prior to core loading.

Acceptance Criteria

Each temporary source range channel responds to a neutron source.

TABLE 14.2-5

SEISMIC INSTRUMENTATION

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To demonstrate operability of the seismic instrumentation.

Test Summary

The seismic instrumentation will be checked out and aligned to calibrated test signals.

The systems and equipment tested will be the free field, containment foundation, containment wall, accumulator tanks in the containment, SI piping in the containment, auxiliary building essential service water return piping, the base slab of the containment, operation floor of the containment, and the counting room of the auxiliary building. Equipment used will be a triaxial time-history control recording accelograph unit, a triaxial seismic trigger, three triaxial acceleration sensors, three triaxial peak accelographs, three triaxial response spectrum recorders, and a triaxial response spectrum annunciator.

Acceptance Criteria

The instrumentation is aligned and operable in accordance with Subsections 3.7.4, 16.3.3.3.3, and 16.B.3/4.3.3.3 and Tables 16.3.3-7 and 6.4.3-4.

TABLE 14.2-6

REACTOR PROTECTION

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test objective

To verify operation of the Reactor Protection channels from each protection sensor through to tripping of the reactor trip breakers.

Test Summary

Prior to core loading the operation of the reactor trip system will be verified under all conditions of logic utilizing outputs or simulated outputs from each of the nuclear and process and other protection sensors. It will demonstrate that both Train A and Train B are independent and a loss of one train will not affect the other. The individual protection channels will be tested to check the redundance of the systems and to demonstrate safe failure on loss of power. The protection channels will be verified through to tripping of the reactor trip breakers. The trip time of each reactor protection signal will be measured from the output of the sensor to tripping of the reactor trip breaker.

Acceptance Criteria

The reactor protection system operates in accordance with Section 7.2.

Verification that the control rod drive mechanisms will unlatch upon opening of the trip breakers will be part of the Initial Criticality Procedure. Demonstration of this will have been accomplished prior in the Rod Drop Measurement Test. Other items such as simulated trip signals, bypass breaker operation, interlocks, rod blocks, and turbine runbacks are verified in the Reactor Protection Preoperational Test.

TABLE 14.2-7

ENGINEERED SAFETY FEATURES

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To verify operation of the safeguards logic systems for all conditions of trip logic.

Test Summary

Prior to core loading the operation of the Engineering Safety Features will be demonstrated. It will include actuation of containment systems, emergency core loading systems (ECCS), habitability systems, fission product removal, and control systems. It will demonstrate that both trains are independent, and that the response time from the measured variable to the sensor meet the Technical Specifications.

Acceptance Criteria

The safeguards logic system operates in accordance with Section 7.3.

TABLE 14.2-8

AREA RADIATION MONITORS

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To demonstrate that area radiation monitors are in calibration and function properly.

Test Summary

The area radiation monitor sensors and channels will be calibrated in accordance with the manufacturer's instructions. The preoperational test will include operation of the check sources, annunciation and alarm on high radiation and circuit failures, test of indicating and recording features, and functioning of interlocks, if applicable.

Acceptance Criteria

The area radiation monitors operate in accordance with Subsections 12.3.4, 16.3/4.3.3, and 16.B.3/4.3.3.1.

TABLE 14.2-9

PROCESS RADIATION MONITORS

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To demonstrate that process radiation monitors are in calibration and function properly.

Test Summary

The process radiation monitor sensors and channels will be calibrated in accordance with the manufacturer's instructions. The preoperational test will include operation of the check sources, annunciation and alarm on high radiation and circuit failures, tests of indicating and recording features, and functioning of interlocks, if applicable. This will include effluent monitors with isolation functions.

Acceptance Criteria

The process radiation monitors operate in accordance with Section 11.4.

TABLE 14.2-11

AUXILIARY POWER SYSTEM

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To verify proper operation of the auxiliary power transformers, breakers, switchgear, and other components.

Test Summary

Prior to core loading the auxiliary power system will be tested and verified that all interlocks, protective features, alarms, and indications are operational. It will demonstrate that a loss of offsite power will transfer to onsite power and function as per its design capabilities. It will also demonstrate that the two ESF Divisions 11 and 12 are completely independent. All metering, voltages, and proper phase rotations will be demonstrated to perform as per its design. Load testing will be performed using the system aux transformer, reserve feed, and diesel-generator.

Acceptance Criteria

Each 480-V or 4-kV Auxiliary Power bus can be supplied with power in accordance with Section 8.15.

TABLE 14.2-12

INSTRUMENT POWER SYSTEM

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To demonstrate proper operation of the instrument power system including the inverters and SOLA transformers.

Test Summary

A preoperational test will demonstrate that the instrument power buses can be supplied from the appropriate power sources. It will demonstrate the capability of the inverters to transfer to the alternate power source on loss of normal power and maintain an uninterrupted source of power to the instrument bus. The inverters and SOLA transformers will be verified to maintain the proper voltage and frequency output while varying the voltage input and loading. Setpoints of associated alarms, relays, and instrumentation will be verified.

Acceptance Criteria

The instrument power system supplies power to the instrument power buses in accordance with Subsection 8.3.1.1.2.

TABLE 14.2-13

D-C POWER

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To verify proper operation of the batteries, battery chargers, switchgear and alarms of the 125-Vdc system.

Test Summary

A preoperational test will be run on the 125-Vdc system including the batteries, chargers, and distribution centers. The battery capacity will be verified with the battery charger electrically disconnected. Individual cell voltage readings will be taken at periodic intervals during the capacity test to ensure that individual cell limits are not exceeded. A performance test will be conducted on the battery chargers to verify its voltage regulation. The test will verify the proper settings of the low voltage alarm, high dc output voltage trip of ac input breaker, ac fail alarm, bus undervoltage alarm, ground detector alarm, and breaker trip alarms.

Acceptance Criteria

Each battery can carry its design load in accordance with Subsection 8.3.2.

TABLE 14.2-14

VITAL BUS INDEPENDENCE VERIFICATION

(Preoperational Test)

Plant Condition or Prerequisite

Prior to plant operation.

Test Objective

To verify the existence of independence among redundant onsite power sources and their load groups.

Test Summary

The plant electric power distribution system, not necessarily including the switchyard and unit and system auxiliary transformers, will be isolated from the offsite transmission network. The onsite electric power system will then be functionally tested successively in the various combinations of power sources and load groups with all d-c and onsite a-c power sources for one load group at a time completely disconnected. Each test will include injection of simulated accident signals, startup of the diesel generator and load group under test, sequencing of loads, and the functional performance of the loads. Each test will be of sufficient duration to achieve stable operating conditions. During each test the d-c and onsite a-c buses and related loads not under test will be monitored to verify absence of voltage at these buses and loads.

Acceptance Criteria

Each redundant onsite power source and its load group are independent of any other redundant load group in accordance with Subsection 8.1.1.

TABLE 14.2-15

ESSENTIAL SERVICE WATER SYSTEM

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To verify acceptable service water flow to all components cooled by the system.

Test Summary

The essential service water system will be operationally checked to verify pressures and flows. Service water flow will be verified to all components in the system. Functional operation of pump discharge strainers will also be verified. Operation will be demonstrated from normal and emergency power sources. Pump head and flow characteristics will be determined. Controls, interlocks, and instrumentation will be demonstrated. During hot functional testing the system will be verified to maintain adequate component temperatures. Proper operation of cooling tower fans and tower level control (Byron only) in normal and backup modes will be verified. Leak detection by means of system flow and pressure drop instrumentation will be demonstrated.

Acceptance Criteria

The essential service water system supplies water to all components in the system under all modes of operation in accordance with Chapter 3 and Subsections 9.2.1.2, 9.2.1.5, 16.3/4.7.4, and 16.B.3/4.7.4.

TABLE 14.2-16

COMPONENT COOLING SYSTEM

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To verify that adequate cooling is supplied to each component and that temperature limits are maintained.

Test Summary

The component cooling supply to the various components in the system will be adjusted. During hot functional testing and during cooldown, data will be taken to verify that adequate cooling is supplied to each component and that temperature limits are maintained. Pump characteristics will be determined, valve operation demonstrated, and system control, indication, and alarm functions verified.

Automatic start feature of the standby CCS pump will be verified. Automatic isolation of the RCS pump thermal barrier cooling lines on high flow will be demonstrated. Automatic closure of valves on Phase A and Phase B isolation will be demonstrated. Auto isolation feature of the surge tank atmospheric vent will be demonstrated.

Acceptance Criteria

The component cooling system supplies cooling to all components in the system in accordance with Subsections 9.2.2, and 16.3.7.3.

TABLE 14.2-17

RESIDUAL HEAT REMOVAL SYSTEM

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load

Test Objective

To verify adequate flow in all modes of operation.

Test Summary

The Residual Heat Removal (RHR) system will be operationally checked prior to initial core load by verifying pressures and flows for the various flow paths. During the cooldown phase of hot functional testing, the cooldown capability of the system will be demonstrated. Pump characteristics will be determined, valve interlocks and controls verified, and system control and alarm functions verified.

Use of the residual heat removal system for the refueling mode will be tested by verification of the following operating procedures during performance of the RHR preoperational testing: preparation for refueling, pumping the refueling cavity to the RWST, and pumping the refueling cavity to the recycle holdup tanks. Plant startup and isolation of RHR from the RCS will be tested during heatup for hot functional testing by monitoring reactor coolant temperature and pressure. Plant shutdown and initiation of RHR will be tested during the cooldown phase of hot functional testing by reducing the temperature and pressure of the reactor coolant.

Testing for RHR pump automatic start on a safety injection signal will be performed during logic testing of the RHR pumps and preoperational testing of the ECCS system. RHR miniflow recirculation and proper operation of the miniflow line isolation valve will be tested during logic and integrated testing of RHR. RHR pump curve data, vibration data, running current, etc. will be taken while on recirculation. Operation of RHR on miniflow recirculation will also be tested during ECCS properational testing. RHR pump automatic suction switch over to the containment sump will be tested as part of the valve logic testing of the safety injection system.

Acceptance Criteria

The RHR system provides flow in accordance with Subsection 5.4.7 and Table 5.4-7.

TABLE 14.2-18

CONTAINMENT SPRAY SYSTEM

(Preoperational Test)

Plant Condition or Prerequisite

Prior to plant operation.

Test Objective

To verify that the containment spray system can deliver water at proper flow and pressure to the containment spray headers.

Test Summary

All modes of containment spray pump operation will be tested to verify flow paths and pump flow and pressure characteristics. System response to a containment high-high-high pressure signal will be demonstrated. Spray nozzles will be tested using hot air injected into the nozzles and infra-red thermography to verify proper nozzle flow. Water injection through the spray nozzles is not planned. Spray pump "Head vs. Flow Curves" will be obtained while the pumps are in a recirculation mode back to the refueling water storage tank. Valve operability, interlocks, and indication will be verified. The paths for the air flow test of the containment spray nozzles will overlap the water flow test paths of the pumps at the connecting spool pieces.

The spray additive tank will be filled with demineralized water and with the containment spray pumps operating adjustment of valves CS021A and B will be made to yield 55 gpm flow across FI-CS015, corrected for specific gravity to simulate a 30% NaOH solution.

Acceptance Criteria

The containment spray system operates in accordance with Subsections 3.1.2.4.9, 6.5.2, 7.3.1.1.13, 16.4.6.2.1, 16.4.6.2.2, 16.B.3/4.6.2.1, 16.B.3/4.6.22, and Attachment A6.5.

TABLE 14.2-19

AUXILIARY FEEDWATER SYSTEM

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To verify the ability of the auxiliary feedwater system to respond to a feedwater demand under any plant condition.

Test Summary

The auxiliary feedwater system will be tested prior to hot functional testing to verify pump performance over extended periods on recirculation, and at various flow rates. Motor- and diesel-driven pumps will be verified to start under any safeguard situation under any possible control lineup, including restart capability, from any control station, following a protective trip. Control logic and interlocks for both manual and automatic operation and protective features for motor- and diesel-driven pumps and all power-operated valves will be verified for setpoint, indication, and alarms.

All motor- and diesel-driven pumps will be tested for five (5) consecutive, successful cold starts per pump.

All power operated valves will be verified to position or reposition to the required lineup from any plant condition, safeguard situation, suction requirement, or loss of power. Emergency service water booster pumps attached to the diesel prime movers will be verified for flow and cooling requirements of the engine and cubicle cooler. All flow limiting devices will be verified by line flow checks and identification tab data.

Acceptance Criteria

The auxiliary feedwater system supplys feedwater in accordance with Subsections 10.4.9, 15.2.6, 15.2.7, and 15.2.8.

TABLE 14.2-20

PRIMARY SAMPLING SYSTEM

(Preoperational Test)

Plant Condition or Prerequisite

During hot functional testing.

Test Objective

To demonstrate that samples may be taken from the primary system.

Test Summary

Operations will be performed to establish purge times and to demonstrate that liquid and gas samples can be obtained from the sample points. Valves, instruments and controls, and the sample cooler will be demonstrated to function properly. Sample vessels will be removed and replaced. Flow paths, hold up times and sampling procedures will be verified.

Acceptance Criteria

The process sampling system operates in accordance with Subsection 9.3.2.1.

TABLE 14.2-21

LEAK DETECTION SYSTEM

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To demonstrate the ability of leak detection systems interfacing between RCS and ECCS systems the periodic tests for leak detection will be performed.

RCS system surge tank level and rad monitors are functionally tested.

The containment floor drains, Rx cavity sump, and totalizing meters will be functionally tested during the preoperational test of the Radwaste Systems.

Test Summary

Temperature detectors in the drain lines from safety valves and the reactor vessel head seal will be checked to verify their sensitivity and ability to detect leaks and to check alarm functions. Drain tank level and temperature sensors will be calibrated and associated alarms checked.

Acceptance Criteria

The leak detection system operates in accordance with Subsection 5.2.5.1.

TABLE 14.2-22

FUEL POOL COOLING AND CLEANUP SYSTEM

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To demonstrate flow through the various flow paths and components.

Test Summary

Tests will be performed to verify flow through the spent fuel pool demineralizers, heat exchanger loops, and other flow paths. Operation of the skimmer loop will be verified. Alarm setpoints will be checked, and valves, instruments and controls tested.

Acceptance Criteria

The fuel pool cooling and cleanup system operates in accordance with Subsection 9.1.3.

TABLE 14.2-23

FUEL HANDLING AND TRANSFER SYSTEMS

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To demonstrate functioning of the fuel transfer system and of the fuel handling tools.

The fuel handling system consists of the fuel building equipment crane, spent fuel pit bridge and hoists, and manipulator crane.

The fuel transfer system consists of the transfer cart and upenders.

Test Summary

All components, including special handling tools, will be tested prior to first use on new fuel. These tests will be conducted using dummy fuel assemblies to verify interlocks, setpoints, indexing, load capacity, and other indications.

The spent fuel pit bridge and hoists and the manipulator crane will be statically tested at over 125% of rated load using a dummy fuel assembly. They will be tested operationally at 100% of rated load and indexed using the dummy fuel assemblies. Special handling tools will be statically tested at 125% of rated load and operationally tested at 100% of rated load using a dummy fuel assembly. The fuel transfer system will be tested at 100% of rated load using a dummy fuel assembly. The fuel building equipment crane (fuel cask handling crane) will be verified to statically withstand 125% of rated load and to operationally withstand 100% of rated load.

Acceptance Criteria

The fuel handling equipment will transfer fuel assemblies safety and in accordance with specifications developed from system design criteria, manufacturer's recommendations, and plant installation.

TABLE 14.2-24

RADIOACTIVE WASTE GAS

(Preoperational Test)

Plant Condition or Prerequisite

Prior to plant operation.

Test Objective

To verify system operation.

Test Summary

Tests will be performed to demonstrate gas transfer from vent header to gas decay tanks and to verify valve operation, iterlocks and reliefs. Alarms and pressure setpoints will be checked.

Acceptance Criteria

The radioactive waste gas system and its components operates in accordance with Subsection 11.3.

TABLE 14.2-25

DIESEL-GENERATOR

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To demonstrate that each diesel generator can start and assume its rated load and to verify operation of alarms, indications, controls, and safety features.

Test Summary

Each diesel will be started and loaded a number of times under normal and simulated accident conditions to prove conformance to Regulatory Guide 1.108, Revision 1, Regulation Positions C.2.a.(1), (3), (4), (6), (9), and C.2.b during this test. Data collected during this test to prove conformance includes voltage, frequency, and current.

Acceptance Criteria

The diesel generators are demonstrated during this test, to conform to Regulatory Guide 1.108, Revision 1, Regulatory Position C.2.a.(1), (3), (4), (6), (9), and C.2.b.

TABLE 14.2-26

DIESEL FUEL OIL TRANSFER SYSTEM

(Preoperational Test)

Plant Condition or Prerequisite

Prior to plant startup.

Test Objective

To demonstrate that diesel fuel oil can be delivered to each diesel engine.

Test Summary

Tests will be conducted to demonstrate that diesel fuel oil can be received, and stored, in the diesel fuel oil storage tanks. Alarms, controls and indications will be checked. Demonstration of the ability of the system to supply fuel for an adequate time to operating engines will be accomplished.

Acceptance Criteria

The diesel fuel oil transfer system will receive, store, and deliver fuel oil to each diesel generator.

Each diesel fuel oil transfer pump will deliver fuel oil to each diesel generator in excess of the maximum demand, as indicated in Subsection 9.5.4.

TABLE 14.2-27

ECCS - EXPANSION AND RESTRAINT

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To verify ECC systems can expand unrestricted with acceptable clearances.

To confirm acceptability of system piping movements under system heatup and cooldown conditions and during steady-state operation.

Test Summary

During heatup to operating temperature selected points on components and piping of the ECC system are checked at various temperature to verify that they can expand unrestricted with acceptable clearance. Baseline data is established at cold plant condition for making measurement during heatup. Any potential points of interferance detected during heatup will be corrected prior to increasing temperature. Following cooldown to ambient temperature the piping and components will be checked to confirm that they return to their approximate baseline position to verify unrestricted movement during cooldown.

Acceptance Criteria

The ECC system components and piping can expand to operation temperature and return to ambient unrestricted in accordance with Subsection 3.9.2.1.

TABLE 14.2-28

ECCS - SAFETY INJECTION PUMPS

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load with reactor vessel open and flooded and reactor coolant system at essentially ambient pressure and temperature conditions.

Test Objective

To demonstrate system and component capability by injecting water from the refueling water storage tank into the reactor vessel through various combinations of injection lines and Safety Injection (SI) pumps.

Test Method

The reactor vessel will be open with provision made for excess water to drain into the refueling canal. Separate flow tests will be made for each pump to check proper runout rates, proper flow balancing in branch injection headers, and capability for sustained operation. Data will be taken to determine pump head and flow. Pumps will be run on miniflow paths to determine a second point on the head flow characteristic curve.

These tests will be conducted with water in the reactor vessel below the nozzles to simulate discharging to atmospheric pressure.

Acceptance Criteria

The SI pumps inject water into the vessel in accordance with Section 6.3.

TABLE 14.2-29

ECCS - CENTRIFUGAL CHARGING PUMPS

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To demonstrate system and component capability by injecting water from the refueling water storage tank into the reactor vessel using various combinations of injection lines and charging pumps.

Test Method

The reactor vessel will be open with provisions made for excess water to flow into the refueling canal. Separate flow tests will be made for each pump to check proper runout rates, proper flow balancing in branch injection headers, and capability for sustained operation. Data will be taken to determine pump head and flow. Pumps will be run on miniflow paths to determine a second point on the head flow characteristic curve.

These tests will be conducted with water in the reactor vessel below the nozzles to simulate discharging to atmospheric pressure.

Acceptance Criteria

The pumps inject water into the vessel in accordance with Table 9.3-2.

TABLE 14.2-30

ECCS - RHR PUMPS

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To demonstrate system and component capability by injecting water from the Refueling Water Storage tank into the reactor vessel using various combinations of injection lines and Residual Heat Removal (RHR) pumps.

Test Method

The reactor vessel will be open with provisions made for excess water to drain into the refueling canal. Separate flow tests will be made for each pump to check proper runout rates and capability for sustained operation. Data will be taken to determine pump head and flow. Pumps will also be run on miniflow paths to determine a second point on the head flow characteristic curve. Tests will be conducted on valves associated with the RHR portion of the SI system to verify that valves installed for redundant flow paths operate as designed, that the proper sequencing of valves occurs on initiation of safety injection signal, and that the fail position on loss of power for each remotely operated valve is as specified. Proper operation of the centrifugal charging pumps and safety injection pumps while aligned to take suction from the RHR pumps discharge will be tested as part of the full flow emergency core cooling test.

Acceptance Criteria

The RHR portion of the Emergency Core Cooling System (ECCS) operates in accordance with Section 6.3.

TABLE 14.2-31

ECCS - ACCUMULATORS

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To demonstrate proper system actuation and to verify that the flow rate is as expected for the test conditions.

To demonstrate that the accumulator isolation valves will open under the maximum differential pressure condition of zero RCS pressure and maximum expected accumulator precharge pressure.

Test Method

Each accumulator will be filled with water from the RWST and pressurized to the maximum expected accumulator pressure with the MOV on the discharge line closed. The valve is then opened and the accumulator allowed to discharge into the reactor vessel with the reactor cold and the vessel head removed. The overflow from the reactor vessel will pass into the refueling canal. Proper operation of the nitrogen fill, vent valves, accumulation drains and accumulation makeup will be verified.

Acceptance Criteria

Motor-operated valves and check valves are free to open. Blowdown response is conservative with respect to the valve used in Section 6.3.

TABLE 14.2-32

ECCS - RECIRCULATION PHASE

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core loading.

Test Objective

To demonstrate recirculation mode of emergency core cooling system (ECCS) operations under maximum differential pressure condition.

Test Method

Demonstrate that the RHR pumps can take suction from the containment sump to verify vortex content and that acceptable pressure drop occurs across screening and suction lines and valves. Temporary arrangements may be made to provide adequate sump capacity of the test. To avoid RCS contaminations, the sump water may be discharged to external drain or other systems.

Acceptance Criteria

The available net positive suction head of the RHR pump is in accordance with Section 6.3.

TABLE 14.2-33

ECCS - SAFETY INJECTION PUMPS

(ECCS - Full Flow Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To demonstrate system and component capability by injecting water from the Refueling Water Storage Tank into the reactor vessel through various combinations of injection lines and Safety Injection (SI) pumps.

Test Method

The initial condition for the full flow ECCS test will be an "at power" line up. The discharge and suction lines to the Centrifugal Charging Pumps will be in the normal "at power" configuration. An "S" signal will be manually initiated. At this point, the automatic suction switchover to the RWST and the automatic isolation of the miniflow bypass and normal charging lines will be verified.

The head will be removed from the vessel and the refueling boot installed allowing the ECCS to flood the refueling cavity. A temporary line and throttle valve will be installed between the refueling cavity and the containment recirculation sumps. Upon reaching the auto switchover level alarm in the RWST the automatic suction switchover for the RHR pumps from the RWST to the containment recirculation sumps will be verified. The containment recirculation sumps will be kept full by manual operator actions with the throttle valve in the temporary installed line between the refueling cavity and the sumps. The suction for the charging pumps and SI pumps will be realigned by manaul operator action to the discharge of the RHR pumps. Pump parameters will be monitored to ensure high pressure injection systems function as designed with the suction aligned to the RHR discharge.

Acceptance Criteria

The SI pumps inject water into the vessel in accordance with Section 6.3.

TABLE 14.2-34

ECCS - CHECK VALVE OPERABILITY

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load with the reactor coolant system hot and pressurized.

Test Objective

To verify that check valves in the emergency core cooling system are functional.

Test Summary

Back leakage tests will be performed on cold and hot leg injection lines' series check valves. Flow tests will be performed using the safety injection pumps to verify the operability of those check valves which experience higher-than-ambient temperatures at this higher temperature. During this test, the injection ability of the safety injection pumps to inject small amounts of water into the primary system conditions will be verified. Also the capability of the safety injection to deliver under accident conditions will be verified by pump and system head-capacity curves without subjecting the system to extreme thermal shocks.

Each accumulator injection train will be tested by decreasing RCS pressure and temperature until accumulator check valves operate as indicated by a drop in the accumulator water level.

Acceptance Criteria

Each check valve operates in accordance with Section 6.3.

TABLE 14.2-35

AUXILIARY BUILDING HVAC

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To demonstrate operation of the Auxiliary Building heating, ventilation, and air conditioning (HVAC) system.

Test Summary

The system will be operated to check for leaks, demonstrate flows to the areas supplied by the system and to verify motor currents, speeds, setpoints, and check alarms. Proper operation of dampers will be demonstrated on high radiation signals. The test will incorporate verification of automatic trip and restart of the system on a LOCA signal.

Acceptance Criteria

The Auxiliary Building HVAC system supplies ventilation in accordance with Subsections 9.4.5.1, 6.5.11.2, 9.2.7.3, respectively, and Regulatory Guide 1.52 (with comments and exceptions as stated in FSAR Volume 14, Appendix A pages A1.52-1 and A1.52-2).

TABLE 14.2-36

CONTROL ROOM HVAC

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To demonstrate operation of the control room heating and ventilation system.

Test Summary

The system will be operated to check for leaks, demonstrate flows to the areas supplied by the system and to verify motor currents, speeds, setpoints, and check alarms. Proper operation of dampers will be demonstrated. The test will include verifying operation of automatic system actions on toxic gas, high radiation, and combustion product detection. Outside purge mode and damper response will be demonstrated on loss of air. This will also encompass verifying the system's ability to establish and maintain the required differential pressure in normal and accident modes, complete recirculation on chlorine detection, and 100% purge operation. Finally the control room chilled water system will be verified for proper operability during station blackout.

Acceptance Criteria

The Control Room HVAC system supplies ventilation in accordance with Subsections 9.4.1, 6.5.1 1.1, and 7.3.1.1.9, 6.4, and Regulatory Guide 1.52 (with comments and exceptions as stated in FSAR Volume 14, Appendix A pages A1.52-1 and A1.55-2).

TABLE 14.2-37

DIESEL-GENERATOR ROOM VENTILATION SYSTEM

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To demonstrate operation of the Diesel-Generator Room Ventilation System.

Test Summary

The system will be operated to check for leaks, demonstrate flows to the areas supplied by the system; and to verify motor currents, speeds, setpoints, and check alarms. Proper operation of dampers will be demonstrated.

Testing will also include automatic start features, tripping of the system on diesel-generator trip w/room temperature less than 100° F or fire protection system actuation, and operation of the storage room fans and heat/smoke ventilators.

Acceptance Criteria

The Diesel-Generator Ventilation System supplies ventilation in accordance with Subsection 9.4.5.2.

TABLE 14.2-38

ESF SWITCHGEAR HVAC

(Preoperational Test)

Plant Condition or Prerequisite

Prior to plant operation.

Test Objective

To demonstrate operation of the Engineered Safety Feature (ESF) Switchgear heating and ventilation system.

Test Summary

The system will be operated to check for leaks, demonstrate flows to the areas supplied by the system; and to verify motor currents, speeds, setpoints, and check alarms. Proper operation of dampers will be demonstrated.

Acceptance Criteria

The ESF Switchgear HVAC system supplies ventilation in accordance with Subsections 7.3.1.1.11 and 9.4.5.4.

TABLE 14.2-39

CONTAINMENT PURGE

(Preoperational Test)

Plant Condition or Prerequisite

Prior to plant operation.

Test Objective

To demonstrate proper operation of the containment purge system.

Test Summary

The system will be operated to verify flows, pressure drops, motor currents and speeds, setpoints, and check alarms. Proper operation of dampers will be demonstrated.

Acceptance Criteria

The Containment Purge system supplies ventilation in accordance with Subsections 6.2.4.2.5, 9.4.9, 9.4.10, and Tables 9.4-25 and 9.4-26.

TABLE 14.2-40

HYDROGEN RECOMBINER

(Preoperational Test)

Plant Condition or Prerequisite

Prior to plant operation.

Test Objective

Prior to plant operation.

Test Objective

To demonstrate operation of the post-LOCA hydrogen control system recombiner.

Test Summary

The hydrogen recombiner system is operated to demonstrate proper flows and to verify design power to the heater units of the recombiner.

Acceptance Criteria

The Hydrogen Recombiner system operates in accordance with Subsection 6.2.5.2, Tables 6.2-59 and 6.2-60, and Subsections 9.4.9, 15.6.5.5, and 16.3/4.8.9.

TABLE 14.2-41

CONTAINMENT VENTILATION

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To demonstrate containment ventilation system operation.

Test Summary

The following subsystems are contained in the Containment Ventilation System; Reactor Containment Fan Coolers, Control Rod Drive-Mechanism Ventilations, Reactor Cavity Ventilation, Containment Charcoal Filtration, and Manipulator Crane Ventilation. These systems will be operated to verify air flows and to balance them, to check air pressure drop, to verify fan speeds and shifts, to verify instrument setpoints and alarms, to verify interlock configuration, to verify proper damper operation, and to check filter and adsorber operation.

Acceptance Criteria

The Containment Ventilation System supplies ventilation in accordance with Subsections 3.1.2.4.9, 3.1.2.4.10, 3.1.2.4.11, 3.11.4.5, 7.3.1.1.12, 7.3.2.2.12, 7.4.1.2.2, and 9.4.8.

The Containment Recirculation Fan motor current will be demonstrated to be within its design value at accident conditions by measuring air density, temperature, humidity, fan speed, air flow and motor current and making engineering extrapolations to accident conditions.

TABLE 14.2-42

MAIN STEAM ISOLATION VALVES

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To verify operation of the main steam isolation valves.

Test Summary

Operation of the main steam isolation valves will be verified at hot conditions with pressure. The closure time of each valve will be measured. Functional tests will be performed on the Main Steam Isolation Valve (MSIV) hydraulic units. Local and remote alarms, indicators, and actuation circuits will be tested.

Acceptance Criteria

MSIV full travel closure times are within the time used in the accident analysis. Alarms, Indicator, and Actuation circuits perform in accordance with specifications developed from system design criteria and technical specifications.

TABLE 14.2-44

REACTOR COOLANT PUMPS

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core loading.

Test Objective

To place the reactor coolant pumps in service.

Test Summary

Vibration sensors on the reactor coolant pumps will monitor the amplitude of vibration during startup and operation. The pump motors will be tested to verify power supply voltage, and power requirements. The pump direction of rotation, flow, and pressure characteristics will be verified. Lubrication, cooling flow, and seal water flow will be checked. Interlocks, controls, and indicators will be tested. The antirotation device for each reactor coolant pump will be checked.

Acceptance Criteria

Flow and pressure parameters are within values in accordance with Subsections 7.6.8, 3/4.4-5 and B.3/4.4.1.

TABLE 14.2-45

REACTOR COOLANT ISOLATION VALVES

(Preoperational Test)

Plant Condition or Prerequisite

Prior to plant operation.

Test Objective

To demonstrate operation of the main coolant isolation valves and associated alarms, indications, and interlocks.

Test Summary

The controls and indications for each isolation valve will be demonstrated. Each valve will be verified to cycle and associated interlocks verified to operate.

Acceptance Criteria

The main coolant isolation valves and interlocks operate in accordance with Subsections 7.6.8, 3/4.4-5, and B.3/4.4.1.

TABLE 14.2-46

CVCS - RCP SEAL WATER SUPPLY

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To establish flow to the reactor coolant pump seals and to verify flow at temperature and pressure.

Test Summary

Design flow to and from the reactor coolant pump seals will be verified.

Acceptance Criteria

RCP seal water flows are in accordance with Table 9.3-2.

TABLE 14.2-47

CVCS - CHARGING AND LETDOWN

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To demonstrate the charging and letdown functions of the Chemical and Volume Control System (CVCS).

Test Summary

Tests will be performed to demonstrate that the CVCS can maintain a programmed water level in the pressurizer during heatup and cooldown of the reactor coolant system. Charging flow into the RCS will be demonstrated using both centrifugal charging pumps and the positive displacement pump. Flow to the Reactor Coolant System via auxiliary pressurizer spray line will be verified. The automatic diversion of letdown flow and automatic switch of charging pump suction on Volume Control Tank levels will also be verified.

Acceptance Criteria

The CVCS programs level in the pressurizer during heatup and cooldown and normal operation of the reactor coolant system in accordance with Subsection 9.3.4.1.2.1.

TABLE 14.2-48

CVCS - REACTOR MAKEUP CONTROL

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To demonstrate the boration and dilution functions of the Chemical and Volume Control System (CVCS).

Test Summary

Operations will be conducted with the CVCS to check out blending operations and verify flows in the different modes of boration and dilution. Sampling ability and techniques will be demonstrated. The ability to control RCS hydrogen concentration will be demonstrated. Proper operation of the batching controls and totalizer, auto makeup, dilution, alternate dilution, boration, and manual modes will be demonstrated.

Acceptance Criteria

Flows through the CVCS piping and operation both in manual and auto mode are in accordance with Subsection 9.3.4.1.2.3.

TABLE 14.2-49

CVCS - PURIFICATION

(Preoperational Test)

Plant Condition or Prerequisite

During hot functional testing, at temperature.

Test Objective

To verify operation of the purification function of the Chemical and Volume Control System (CVCS).

Test Summary

During hot functional testing with the demineralizers charged with resin, operation of the purification system will be demonstrated by verification of flow, pressure drops, and temperature.

Acceptance Criteria

The CVCS purification is in accordance with Subsection 9.3.4.1.2.2.

TABLE 14.2-50

PRIMARY SAFETY AND RELIEF VALVES

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To verify setpoints of the pressurizer safety valves.

Test Summary

The setpoint of the pressurizer safety valves will be verified from vendor certification data.

Acceptance Criteria

The valve setpoints are in accordance with Technical Specifications, Chapter 16.0.

TABLE 14.2-51

STEAM GENERATOR SAFETY AND RELIEF VALVES

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To verify setpoints of the steam generator pressure relief and safety valves.

Test Summary

The setpoints of safety valves will be verified from in-plant tests at pressure and temperature. Setpoints will be checked by using a pressure assist device which adds to the force due to pressure. Once the valve leaves the sealed position the assist device will be vented, allowing the valve to reseat immediately. Main Steam Power-Operated Relief valves will be set during instrument alignment and verified by plant transient tests. Local and remote alarms, indicators, and actuation circuits will be tested for the power-operated relief valves. Safety and relief valve capacities will be verified from vendor certification data due to the large amounts of steam flow and severe conditions involved.

Acceptance Criteria

The alarms, indicators, and actuation circuits for the power operated relief valves, and the steam generator relief and safety valve setpoints are in accordance with the Technical Specifications, Chapter 16.0.

TABLE 14.2-52

PRESSURIZER

(Preoperational Test)

Plant Condition or Prerequisite

Prior to Core load.

Test Objective

To demonstrate the capability of the pressurizer to control the reactor coolant system pressure.

Test Summary

Prior to hot functional testing the pressurizer heaters and spray functions will be checked. During hot functional testing the pressure controlling capability will be demonstrated. Pressurizer spray flow and bypass spray flow controls will be tested.

Acceptance Criteria

The pressurizer spray and heater controls operate in accordance with Subsection 7.7.1.5.

TABLE 14.2-53

STEAM GENERATOR

(Preoperational Test)

Plant Condition or Prerequisite

At ambient conditions and during hot functional testing during heatup and at temperature.

Test Objective

To demonstrate the operability of instrumentation and control systems, the ability to cooldown the plant using the steam generators to dump steam, and the functioning of the blowdown system.

Test Summary

The steam generator level and pressure and flow instruments will be aligned and operable prior to heat up. During heatup and at temperature the instrumentation and control systems of the steam generators are checked under operating conditions. The ability to cooldown the plant using the steam generators to dump steam will be demonstrated. The steam generator blowdown system will be operationally tested.

Acceptance Criteria

The steam generator and associated systems operate in accordance with Subsections 7.7.1.7, 7.7.1.8, 10.4.8.2, and 11.2.2.1.1.

TABLE 14.2-54

REACTOR COOLANT SYSTEM EXPANSION AND RESTRAINT

(Preoperational Test)

Plant Condition or Prerequisite

During hot functional testing prior to core load.

Test Objective

To verify that components and piping of the reactor coolant system can expand unrestricted with acceptable clearances.

Test Summary

Baseline data will be taken at cold plant conditions prior to heatup. During the heatup to operating temperatures, selected points on components and piping will be checked at various temperatures to verify that they can expand unrestricted with acceptable clearances. Any potential points of interference detected during the heatup will be corrected prior to increasing the temperature. Following cooldown to ambient temperature, the piping and components will be checked to confirm that they return to their approximate baseline positions to verify unrestricted movement during cooldown.

Acceptance Criteria

The piping and components are verified to expand without restricted movement in accordance with Subsection 3.9.2.1.

TABLE 14.2-56

CONTAINMENT LEAK RATE

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To verify components structures, and systems used for containment isolation.

Test Summary

Type A, B, and C leak rate tests will be conducted in accordance with the requirements of 10 CFR 50 Appendix J.

Acceptance Criteria

The leak rates are in accordance with Subsection 6.2.6 and the Technical Specification, Chapter 16.0.

TABLE 14.2-58

INTEGRATED HOT FUNCTIONAL HEATUP

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load following hydrostatic testing of primary and secondary systems.

Test Objective

To demonstrate ability to heat primary system to normal operating temperature and pressure.

Test Summary

The reactor coolant system will be taken to normal operating temperature and pressure using reactor coolant pump heat input. Tests will be performed to demonstrate operation of excess letdown and seal water flow paths and letdown flow rates. Thermal expansion checks will be conducted. Isothermal calibration of resistance temperature detectors and incore thermocouples will be performed.

Acceptance Criteria

Preoperational tests to be performed during plant heatup are accomplished and the reactor coolant system taken to normal operating temperature and pressure in accordance with Subsection 3.9.2.

TABLE 14.2-59

INTEGRATED HOT FUNCTIONAL AT TEMPERATURE

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To verify proper operation of instrumentation, controls and alarms, and provide design operating conditions for testing auxiliary systems.

Test Summary

The reactor coolant system will be maintained at the normal operating temperature and pressure using reactor coolant pump heat input as required. Tests will be conducted to demonstrate the response of the system to changes in pressurizer level. Steam generator level instrumentation response to level changes will be demonstrated. Equipment used for maintaining the plant in hot shutdown outside the control room will be verified.

Acceptance Criteria

Preoperational tests to be performed while the plant is at temperature and pressure are performed and reviewed.

The pressurizer level control system, steam generator level instrumentation, steam generator levels, and hot shutdown condition are in accordance with Subsection 3.9.2.

TABLE 14.2-60

INTEGRATED HOT FUNCTIONAL TESTING COOLDOWN

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To demonstrate the ability to cooldown the plant from normal operating temperature and pressure to cold shutdown conditions.

Test Summary

The plant will be taken from hot to cold conditions using steam generator steam dump and the residual heat removal system as applicable. The thermal contraction of piping systems will be monitored. Auxiliary systems required for cooldown will be operationally demonstrated.

Acceptance Criteria

The preoperational tests required to be performed during cooldown of the system are completed and reviewed. Steam dump and residual system cool the plant from normal operating temperature and pressure to cold shutdown conditions, thermal contraction of piping systems, and auxiliary systems required for cooldown are in accordance with Subsection 3.9.2.

TABLE 14.2-61

REACTOR CONTAINMENT CRANE AND HOISTS

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To verify operation of reactor containment polar crane, main hoist, and auxiliary hoist used for handling reactor equipment.

Test Summary

Tests will be performed to demonstrate the functioning of polar crane and hoists used to handle reactor equipment. Protective interlocks will be verified for proper operation.

Acceptance Criteria

The polar crane and hoists operate in accordance with Subsection 9.2.5.

TABLE 14.2-65

REACTOR TRIP CIRCUIT

(Startup Test)

Plant Conditions or Prerequisites

Prior to initial criticality.

Test Objective

To verify the reactor protection circuits in the various modes of tripping.

Test Summary

Operational testing will be conducted to verify the reactor protection circuits in the various modes of tripping, including manual reactor trip up to the tripping of the reactor trip breakers.

Acceptance Criteria

The reactor trip circuits function in accordance with criteria established from design requirements, the safety analysis report, and plant installation. The purpose of this test is to demonstrate that the various reactor trip circuits are operational.

TABLE 14.2-66

ROD DROP MEASUREMENTS

(Startup Test)

Plant Condition or Prerequisites

Prior to initial criticality.

Test Objective

To measure rod drop times at cold no-flow, cold full-flow, hot no-flow, and hot full-flow plant conditions following core loading.

Test Summary

The drop time for each control rod will be measured at cold no-flow, cold full-flow, hot no-flow, and hot full-flow conditions. All rods falling outside the two-sigma limit will be retested a minimum of three additional times each. The drop time will be measured from the decay of the stationary gripper coil voltage until the rod enters the top of the dashpot. The RCCA drop traces will confirm proper operation of the decelerating devices.

Acceptance Criteria

The rod drop time is verified to be less than the maximum value specified in the technical specifications.

TABLE 14.2-70

REACTOR COOLANT SYSTEM FLOW

(Startup Test)

Plant Condition or Prerequisites

Prior to initial criticality at hot shutdown.

Test Objective

To determine reactor coolant flow and flow coastdown times.

Test Summary

Following core loading, measurements will be made of elbow tap differential pressure instrument voltages to make relative comparison. At hot shutdown conditions following core loading, measurements of loop elbow differential pressure drops are made at various flow conditions. This data will be used with the reactor coolant pump performance curve to calibrate flow. Data will be taken to ensure that loop and core flows are within their required minimum and maximum flows and that flow coastdown times are in accordance with accident analysis assumptions.

Data will be taken to ensure pump performance, rotational speed and indicated flow are consistent with performance curves.

Vibration monitoring of the reactor coolant pumps will be done using 2 IRD pickups mounted to the motor supports (90 degrees apart in the horizontal plane). In addition, baseline vibration data on the pumps will be obtained using a portable IRD vibration measurement unit. These will be taken at bearing points on the motor (in three directions, where possible) during the preoperational test.

Acceptance Criteria

The calibrated flows and coastdown times are verified conservative with respect to the safety analysis.

TABLE 14.2-81

PSEUDO ROD EJECTION

(Startup Test)

Plant Condition or Prerequisites

Hot zero power and at approximately 30% power during power ascension.

Test Objective

To verify hot channel factors and rod worth with a rod cluster control assembly (RCCA) withdrawn from its bank position.

Test Summary

Incore measurements will be made with the most reactive RCCA withdrawn from its bank position to determine the resulting hot channel factors. The worth of the most reactive RCCA will be verified to be conservative with respect to the accident analysis. Measurements will be made using the incore flux monitoring system. Tests will be run at hot zero power and at approximately 30% reactor power.

Acceptable Criteria

Hot channel factors and rod worth are verified to be within expected limits.

TABLE 14.2-82

POWER REACTIVITY COEFFICIENT MEASUREMENT

(Startup Test)

Plant Condition or Prerequisites

During power level changes at approximately 30, 50, 75, and 100% reactor power.

Test Objective

To determine the power coefficient of reactivity and power defect.

Test Summary

Duing power level changes when the reactivity effects of xenon can be adequately accounted for, measurements will be made of reactor power and associated reactivity changes as follows:

> Reactor thermal power will be determined using calorimetric data. Associated reactivity changes will be measured by reactivity computer response and the response of T_{avg} and delta T recorders.

The power coefficient of reactivity and power defect will be determined from these measurements.

Acceptance Criteria

The power reactivity coefficient is measured within a specified accuracy to be within limits compatible with values used in the safety analysis report.

TABLE 14.2-87

LOSS OF OFFSITE POWER

(Startup Test)

Plant Condition or Prerequisites

Above 10% power.

Test Objective

To demonstrate starting of emergency diesels, stripping of vital buses, and sequencing loads on vital buses following a trip of the plant without an available offsite source of power.

Test Summary

At above 10% power, a generator trip will be initiated without an offsite source of power being available. Starting of the emergency diesels, stripping of vital buses, and sequencing of emergency loads on the vital buses will be demonstrated. The test will be of sufficient duration to ensure that the necessary equipment, controls and indication are unavailable following the blackout to remove decay heat from the core using only emergency power supplies.

Acceptance Criteria

The plant is shown to respond to a plant trip concurrent with loss of offsite power in accordance with criteria established from the safety analysis report and system design specifications. The duration of the blackout will be at least 30 minutes.

TABLE 14.2-90

RTD CROSS CALIBRATION

(Startup Test)

Plant Condition or Prerequisites

Prior to initial criticality.

Test Objective

To provide data for the wide range RTD's, narrow range RTD's, and incore thermocouple calibration.

Test Summary

At various plant temperatures the average RTD temperature will be compared to each RTD and incore thermocouple temperature to provide a basis for their calibration.

Acceptance Criteria

The RTD's calibration data is taken. The delta temperature measurements are within specifications for the appropriate control systems.

QUESTION 010.39

"Your response to Question 010.2 and Question 010.16 has not considered the effect of multiple missiles generated by one tornado on the various safety related components located outdoors and on air intakes, exhausts and other building openings. It is our position that redundancy alone is insufficient assurance against the loss of safety related functions in the event of missile impacts in a tornado, and that specific design capability must be provided each component. Provide a description of the methods used to protect these structures, systems, and components from damage by multiple missiles generated by a tornado. Include the following:

Byron Station Only

Describe the protection provided to the essential service water cooling towers to prevent damage or loss of the fans or motor drives from the impact of multiple vertical tornado missiles falling into all the cell openings.

Byron/Braidwood Stations

a. Describe the protection provided to the exposed exhaust stacks of the station emergency diesel engines to prevent unacceptable damage or stack blockage from a single or multiple missile impacting both stacks of one unit.

b. Describe the protection provided to prevent obstruction of flow of ventilating and combustion air to both emergency diesel engines of one unit from the impact of multiple missiles.

c. Describe the capability of the fuel handling building railroad freight door to withstand the forces of tornado wind and missile impact and the degree of protection or hazard presented by the wash down area structure. Consider the probabilities and potential adverse affects of lightweight objects of large area being impelled through an open, damaged or missing freight door into the spent fuel pool. Describe the administrative or other controls to assure closure of the freight door during normal plant operation."

RESPONSE

Effects of tornado missiles have been assessed for safety-related components located outdoors. These components are the essential sevice water cooling towers (Byron only), the emergency diesel exhaust stacks, diesel ventilating and combustion air intake, the fuel handling building door, and the main steam safety and relief valve stacks.

Essential Service Water Cooling Tower (Byron)

The following components of the Essential Service Water Cooling Towers are currently unprotected from tornado missiles:

a. external portion of return lines

b. fans

c. fan motors

d. fan drives.

An analysis of cooling tower capacity without fans has been made. Using the most conservative design conditions, it is predicted if the plant is shut down under non-LOCA conditions with loss of offsite power, the temperature of the service water supplied to the plant will not exceed 110° F. Although this exceeds the normal maximum temperature of 100° F, no adverse impact on safety equipment will result.

If all fans are inoperable, additional cooling can be achieved by blowing down service water using the strainer backflush system and introducing makeup water (approximately 55° F) from the onsite wells which are provided with a safety-related power supply. This would reduce the predicted maximum supplied service water temperature to approximately 105° F.

The analysis assumed no wind, 78° F wet bulb temperature, conservative plant cooling loads (normal shutdown loads for both units plus diesel cooling loads), and a maximum initial service water temperature. In reality, the wind velocities and reduced wet bulb temperature which could be expected in conjunction with weather conditions which produce tornados would insure that the service water temperature would remain below 100° F.

Protection will be provided for the piping which is routed external to the tornado proof structure of the cooling towers.

Emergency Diesel Exhaust Stacks

The diesel generator exhausts are completely protected up to the point where they penetrate the tornado proof concrete enclosure on the auxiliary building roof. Above this point, they are exposed for about 35 feet as they travel vertically. Analysis has established that the stacks can be damaged to the extent that the flow area is reduced to 50% of the original flow area without reducing the diesel power output.

To prevent the stacks from being damaged to the extent that diesel performance is reduced, positive action will be taken to insure operability in spite of tornado missile impact. Two alternatives are being investigated. The stacks may be

strengthened to insure that the postulated tornado missiles will not cause unacceptable damage. If this approach proves to not be feasible, exhaust relief will be provided via a tornado proof weighted damper system.

Diesel Generator Ventilating and Combustion Air

Ventilation and combustion air for the emergency diesels is inducted through tornado proof intakes in the auxiliary building roof.

Fuel Handling Building Railroad Freight Door

The railroad freight door is not designed to be tornado proof. In the event the door is missing or open, missiles would potentially enter the tunnel to the fuel handling building. To reach the fuel handling area, missiles would have to travel over 100 feet down the tunnel which is approximately 25 feet square. The two most vulnerable areas are the fuel pool heat exchangers on the lower level and fuel storage are on the upper level. After negotiating the tunnel, the missile would have to make a 90° turn and penetrate a wall to damage either of the heat exchangers (which are redundant) or make two 90° turns (up and right) to reach the fuel storage area. Based on this assessment, it is concluded that tornado missiles pose no hazard to the fuel handling building.

Main Steam Safety and Relief Valve Stacks

The main steam safety and relief valve stacks penetrate the valve room roof slightly over 25 feet above grade. The stacks extend 7 feet above the roof (measured to the low point of the diagonally cut end). The exhaust of the power operated relief valve is in a recessed area between the valve room roof and the containment wall, and is, therefore, protected from horizontal missiles. The stacks are 16-inch diameter pipe with 1/2-inch thick walls. All are located near the containment. Bending or breaking of the pipe would not seriously affect the function of the safety and relief valves. Because of the relatively short height of the pipes and the thickness of the walls, no significant denting or crimping of the pipes is expected.

QUESTION 010.48

"Provide an analysis of the minimum temperature conditions which will be reached in the Byron river screen house following prolonged loss of the building unit heaters or loss of offsite power during extreme cold weather. Define the minimum operating temperature conditions at the essential service water makeup pump diesel drive units, the diesel oil supply system, and the essential service water lines as a function of time from heating system failure and of ambient temperature. State the reliability of starting the diesel drive units and of provisions to prevent freezing in stagnant water lines during the minimum temperature period."

RESPONSE

Byron station procedures will specify starting the essential service water makeup pumps upon a River Screen House HVAC trouble annunciator coincident with ambient temperatures below 40° F.

QUESTION 010.49

"In Amendment 21, you revised your response to Q010.10 to delete your commitment to verify the operability of the air-operated atmospheric relief valves with no offsite power during low-power testing of the plant. It is our position that you recommit to perform this verification, or verify that the air-operated atmospheric relief valves can be opened remotely from the control room assuming loss of offsite power. Any backup air source for this purpose should be seismic Category I."

RESPONSE

The steam generator atmospheric relief valves are being modified to allow operation during loss of offsite power. Class 1E qualified solenoid actuated hydraulic operators will be installed on these valves. The operators will be powerd from emergency power buses. The valve operators and control circuit for loops A and D will be powered by Division 11 emergency power and loops B and C will be powered by Division 12 emergency power. Upon loss of power, the valves will fail closed.

Standard Review Plan 3.6.1 defines the postulated failure of moderate energy piping as a through wall leakage crack with an opening equal to 1/2 the pipe diameter in length and 1/2 the wall thickness in width. Gravity flow from the cooling tower basins through a crack in a 96-inch circulating water pipe is approximately 2100 gpm. Assuming all four circulating water pipes are cracked, 8400 gpm will flow into the Turbine Building basement. At this flowrate, the main steam tunnel will begin flooding in approximately 35 minutes and the main steam isolation valve will become flooded in approximately 1 hour. There is sufficient time for the operator to close the main steam isolation valves before they are rendered inoperable.

QUESTION 010.51

"In Q010.13 we indicated that we were evaluating the preheat model steam generator (such as those utilized at the Byron/Braidwood Station) for hydraulic instabilities (water hammer phenomenon potential) and may impose further requirements. Based on these studies we have established the need for a verification test to demonstrate that no damaging water hammer will occur in the steam generator and/or feedwater system. It is our position that you commit to perform a test using the standard plant operating procedures to verify that unacceptable water hammer will not occur. We require that you provide us with a copy of the test procedure prior to performing the test."

RESPONSE

A verification test will be conducted (per NUREG CR-1606) to ensure that no damaging water hammer will occur in the steam generator and/or the feedwater systems. The plant will be run at approximately 25% of full power using feedwater to the top feedwater sparger at the lowest feedwater temperature permitted by standard plant operating procedures (SOP). Feedwater delivery will then be transferred to the main feed nozzle using the SOP. The transient will be observed for water hammer and the results recorded.

Response

(1) The AF flow path verification following maintenance will be performed by procedure from one of either three ways. Specifically:

a) a functional verification of the AF system to deliver feedwater to the steam generators

b) an operator independently verifies proper valve alignment, or

c) the use of status display as provided by Engineered Safeguards Display in conjunction with process computer alarms.

(2) The AFW system must be demonstrated to be operable prior to leaving Operational Mode 4 (Hot Shutdown). This requires a surveillance test that demonstrates flow to the steam generators. This requirement will be made part of the technical specifications.

1.7 NRC Recommentation GS-7

The licensee should verify that the automatic start AFW system signals and associated circuitry are safety-grade. If this cannot be verified, the AFW system automatic initiation system should be modified in the short-term to meet the functions requirements listed below. For the longer-term, the automatic initiation signals and circuits should be upgraded to meet safety grade requirements, as indicated in Recommendation GL-5.

(1) The design should provide for the automatic initiation of the AFW system flow.

(2) The automatic initiation signals and circuits should be designed so that a single failure will not result in the loss of AFW system function.

(3) Testability of the initiation signals and circuits shall be a feature of the design.

(4) The initiation signals and circuits should be powered from the emergency buses.

(5) Manual capability to initiate the AFW system from the control room should be retained and should be implemented so that a single failure in the manual circuits will not result in the loss of system function.

(6) The ac motor-driven pumps and valves in the AFW system should be included in the automatic actuation (simultaneous and/or sequential) of the loads to the emergency buses.

(7) The automatic initiation signals and circuits shall be designed so that their failure will not result in the loss of manual capability to initiate the AFW system from the control room.

Response

The automatic initiation signals to the AFW system and the associated circuitry are safety-grade.

1.8 NRC Recommendation GS-8

The licensee should install a system to automatically initiate AFW system flow. This system need not be safety-grade; however, in the short-term, it should meet the criteria listed below, which are similar to Item 2.1.7 (a) of NUREG-0578. For the longer-term, the automatic initiation signals and circuits should be upgraded to meet safety-grade requirements, as indicated in recommendation GL-1.

(1) The design should provide for the automatic initiation of the AFW system flow.

(2) The automatic initiation signals and circuits should be designed so that a single failure will not result in the loss of AFW system function.

(3) Testability of the initiating signals and circuits should be a feature of the design.

(4) The initiating signals and circuits should be powered from the emergency buses.

(5) Manual capability to initiate the AFW system from the control room should be retained and should be implemented so that a single failure in the manual circuits will not result in the loss of system function.

(6) The ac motor-driven pumps and valves in the AFW system should be included in the automatic actuation (simultaneous and/or sequential) of the loads to the emergency buses.

(7) The automatic initiation signals and circuits should be designed so that their failure will not result in the loss of manual capability to initiate the AFW system from the control room.

Response

The design of the AFW system meets the criteria listed above.

Section 2: Response to Additional Short-Term Recommendations

2.1 NRC Recommendation

The licensee should provide redundant level indication and low level alarms in the control room for the AFW system primary water supply, to allow the operator to anticipate the need to make up water or transfer to an alternate water supply and prevent a low pump suction pressure condition from occurring. The low level alarm setpoint should allow at least 20 minutes for operator action, assuming that the largest capacity AFW pump is operating.

Response

The condensate storage tank, the AFW system normal water supply, will be equipped with redundant level instrumentation and alarms. The low level alarm setpoint will allow at least 20 minutes for the operator to manually transfer AFW pump suction.

2.2 NRC Recommendation

The licensee should perform a 72 hour endurance test on all AFW system pumps, if such a test or continuous period of operation has not been accomplished to date. Following the 72 hour pump run, the pumps should be shutdown and cooled down and then restarted and run for one hour. Test acceptance criteria should include demonstrating that the pumps remain within design limits with respect to bearing/bearing oil temperatures and vibration and that pump room ambient conditions (temperature, humidity) do not exceed environmental qualification limits for safety-related equipment in the room.

Response

The NRC recommended AF endurance test is changed to 48 hour duration from 72 hours. The recommended endurance test will be performed on each AFW pump and the startup feedwater pump during the preoperational testing period and will be documented.

2.3 NRC Recommendation

The licensee should implement the following requirements as specified by Item 2.1.7.b on page A-32 of NUREG-0578:

(1) Safety-grade indication of AFW flow to each steam generator should be provided in the control room.

(2) The AFW flow instrument channels should be powered from the emergency buses consistent with satisfying the emergency power diversity requirements for the AFW system set forth in Auxiliary Systems Branch Technical Position 10-1 of the Standard Review Plan, Section 10.4.9.

Response

The AFW flow to each steam generator is indicated in the control room, meets safety grade requirements and is powered from the ESF buses.

2.4 NRC Recommendation

Licensees with plants which require local manual realignment of valves to conduct periodic tests on one AFW system train and which have only one remaining AFW train available for operation should propose Technical Specifications to provide that a dedicated individual who is in communication with the control room be stationed at the manual valves. Upon instruction from the control room, this operator would re-align the valves in the AFW system from the test mode to its operational alignment.

Response

Local manual realignment of valves is not necessary to conduct periodic tests on the AFW system.

Section 3: Response to Long-Term Recommendations

3.1 NRC Recommendation GL-1

For plants with a manual starting AFW system, the licensee should install a system to automatically initiate the AFW system flow. This system and associated automatic initiation signals should be designed and installed to meet safety-grade requirements. Manual AFW system start and control capability should be retained with manual start serving as backup to automatic AFW system initiation.

Response

AFW system flow is automatically initiated.

3.2 NRC Recommendation GL-2

Licensees with plant designs in which all (primary and alternate) water supplies to the AFW system pass through valves in a single flow path should install redundant parallel flow paths (piping and valves).

Licensees with plant designs in which the primary AFW system water supply passes through valves in a single flow path, but the alternate AFW system water supplies connect to the AFW system pump suction piping downstream of the above valve(s), should install redundant valves parallel to the above valve(s) or provide automatic opening of the valve(s) from the alternate water supply upon low pump suction pressure.

The licensee should propose Technical Specifications to incorporate appropriate periodic inspections to verify the valve positions into the surveillance requirements.

Response

The ESW system supply connects downstream of the condensate supply valves. The valves automatically open on low pump suction pressure and low low steam generator level.

Periodic testing of the AFW systems is required by the Technical Specifications. This testing includes verification of valve positions.

3.3 NRC Recommendation GL-3

At least one AFW system pump and its associated flow path and essential instrumentation should automatically initiate AFW system flow and be capable of being operated independently of any ac power source for at least two hours. Conversion of dc power to ac power is acceptable.

Response

The diesel driven AFW system pump, its flow path and its essential instrumentation are capable of being operated independently of any ac power source for two hours.

3.4 NRC Recommendation GL-4

Licensees having plants with unprotected normal AFW system water supplies should evaluate the design of their AFW systems to determine if automatic protection of the pumps is necessary following a seismic event or a tornado. The time available before pump damage, the alarms and indications available to the control room operator, and the time necessary for assessing the problem and taking action should be considered in determining whether operator action can be relied on to prevent pump damage. Consideration should be given to providing pump protection by means such as automatic switchover of the pump suctions to the alternate safety-grade source of water, automatic pump trips on low suction pressure, or upgrading the normal source of water to meet seismic Category I and tornado protection requirements.

Response

To prevent air binding of the AFW pumps, switchover from the condensate storage tank supply to the essential service water system occurs at a tank level of 7 feet (approximately 56,000 gallons). This is 3 feet above the AFW pump trip setpoint and 4 feet above the minimum required NPSH.

The pressure switches used to transfer the suction supply from the condensate storage tank to the essential service water system are located in the Category I supply piping. Failure of the Category II condensate storage tank or piping will result in a low suction pressure, and the pressure switches will open the essential srevice water supply valves. In the event that the essential service water supply valves fail to open, the low-low pressure switch setpoint will trip the auxiliary feedwater pump.

3.5 NRC Recommendation GL-5

The licensee should upgrade the AFW system automatic initiation signals and circuits to meet safety-grade requirements.

Response

The automatic initiation signals and circuitry for the AFW system are safety grade.

QUESTION 022.12

"Provide an analysis demonstrating that the assumed times for full operation of the RCFC system and containment spray system in the containment functional analyses are conservative, i.e., 40.0 and 45.0 seconds, respectively, for the LOCA cases (FSAR Tables 6.2-6, 7, and 8) and 40.0 and 88.0 seconds, respectively, for the MSLB (FSAR Table 6.2-9)."

RESPONSE

The 40-second startup time given in FSAR Tables 6.2-6, 6.2-7, 6.2-8, and 6.2-9 assures loss of offsite power simultaneously with the LOCA or MSLB events. If there is no loss of offsite power, the RCFC units will continue to function during the event.

The containment spray pumps are actuated only on containment high pressure or manually by the operator. Assuming no loss of offsite power and that the piping from the pump to the spray ring headers is dry, it will take approximately one minute from the beginning of the MSLB or LOCA event for water to be flowing out of the spray ring nozzles at full pressure. Half of this time is required to fill the piping to the nozzles.

In the event of a loss of offsite power, the CS pumps are given a permissive signal to start 25-seconds after the diesel generator starts. If a containment high pressure signal has not been received within 30-seconds after the diesel has started, the CS pumps will be locked out for another 20-seconds. Fifty-seconds after the diesel has started, the CS pumps will again be given a permissive to start. If no high pressure signal has been received, the operator may start the pump manually or block it out from operation depending on the circumstances. It is assumed that the additional time lag for the MSLB (38-seconds vs. 15-seconds for LOCA) is caused by the operator.

QUESTION 022.29

"Describe the containment isolation provisions for the test connection penetration (P-4) and the spare penetrations listed in FSAR Table 3.8-1. Specifically include the design criteria connecting piping."

RESPONSE

The leak testing test connection penetration (P-4) and the spare penetrations are closed with welded cover plates. The design criteria for these cover plates are equivalent to the containment liner.

Drawing M-197-2 Revision G now contains the design information for 1PC-4. This penetration will be used for the integrated leak rate test. The penetration will be sealed off between the pipe and sleeve with a steel plate welded to both members. This is a blind flange outside containment which will seal the pipe when it is not being used for leak rate testing.

Drawing M-105-3 shows the piping arrangement.

QUESTION 022.48

"Concerning the capability of the hydrogen recombiner system to provide adequate hydrogen control in containment following a LOCA:

a. Provide the analysis results showing the containment hydrogen concentration as a function of time following the worst case LOCA with operation of one and two hydrogen recombiners and with operation of the post-LOCA purge system. Provide all analysis assumptions including when operation of the hydrogen recombiners or post-LOCA purge system is initiated, i.e., upon reaching a designated hydrogen concentration in containment or after a stated period of time following the LOCA.

b. Describe the procedures and all required actions (e.g., installation and connection of equipment, construction of temporary shielding, leak testing, etc.) necessary to place into operation following a LOCA the portable skid-mounted hydrogen recombiners with separate remote portable skid-mounted control and power panels. Estimate the maximum length of time immediately following a LOCA when access to the Auxiliary Building may be prohibited due to high radiation (see also Question No. 6.2.5-2). Compare this estimated time with the time when hydrogen recombiner operation is required (See Part (a) above).

c. It is the NRC staff position that within a time period equal to or less than one-half the time before the hydrogen recombiner system is required to operate (see Part (a) above), two hydrogen recombiner packages must be available for containment hydrogen control to satisfy the single failure criterion (i.e., in the event of failure of one hydrogen recombiner package an independent and redundant recombiner package must be immediately available for hydrogen control). Based on our review of the FSAR, it is unclear whether this requirement has been met. Provide additional information on the design, installation, and procedural provisions that demonstrate compliance with this staff position. If the hydrogen recombiner package from Unit 2 will be required to meet this requirement for Unit 1, describe the Unit 2 equipment and design features (e.g., emergency Class 1E power supply; auxiliary building HVAC, shielding, instrumentation and controls) that must be operational or completed for Unit 1 operation while Unit 2 is still under construction.

d. The Atomics International hydrogen recombiner systems used at Byron/Braidwood have maximum operating limits of 150° F and 10 psig. Provide an evaluation which demonstrates that the containment temperature and pressure will be reduced below 150° F and 10 psig prior to the time before the hydrogen recombiners are required to operate (see Part (a) above for when hydrogen recombiner operation is required and Question No. 6.2.5-13 for concerns on which LOCA should be considered as the worst case)."

RESPONSE

a. The hydrogen recombiner analysis has been updated to include the current 70 cfm recombiner. This will be incorporated into the FSAR. The analysis assumes that the recombiner begins operation within 4 housr of a LOCA. Only the limiting case of a single recombiner has been analyzed. The attached figure (Figure Q022.58-1) shows the results with and without the recombiner for the limiting case.

b. Procedure for a recombiner startup is as follows:

1. Open up all process line valves that are closed (external to the recombiner skid package).

2. Close all recombiner circuit breakers in Power and Control Cabinet

3. Verify all controls, settings, switches, and valves are in the operating/startup condition.

4. Insert key into start/stop switch and turn it on. In 1 to 2 hours, the recombiner will be at stable operating conditions.

5. Periodically check H_2 analyzer for a high H_2 concentration which would require N_2 dilution (LOCA only).

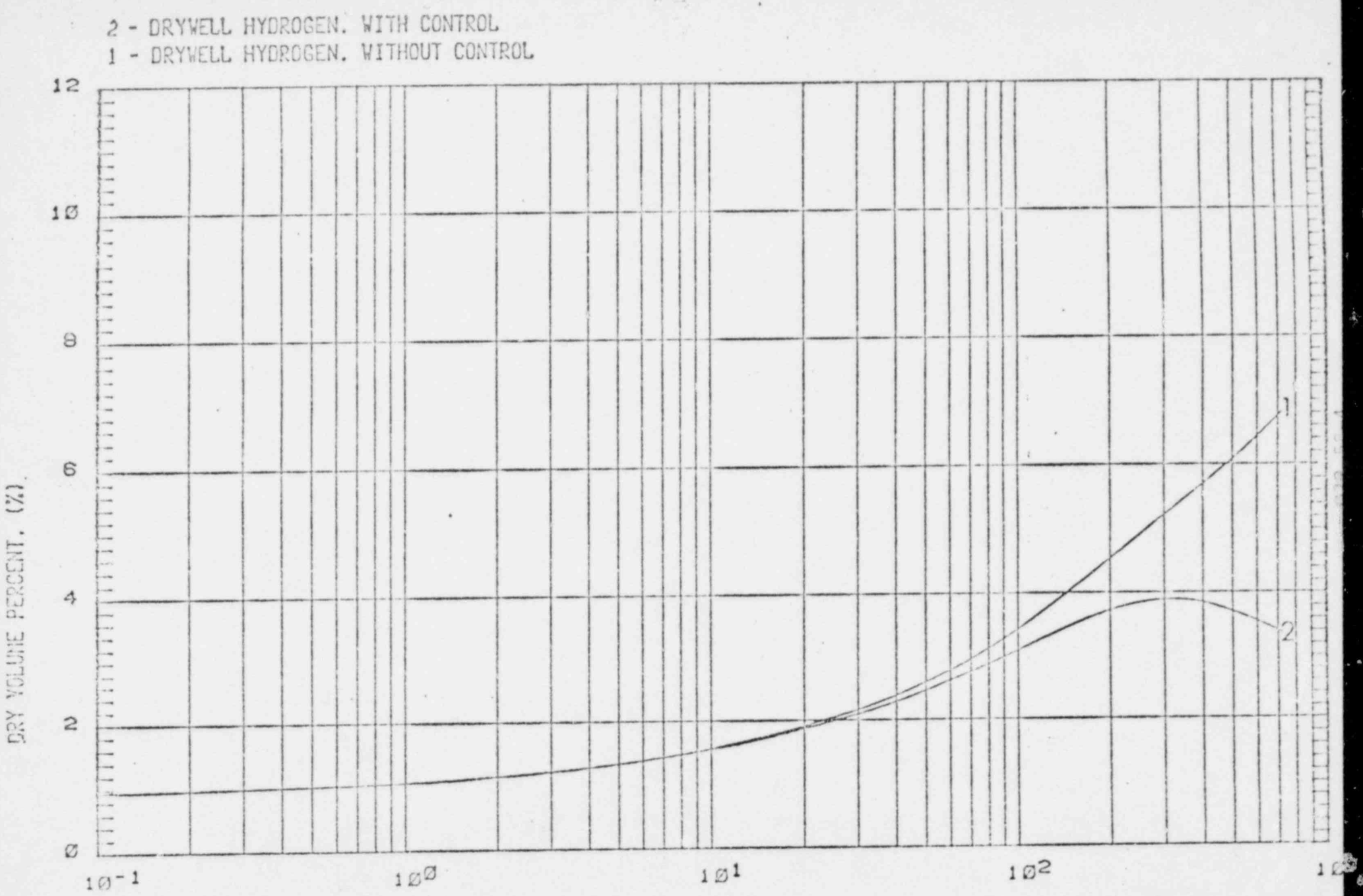
Permanent shielding is provided. The recombiners are no longer portable.

c. The current hydrogen generation analysis assumes that the recombiner is started four hours after LOCA. This will result in a peak hydrogen concentration below 4.0%. As can be seen in Figure Q022.58-1, the recombiner has very little effect before about 10 hours due to the low hydrogen content prior to this time. Peak hydrogen

level is relatively insensitive to the recombiner initiation time. As demonstrated by the procedural outline in item (b), operation of the recombiners requires only valve and switch operation. No difficulty is anticipated in initiating hydrogen recombination within the four hours.

The hydrogen recombiner is one of the components on a list of common components and systems which has been developed to insure that all required equipment will be operational when Unit 1 is started. The hydrogen recombiner is, to a large extent, a self-contained package. The piping system required for the crosstie between units is uniqe to the system and will be in place. Normal and emergency power supplies to the recombiner and system valves will be provided as required by the original system design.

d. The maximum operating conditions for the recombiners have been reevaluated. The recombiners will operate with temperatures up to 225° F and pressures of 22 psig. The recombiners may be operated any time after LOCA condition sare reduced to these levels. This will be less than 3 hours after LOCA.



B/B-FSAR

Figure Q022.58-1 CONCENTRATION OF COMBUSTIBLES AS A FUNCTION OF TIME WITH AND WITHOUT OPERATION OF THE COMBUSTIBLE GAS CONTROL SYSTEM

QUESTION 022.62

"Based on our review of the FSAR, the hydrogen monitoring system does not provide the required capability to adequately monitor combustible gas concentration in containment. Provide information demonstrating how the hydrogen monitoring system will meet the following:

a. NUREG-0737 Item II.F.1 Attachment 6, 'Containment Hydrogen Monitor.' Specifically address all position requirements and points of clarification. (NOTE: Local actuation of the hydrogen analyzers is not acceptable since actuation within 30 minutes following safety injection cannot be assured with local control.)

b. The capability to continuously monitor containment hydrogen concentration independent of hydrogen recombiner operation and assuming a single failure (i.e., redundancy).

c. Regulatory Guide 1.26 (i.e., Quality Group B).

d. Regulatory Guide 1.29 (i.e., Seismic Category I)."

RESPONSE

The following description of the Byron and Braidwood Stations hydrogen monitors will be included in Appendix E to the FSAR:

The recommendation to have a continuous indication of containment hydrogen concentration available in the control room is met with redundant Delphi K-III monitoring units. Their capability covers the range of 0% to 10% hydrogen concentration by volume over a pressure regime of minus 5 psig (9.7 psia) to plus 60 psig. The monitors are IEEE 323-1974 qualified.

Byron/Braidwood Stations meet the requirements for continuous indication in the control room via seismically qualified recorders. This equipment is testable on-line from the control room.

SAMPLE CONDITIONING

The K-III monitoring system is designed to monitor containment gas for percentage by volume of hydrogen. The operating range is -5 of 60 psig, above saturation of 3000° F and relative humidity from 0% to 100%. After sample

passes through the entry valve, it enters the heated cell housing with the temperature maintained at 275° F. The sample then passes through a combination moisture separator and air vent, where 175 cc/min of the steam is directed to the sample measuring cells, and the remainder of the gas and any moisture droplets are passed through a back pressure regulator to the system exhaust and returned to the containment.

A flow controller assembly downstream of each cell provides a constant pressure differential across the measuring cells and the sample flowmeter. The sample, reference and bypass flows are cooled by natural convection to less than 105° F and returned to the containment by a diaphragm pump.

CALIBRATION

Instrument calibration is performed by actuating the appropriate solenoid valve directing zero or span gas with a known concentration through a flow controller and into the cell.

GAS MEASUREMENTS - GENERAL DISCUSSION

Analysis is accomplished by using the well established principle of thermal conductivity measurements of gases. This technique utilizes a self-heating filament fixed in the center of a temperature-controlled metal cavity. The filament temperature is determined by the amount of heat conducted by the presence of gas from the filament of the cavity walls. Thermal conductivity varies with gas species, thereby causing changes. Filament resistance changes with temperature, therefore, by using two filameters in separate cavities and connecting them in an electrical bridge, the difference in thermal conductivity of gases in the separate cavities may be determined electrically.

Electrical zero is set by first introducing the same gas to both cavities, then adjusting the electrical bridge to balance, resulting in a zero output. As different gases are introduced to the two individual cavities, the bridge will become unbalanced and the electrical output will amplify with increasing differences in thermal conductivity of the gases used.

Although this technique is nonspecific, it is an extremely reliable technique when the gases or gas mixtures are known, and the variation in composite thermal conductivity can be accurately determined.

HYDROGEN MEASUREMENT

The measurement of hydrogen in the presence of nitrogen, oxygen and water vapor is possible because the thermal conductivity of hydrogen is approximately seven times higher than nitrogen, oxygen or water vapor, which have nearly the same thermal conductivities (at the filament operational temperature of approximately 500° F). The measurement is accomplished by using a thermal conductivity measurement cell and a catalytic reactor. The sample first flows through the reference section of the cell, then passes through the sample section of the measuring cell that includes the catalyst. The change is sample composition, due to the catalytic reaction, is therefore, indicated by the difference measured in the sample and reference sides of the cell.

If an excess amount of oxygen does not exist in the sample for recombining all the hydrogen, oxygen can be provided ahead of the hydrogen analyzer. The amount of oxygen added is determined by the highest range of the analyzer.

Span calibration is accomplished by introducing a known amount of oxygen and gas mixture of hydrogen in nitrogen to the cell; this will give a specific output for a readout calibration.

Zero calibration may be accomplished by shutting off the oxygen supply of the span gas mixture.

This will result in the gas flowing unchanged through both sides of the cell and the thermal conductivity will also remain unchanged, the cell will be balanced, and the electrical output will be zero.

CONTROLS

Calibration, zero and span controls and lights are located on the analyzer cabinet. A master off, standby power on, and analysis mode selector switch is located in the control room.

OUTPUTS

In addition to high hydrogen, and instrument failure alarms, a 4-20ma current output from each analyzer provides the signal which feeds the seismically qualified control room recorders.

The reference and span gas bottles are installed on a seismically qualified bottle rack, and are sized for 100 days of continuous unattended operation during post-LOCA events, with calibration checks possible from the control room.

The units are to have an accuracy of approximately ±5% of full scale.

The operation of these monitors is such that several hours of warmup time for stabilization of the hot-box which houses the sample chamber is required. Because of this, Byron/Braidwood plans to maintain these monitors in a "standby" mode continuously, which maintains the monitors in a warmed-up condition, so that accurate sampling may begin when a LOCA occurs and the sample pump is started. Actuation and control of the hydrogen monitors will be from the main control room.

The items requested in Question 022.62 are also addressed as follows in the order of the question:

a. Address positions and clarifications of NUREG-0737, II.F.1-6.

   1. The monitors will be maintained in a standby mode and manually actuated from the main control room when required to operate.

   2. The range of the monitors is 0% to 10% hydrogen concentration by volume over the pressure range from -5 psig to 60 psig.

   3. The hydrogen monitors are qualified to IEEE 323-1974.

   4. Indication and recording of hydrogen concentration will be available in the main control room when the monitors are operating.

   5. The hydrogen monitors are located at Auxiliary Building elevation 401 feet. Samples are piped from containment penetrations to the monitors. The accuracy of the monitors is to be ±5% of full scale.

b. Operation of the hydrogen monitors is independent of the hydrogen recombiner since both systems used separate piping and containment penetrations and are not dependent upon the other to operate in any way.

c. The portions of the hydrogen monitoring piping system which form the containment atmosphere isolation barrier are designated Seismic Category I, Quality Group B. The remainder of the system outside the containment is Seismic Category I and classified as ANSI B31.1 piping supplied with material manufacturer's and supplier's certifications.

d. Refer to c above.

Samples of the containment atmosphere will be taken at or near the containment penetration through which the sample piping passes. The samples taken are representative of the containment atmosphere due to the mixing system effects which is discussed in Subsection 6.2.5.2.3.

The mechanical piping penetrations used for the hydrogen monitoring system are 1PC-12 and 1PC-31 for Unit 1 and 2PC-12 and 2PC-31 for Unit 2. Penetrations 1PC-12 and 2PC-12 will be for the Train A monitors and 1PC-31 and 2PC-31 are for the Train B monitors. Additional information concerning the mechanical penetration's elevations and azimuths are listed in Table 3.8-1.

QUESTION 022.66

"The FSAR (p.6.2-46) references Al-72-61, Zion Station FSAR, Appendix 6B, Amendment 25, January 1973 for demonstration test results on the hydrogen recombiners to be used at Byron/Braidwood. Reference and summarize the results of all subsequent testing on the Al hydrogen recombiners since the date of this reference."

RESPONSE

Test results for the hydrogen recombiner are proprietary to the vendor. However, the Byron/Braidwood recombiner proposal referenced performance test results in Atomics International Report AI-75-2, "Thermal Hydrogen Recombiner Systems for Water Cooled Reactors," Revision 2, 1975. Atomics International Report AI-72-61, "Thermal Recombiner Demonstration Test," is also applicable to the Byron/Braidwood recombiners.

QUESTION 022.78

"a. Provide the test schedules for all Type B and Type C tests. Provide the test pressures for these tests; Pa is an acceptable test pressure. Specify the test media (for example, air or nitrogen) and test durations for each of these tests.

b. Describe in detail the leakage testing program for the two personnel air locks (access hatches) and show that the program complies with all of the requirements of section III.D.2(b) of Appendix J to 10 CFR Part 50. Include test pressure and duration for leak tests performed by pressurizing between the door deals."

RESPONSE

a) Type B and C tests shall be performed at each refueling outage, but in no case shall any individual test be conducted at intervals greater than 2 years. Type B and C tests shall be conducted at a test pressure of Pa or greater. Air or nitrogen shall be the test media. When the pressure decay method of local leak rate testing is employed, a minimum of 15 minutes duration will be used. The majority of the Type B and C tests will be performed using a direct measurement system, for example, a flow meter. An appropriate method to demonstrate stabilized conditions will be used to determine the duration of this type of test.

b) The airlocks shall be tested at six month intervals at an internal pressure not less than Pa. In lieu of testing the airlocks after a period when containment integrity is not required (as specified in Section III.D.2.bii of 10 CFR 50, Appendix J), a Type B test shall be performed on the airlock door seals at the end of that period. The equipment door seals shall be tested in accordance with Type B testing as described in part (a) above. The Type B test for the airlock door seals shall be performed at a pressure between 3 and 12 psig either as described in Section III.D.2.biii of 10 CFR 50, Appendix J or by installing a continuous pressurization source to the airlock door seals that will be monitored by a flowmeter and alarm.

Stabilization criteria for airlock and airlock door seals testing shall be "less than 1 psig change in the test volume pressure in the last 15 minutes and less than 20% change in the flowrate reading in the last 5 minutes."

QUESTION 022.80

"Many containment isolation valves are shown on Table 6.2-58 as not receiving Type C tests. For each such valve, justify this lack of testing and show that this is in conformance with the requirements of Appendix J to 10 CFR Part 50."

RESPONSE

All containment isolation valves not receiving Type C tests will be identified and justified during the review of the plant Technical Specifications.

QUESTION 022.81

"Identify any instrumentation lines that will be isolated during the Type A test. If instrumentation lines are isolated, they should be locally (Type C) tested and the measured leakage added to the Type A result. Discuss your plans for complying with this position."

RESPONSE

There are currently no instrumentation lines penetrating the containment that will be isolated duirng the Type A test. If any instrumentation lines will have to be isolated during the Type A test, they will be locally (Type C) tested and the measured leakage added to the Type A result.

QUESTION 040.131

"Your response to request 040.30 is unacceptable. A tornado missile could damage all the diesel engine exhaust piping so that the exhaust systems for all engines become restricted or blocked. This is an unacceptable situation. Provide tornado missile protection for the exposed sections of the diesel engine exhaust system."

RESPONSE

The diesel generator exhausts are completely protected up to the point where they penetrate the tornado proof concrete enclosure on the auxiliary building roof. Above this point, they are exposed for about 35 feet as they travel vertically. Analysis has established that the stacks can be damaged to the extent that the flow area is reduced to 50% of the original flow area without reducing the diesel power output.

To prevent the stacks from being damaged to the extent that diesel performance is reduced, positive action will be taken to insure operability in spite of tornado missile impact. Two alternatives are being investigated. The stacks may be strengthened to insure that the postulated tornado missiles will not cause unacceptable damage. If this approach proves to not be feasible, exhaust relief will be provided via a tornado proof weighted damper system.

RESPONSE

The Applicant is in compliance with Regulatory Guide 1.142 with the following clarifications:

1. Position C.7 requires compliance with ANSI Standard N45.2.5-1974, i.e., two test cylinders per 100 cubic yards of concrete tested at 28 days with a minimum of one test per day for each class of concrete. The Applicant's position is to take six test cylinders per 150 cubic yards of concrete tested in pairs at 7, 28, and 91 days with a minimum of one test per day for each class of concrete. This position is in compliance with ACI-318-71 and ACI-318-77.

   At Byron and Braidwood six standard cylinders for compressive testing were prepared from concrete samples representing every 150 cubic yards of concrete placed in Category I structures other than the containment. These specimens are tested for compressive strength at 7, 28, and 91 days.

   Concrete acceptance is based on the 91 day results; however, the 7 and 28 day results are used for monitoring the compressive strength development ages. Requirements in ACI-318 and ACI-301 are intended to cover commercial structures, in which the total number of samples is small because the total volume of concrete used is also small.

   For the large volume of concrete used in a nuclear power plant, a frequency of "every 150 cu. yd." results in a much higher confidence level and reliability than the "every 100 cu. yd." in ACI-301.

   The rate at which concrete was placed varied in a range of 50 cubic yards per hour up to 240 cubic yards per hour. This rate was governed by the size and location of the concrete element being placed and the method of placement which was used.

   The onsite concrete batching plant has more production quality control and lends itself to a more consistent product than commercial concrete produced by the ready mix industry. The referenced ACI-301 and ACI-318 requirements have been designed for ready mix industry conditions.

   The frequencies for testing fresh concrete (slump and air content) in ACI-301 and ACI-318 are 100 cubic yards and 150 cubic yards, respectively. For Byron and Braidwood, a frequency of every 50 cubic yards was used for testing slump, air content and temperature, as in Table B of ANSI N45.2.5-1974. In addition, the tightened sampling frequency implemented (testing of every truck) any time the properties

of the fresh concrete were out of the allowable limits and the positive action savailable to reject individual trucks (Table B.1-5) and to stop production (B.1.10), further reduced the probability that sub-standard concrete was placed.

ACI 349-76, "Code Requirements for Safety-Related Concrete Structures," establishes a compressive strength test frequency of one for every 150 cubic yards of concrete placed for safety-related structures other than the containment.

Section 4.3.1 of ACI 349-76 allows an increase in the number of cubic yards representative of a single test by 50 cubic yards for each 100 psi lower than a standard deviation of 600 psi.

Table CC-5200-1 of the Summer 1981 Addenda of the ASME Boiler and Pressure Vessel Code, Section III, Div. 2 allows a testing frequency of every 200 cubic yards if the average strength of at least the latest 30 consecutive compressive strength test exceeds the specified strength f'_c by an amount expressed as:

$$f_{cr} = f'_c + 1.419\ (f'_c\ /8.69).$$

At the Byron/Braidwood Stations, the average compressive strength consistently exceeded this f_{cr} for all the concrete placed.

2. Position C.8 requires minimum pressure testing of embedded piping in accordance with ACI-318-71. The Applicant's position is that all Category I embedded piping is tested in accordance with ASME Section III and all Category II embedded piping is tested in accordance with ANSI B31.1.

3. Position C.9 has been complied with by the Applicant. However, the load factor for R_o used in the ACI combinations 1, 2, and 3 is different than the load factor for R_o given in SRP Section 3.8.3. The load factor used in the FSAR combinations is in compliance with the load factor required by the SRP.

   Load combination equations 2b' and 3b' of SRP Section 3.8.4 have been complied with by equation numbers 6 and 5, respectively of FSAR Table 3.8-10. Note 2 of the FSAR table when applied to equation number 6 of the FSAR reduced this equation to equation 2b' of the SRP with the exception of the load factor for dead load D. The load factor used in the FSAR is higher than the load factor used in the SRP when the seismic load and the dead load are in the same direction. This will result in a more conservative design. If the dead load and seismic load are not in the same direction, the load factor for D is in compliance with position C.11 and ACI-349-76 Section 9.3.3.

   In similar manner, using Note 2 of FSAR Table 3.8-10, equation 3b' can be reduced to equation number 5.

QUESTION 130.35

"Section 3.8.1.4.7 of the FSAR implies that the only transient load that has been considered is that of thermal gradient. Indicate if what and how other transient loads have been considered in the design of the containment, (e.g., resulting from pipe break due to LOCA)."

RESPONSE

Containment Shell

The transient thermal gradient described in Subsection 3.8.1.4.7 occurs as the containment wall heats up gradually after a LOCA in response to elevated containment atmospheric temperatures. Therefore, it is treated as a static load.

The seismic loads on the structure are transient and are determined from a dynamic analysis as indicated in Subsection 3.7.2.

LOCA pressures are transient; however, LOCA pressures are considered as a static loading because the rate of pressurization is gradual as shown in Figures 6.2-1 through 6.2-6. Pipe loads resulting from pipe breaks are transient. In design the bounding values of these loads are calculated on the basis of the collapse mechanism of the pipe (e.g., the pipe's plastic moment).

Containment Concrete Internal Structures

Asymetric LOCA loads resulting from the postulated ruptures of the reactor coolant piping at various locations have been investigated. These loads have been applied as subcompartmental pressure between the secondary shield wall and the primary shield wall. The pressures were applied based on a time history approach on the 53 postulated subcompartments. These pressures are transient in nature and were considered as a static load factored with a dynamic load factor. The peak pressures were applied to the structure utilizing the appropriate FSAR load combinations.

QUESTION 130.38

"Section 3.8.1.7.3.2 of the FSAR and Appendix A indicate that inservice tendon surveillance program will meet the 'intent' of R.G. 1.35. Such a statement implies that there may be some deviations from the Regulatory Guide. Furthermore, the present position of the Regulatory staff regarding inservice tendon surveillance program is stated in R.G. 1.35, April 1979 and R.G. 1.35.1, April 1979. Specify and justify any deviations in your inservice tendon surveillance program from the provisions of these Regulatory Guides."

RESPONSE

The inservice tendon surveillance program is presented in the Technical Specifications (B/B-FSAR Subsection 16.3/4.6.1.7) and will be changed to conform to the Regulatory staff position per Regulatory Guides 1.35 and 1.35.1.

Load testing using the System Aux Transformer, Reserve Feed, and Diesel Generator will be performed.

See revised Table 14.2-11.

8. See revised Table 14.2-12.

   The instrument power system corresponds to the instrument and control power system described in Subsection 7.1.2.1.3.

9. See revised Table 14.2-13.

   D-c loads will be assured to function at minimum battery terminal voltage from manufacturer's guarantee (certificate of conformance).

10. See revised Table 14.2-15. Diesel qualification testing is performed by the vendor.

11. See revised Table 14.2-16.

12. See revised Table 14.2-17.

13. See revised Table 14.2-18.

14. See revised Table 14.2-19. Diesel qualification testing is performed by the vendor.

15. See revised Table 14.2-21.

16. See revised Table 14.2-22.

17. See revised Tables 14.2-23 and 14.2-61.

18. See revised Table 14.2-25.

19. See revised Section 9.5 of the FSAR.

20. See revised Table 14.2-27.

    This response includes all of the ECC systems.

21. See Table 14.2-33.

22. See revised Table 14.2-31.

23. The response to this part will be provided later.

24. See Revised Tables 14.2-28, 29, 31, 33, and 34.

25. See revised Table 14.2-35.

26. See revised Table 14.2-36.

QUESTION 423.22

"The response to Item 423.1 is not totally acceptable. Modify Subsection 14.2.2 as follows:

1. The QA Topical Report is referenced to Chapter 14. The proper reference is Chapter 17.

2. State the composition of the Onsite Review Group."

RESPONSE

1. Subsection 14.2.2 will be revised to correct the reference to Chapter 17.0.

2. Subsection 14.2.2 will be revised to include the following information:

   The Assistant Superintendent, Administrative and Support Services is appointed as the senior participant of the On-Site Review Group. Other Assistant Superintendents are appointed as alternates on a case basis. The senior participant will choose participants for a particular review from designated individuals qualified in the disciplines listed in Technical Specification 6.1.G.1.f.

QUESTION 423.23

"Modify Subsection 14.2.4 to address the following items:

1. Inclusion of the entire initial test program (both preoperational and startup tests).

2. Incorporate the response to Item 423.6 into this subsection.

3. Ensure that all data from unsuccessful tests will be recorded to permit post-test analysis.

4. State how test procedure modification (both major and minor) is accomplished. Note that the technical specifications will require that minor temporary changes to procedures covering test activities of safety-related equipment must be approved by two members of the plant management staff, at least one of which holds a Senior Reactor Operator's License on the affected unit. Since most, if not all, startup tests affect safety-related systems, this requirement applies to startup test procedures. (It does not apply to preoperational tests conducted before fuel loading.) Therefore, indicate that minor changes to startup test procedures will be made in accordance with technical specification requirements for safety-related systems."

RESPONSE

Subsection 14.2.4 will be revisaed to incorporate the following:

1. The entire test program will be described to include both preoperational and startup tests.

2. The response to item 423.6 will be included in the text.

3. Unsuccessful results will be recorded to permit posttest review and resolution.

4. Later.

QUESTION 423.24

"The response to Item 423.13 is not acceptable. Section 9.3 states that some valves in the compressed air system, namely certain containment isolation valves, power-operated main steam relief valves and auxiliary feedwater flow control valves, fail in the safe position on loss of air. The operability of safety-related equipment and processes would be compromised if these valves failed in the unsafe position. Demonstrate proper operation of these valves in accordance with the testing requirements of Regulatory Guide 1.80."

RESPONSE

The containment isolation valves for the compressed air systems, the power operated main steam relief valves and auxiliary feedwater control valves will be tested to insure they fail to their designed safe position on loss of air.

QUESTION 423.25

"The information contained in Subsections 14.2.5. and 14.2.11 is inconsistent. Revise the subsections as follows:

1. State that all preoperational tests will be completed, evaluated, and approved prior to core load.

2. State that all startup test data obtained at each power test plateau will be evaluated and approved before increasing power level."

RESPONSE

1. All preoperational tests will be completed, evaluated, and approved prior to core load. Subsections 14.2.5 and 14.2.11 will be revised to include these commitments.

2. All startup test data obtained at each power test plateau will be evaluated and approved before increasing power level. Subsections 14.2.5 and 14.2.11 will be revised to include these commitments.

QUESTION 423.27

"The response to Item 423.3 is not acceptable. Modify Subsection 14.2.11 to state that any initial test schedule overlap at the Byron and Braidwood Stations will not result in significant divisions of responsibilities or dilutions in the staff provided to implement the test programs."

RESPONSE

Subsection 14.2.11 will be revised to state that any initial test schedule overlap at the Byron and Braidwood Station will not result in significant divisions of responsibility or dilutions in the staff provided to implement the test programs.

QUESTION 423.28

"The response to Item 423.9 is not totally acceptable. Modify Subsection 14.2.11 to state that test procedures will be available for review by IE inspectors at least 60 days prior to the scheduled fuel loading date for startup tests."

RESPONSE

Subsection 14.2.11 will be revised to state that preoperational test procedure drafts will be available for review by I&E inspectors at least 60 days prior to their intended use and not less than 60 days to scheduled fuel loading date for startup test procedure drafts.

QUESTION 423.29

"List any tests, or portions of test, described in Subsection 14.2.12 which you do not intend to perform on each unit and provide technical justification for deletion of each."

RESPONSE

Essentially an identical test program will be conducted for each unit. Initial tests conducted on common systems or startup tests conducted to prove acceptance or a prototype core will be completed to the extent necessary to support Byron Unit 1 operation. Operational components in common systems will not be retested in the Unit 2 test program.

QUESTION 423.31

"The prerequisites of your preoperational test abstracts are usually either 'prior to core load' or 'prior to plant operation'. These are, by definition, the prerequisites for all preoperational tests, as stated in Subsection 14.2.11. Revise the appropriate preoperational and startup test abstracts to provide prerequisites that identify the major component or system status necessary to conduct the test."

RESPONSE

Prerequisites that identify the major components or system status necessary to conduct a given test are included in the test draft procedures made available 60 days prior to intended use for preoperational test and 60 days prior to core load for startup test.

QUESTION 423.32

"Certain terminology used in the individual test descriptions does not clearly indicate the source of the acceptance criteria to be used in determining test adequacy. An acceptable format for providing acceptance criteria for results includes any of the following:

Referencing technical specifications (Chapter 16)

Referencing accident analysis (Chapter 15)

Referencing other specific sections of the FSAR

Referencing vendor technical manuals

Providing specific quantitative bounds (only if the information cannot be provided in any of the above ways).

"Modify the individual test description abstracts presented below to provide adequate acceptance criteria for all items in the respective test summaries or, if applicable, add a paragraph to Subsection 14.2.12 that provides an acceptable description to each of the following nuclear terms found in the identified tables.

(1) Design, as designed, design values, design criteria, design specifications, design requirements, design limits, design conditions

Table 14.2-2
-5
-6
-7
-8
-9
-11
-12
-13
-15
-16
-17
-18
-20
-21
-22
-23
-24
-26

-28
-29
-30
-33
-34
-35
-36
-37 (2 times)
-38
-39
-40
-41
-45
-46
-48 (2 times)
-49
-51
-53
-60
-61
-62
-64
-65
-67
-68
-71
-73
-74
-75
-84
-87
-89

(2) Plant installation

Table 14.2-3
-5
-6
-7
-8
-9
-18
-20
-21
-22
-23
-24
-25
-26
-28
-29

-30
-33
-34
-35
-36
-37
-38
-39
-40
-41
-45
-49
-51
-53
-61
-64
-65
-67
-68
-71
-73
-74
-89

(3) Manufacturer's recommendations, vendor recommendations

Table 14.2-3
-5
-8
-9
-20
-23
-24
-25
-35
-36
-37
-38
-39
-40
-41
-61
-64
-67
-74

(4) Safety analysis report, FSAR (state specific section)

Table 14.2-6 (2 times)
-7
-18
-28
-29
-30

-33
-34
-45
-51
-53
-61
-63
-65
-68
-71
-73
-75
-77
-78
-79
-80
-82
-83
-84
-87
-89

(5) Appropriate, applicable

Table 14.2-2
-11
-12
-35
-36
-37
-38
-39
-41
-48
-60

(6) Acceptable, adequate, sufficient, unacceptable

Table 14.2-12
-15 (2 times)
-16
-19
-27
-54
-68
-85 (2 times)

(7) Specified, required, expected, predetermined

Table 14.2-13
-32
-59 (2 times)
-77
-78
-79
-81
-82
-83
-85
-88

(8) Function, can function, are functional, systems analysis of functional requirements

Table 14.2-14
-44
-52

(9) Various

Table 14.2-17
-19

(10) Verify, verified

Table 14.2-22
-74

(11) Safety, properly

Table 14.2-23
-31

(12) Appropriate regulatory guidelines or requirements, other applicable regulations

Table 14.2-25
-73

(13) Maintain, maintained

Table 14.2-47
-59

(14) Approved procedures, applicable procedures

Table 14.2-58
-62
-75

(15) Capable

Table 14.2-60

(16) Operational, verified to operate

Table 14.2-60
-63

(17) Compatible

Table 14.2-77
-78
-79
-80
-82
-83

RESPONSE

FSAR tables describing preoperational tests have been revised. Tables describing startup tests will be revised by January 15, 1982.

QUESTION 423.33

"We could not conclude from our review of the preoperational test phase description, the test abstracts provided in Tables 14.2-2 through 14.2-61, and the responses to Item 423.12 that required testing is scheduled for several systems and components. Therefore, clarify or expand the description of the preoperational test phase to address the following:

1. Table 14.2-6, Reactor Protection. The response to Item 423.12, Sub-item 3, is not acceptable. Modify the test description to include the following:

   a. Account for process-to-sensor hardware (e.g., instrument lines, hydraulic snubbers, sensing lines) delay times:

   b. Provide assurance that the response time of each primary sensor is acceptable:

   c. Account for output of the sensor-to-tripping of the reactor trip breaker delay times;

   d. Provide assurance that the total reactor protection system response time (the sum of the above three time delays) is conservative with respect to the accident analysis assumptions.

   Note: Item b can be accomplished by measuring the response time of each sensor during the preoperational test, stating that the response time of each sensor will be measured by the manufacturer within two years prior to fuel loading, or description the manufacturer's certification process in sufficient detail for us to conclude that the sensor response times are in accordance with design.

2. Table 14.2-7, Engineered Safety Features. The response to Item 423.12, Sub-item 4, is not acceptable. Modify the test description to include the following:

   a. Title the test "Engineered Safety Features Actuation System";

   b. Modify the test summary to include testing to demonstrate redundancy, coincidence, nad safe failure on loss of power;

c. Modify the response time testing to:

i. Account for process-to-sensor hardware (e.g., instrument lines, hydraulic snubbers, sensing lines) delay times;

ii. Provide assurance that the response time of each primary sensor is acceptable;

iii. Account for output of the sensor-to-engineered safety features actuation delay time;

iv. Provide assurance that the total engineered safety features actuation system response time (the sum of the above three time delays) is conservative with respect to the accident analysis assumptions.

Note: Item ii can be accomplished by measuring the response time of each sensor during the preoperational test, stating that the response time of each sensor will be measured by the manufacturer within two years prior to fuel loading, or describing the manufacturer's certification process in sufficient detail for us to conclude that the sensor response times are in accordance with design.

3. Table 14.2-13, D-C Power. Modify the test abstract to provide the following:

a. Ensure that each battery charger is capable of charging the battery within 24 hours while supplying the largest combined demands of the expected steady-state loads under all plant operating conditions;

b. The response to Item 423.12, Sub-item 9, is not totally acceptable. Either provide a test description that demonstrates that d.c. loads will perform as necessary to assure plant safety at a battery terminal voltage equal to the acceptance criteria that has been established for minimum battery terminal voltage for the discharge load test or reference a description of the manufacturer's testing at this voltage that ensures proper operation. Commit to including this information as part of your plant records.

4. Table 14.2-14, Vital Bus Independence Verification.

   Modify this test abstract to conform to the requirements of Regulatory Guide 1.41 as follows:

   a. State whether the isolation of the plant electric power distribution system will include the switchyard and the unit and system auxiliary transformers;

   b. State how the system isolation will be effected;

   c. Provide assurance that all sources of power supply to vital buses are capable of carrying full accident loads. If some portions of the power supplies cannot be full-load tested, provide justification.

5. Table 14.2-16, Component Cooling System. The response to Item 423.12, Sub-item 11, is not totally acceptable. Provide acceptance criteria for bench testing of the surge tank relief valves.

6. Table 14.2-18, Containment Spray System. Verify that paths for the air-flow test of containment spray nozzles overlap the water-flow test paths of the pumps to demonstrate that there is no blockage in the flow path.

7. Table 14.2-19, Auxiliary Feedwater System. Modify the test abstract to provide the following:

   a. The reference to 'prime movers' is unacceptable. Specifically identify the equipment in question;

   b. Our review of licensee event reports has disclosed several instances of auxiliary feedwater pump failure to start on demand. It appears that many of these failures could have been avoided if more thorough testing had been conducted during the plant's initial test programs. In order to discover any problems affecting pump startup and to demonstrate the reliability of your auxiliary cooling system, state your plans to demonstrate at least five consecutive, successful, cold, quick pump starts during your initial test program.

8. Table 14.2-20, Primary Sampling System. Verify flow paths, holdup times, and procedures.

9. Table 14.2-21, Leak Detection System. The response to Item 423.12, Sub-item 15, is not acceptable. Modify the test abstract to provide the following:

   a. Rewrite the Test Objective. The first paragraph needs clarification; the remaining paragraphs do not deal with test objectives;

   b. Define the usage of "RCS surge tank" and provide a test summary for RCS surge tank level and radiation monitors;

   c. Provide a preoperational test of the Radwaste Systems that describes testing of the containment floor drains, reactor cavity sump, and totalizing meters.

10. Table 14.2-22, Fuel Pool Cooling and Cleanup System. Modify the test abstract as follows:

    a. Expand the test summary to specify the other flow paths;

    b. The response to Item 423.12, Sub-item 16, is not acceptable. Provide test objectives, a test summary, and acceptance criteria for the requested systems and operations.

11. Table 14.2-23, Fuel Handling and Transfer Systems. Modify the test abstract as follows:

    a. Provide the system description in the Test Objective, not the Test Summary;

    b. Describe load testing to be performed to meet the requirements of Regulatory Guide 1.68, Appendix A, Part 1.m(4).

12. Table 14.2-25, Diesel-Generator. The response to Item 423.12, Sub-item 18, is not acceptable. Modify this test abstract, or other test abstracts, to quantitatively conform to the requirements of Regulatory Guide 1.108, Rev. 1, Regulatory Position 2.

13. Table 14.2-26, Diesel Fuel Oil Transfer System. The response to Item 423.12, Sub-item 19, is not acceptable. Modify the test summary and acceptance criteria to ensure that the capacity of each fuel oil transfer pump to deliver flow in excess of the maximum demand, as indicated in Subsection 9.5.4, is verified. (See also response to Item 040.102.)

14. Table 14.2-28, ECCS - Safety Injection Pumps; Table 14.2-29, ECCS - Centrifugal Charging Pumps; and Table 14.2-30, ECCS - RHR Pumps. Modify these test abstracts as follows:

    a. For the Safety Injection Pumps and the Centrifugal Charging Pumps, the second paragraph in the Test Summary of each abstract must be rewritten due to an inconsistency. The first statement excludes due to an inconsistency. The first statement excludes the situation addressed in the second statement.

    b. The response to Item 423.12, Sub-item 21, is not acceptable:

        i. The requested information was provided in Table 14.2-33, not in Tabels 14.2-28, 29, and 30 as stated. Either modify Tables 14.2-28, 29, and 30 to reflect the response, or revise the response appropriately.

        ii. For the Safety Injection Pumps and the RHR Pump abstracts, change Reactor Water Storage Tanks to Refueling Water Storage Tanks.

15. Table 14.2-31, ECCS - Accumulators. The response to Item 423.12, Sub-item 22, is not acceptable. Modify the test summary and acceptance criteria to verify proper operation fo the nitrogen fill, venting and relief valves, accumulator drains, and accumulator makeup.

16. Table 14.2-37, Diesel-Generator Room Ventilation System. The response to Item 423.12, Sub-item 27, is not totally acceptable. Modify the test description to show that testing of the filtration and absorption units will be performed in accordance with Regulatory Guide 1.52.

17. Table 14.2-40, Hydrogen Recombiner. Modify the test abstract as follows:

    a. Demonstrate the capability of the system to operate in response to post-LOCA requirements;

    b. Demonstrate that post-LOCA hydrogen monitors function properly.

18. Table 14.2-41, Containment Ventilation. Modify the test abstract as follows:

    a. Replace 'specialized' with the appropriate terminology;

    b. Verify that containment recirculation fan motor current is within its design value at conditions representative of accident conditions. Address such issues as air density, temperature, humidity, fan speed, and blade angle.

19. Table 14.2-42, Main Steam isolation Valves. Modify the test abstract as follows:

    a. State that you will measure the full travel of the valves or provide technical justification for other methods of measurement. If the measurement is to be based on 90% travel, calculate MSIV closure time as equal to the interval from deenergizing solenoids until the valve reaches 90% closed, plus the period from 10% closed to 90% closed times 1/8, or provide technical justification for any method which 'double-counts' delay time.

    b. Expand the acceptance criteria to include all of the items in the test summary.

20. Table 14.2-50, Primary Safety and Relief Valves. The response to Item 423.12, Sub-item 35, is not acceptable. Modify the test abstract as follows:

    a. Describe how proper actuation and operation of the power-operated relief valves is demonstrated. Note that in Subsection 5.2.2.11 credit is taken for PORV operation to provide protection against exceeding 10 CFR 50 limits.

    b. Safety valve setpoint verification from vendor certification data is not acceptable. Expand the test to include in-plant preoperational testing of the pressurizer safety valves (and modify your test summary as appropriate). Include testing to ensure seat leakage is within acceptable limits.

21. Table 14.2-51, Steam Generator Safety and Relief Valves. Revise the test abstract to provide acceptance criteria for all components and systems indentified in the test summary.

22. Table 14.2-61, Reactor Containment Crane and Hoists. Modify the test abstract to describe load testing to be performed to meet the requirements of Regulatory Guide 1.68, Appendix A, Part 1.o.(1).

RESPONSE

Item 5: "Component Cooling System"

Table 14.2-16 will be revised to remove the sentece "Surge tank relief valves will be bench tested at the plant site." Acceptance Criteria for bench testing of the surge tank relief valves will therefore not be added.

The component cooling surge tank relief valves are outside the preoperational test program and are covered under ASME Section XI, IWV-3500, Category "C" valves.

Item 6: "Containment Spray System"

Table 14.2-18 will be revised to state that the paths for the air-flow test of the containment spray nozzles will overlap the water-flow test paths of the pumps at the connecting spool pieces.

Item 7: "AF Pumps"

Table 14.2-19 has been revised to identify the "prime movers" in question and commits to 5 consecutive, successful, cold starts per pump.

Item 8: "Primary Sampling System"

The Test Summary section of Table 14.2-20 will be revised to include verification of flow paths, holdup times and sampling procedures.

Item 10: "Fuel Pool Cooling and Cleanup System"

a. The Test Summary section of Table 14.2-22 is revised to specify the other flow paths. See revised Table 14.2-22.

b. Test objectives, a test summary, and accpetance criteria have been provided for the anti-siphon feature in the return line and for the operation of the filters and demineralizers in purifying the Refueling Water Storage Tanks. Test objectives and a test summary have been provided for the leakage detection system. See revised Table 14.2-22.

Item 11: "Fuel Handling System Testing"

Table 14.2-23 has been revised to incorporate the following changes:

a. The system description has been moved from the Test Summary section to the Test Objective section.

b. A description of load testing for the Fuel Handling System hoists and cranes to meet the requirements of Regulatory Guide 1.68, Appendix A, Part 1.m.(4) revision 2 was added to the Test Summary section.

Item 12: "Diesel Generators"

Table 14.2-25 has been revised to state that data is taken to conform to Regulatory Guide 1.108, Rev. 1, Reg. Position C2.a.(1), (3), (4), (6), (9) and 2.b. See revised Table 14.2-25.

Item 13: "Diesel Fuel Oil Transfer Pump"

Table 14.2-26 has been revised to state that each fuel oil transfer pump will deliver fuel oil to each diesel generator in excess of the maximum demand, as indicated in Subsection 9.5.4. See revised Table 14.2-26.

Item 14: "Tables 14.2-28, -29, -30, ECCS - Safety Injection Pumps, Centrifugal Charging Pumps, RHR Pumps"

The response to item 423.12 sub-item 21 will be revised to read "see Table 14.2-33" instead of "see revised Tables 14.2-28, -29 and -30".

The Safety Injection Pumps and RHR pump abstracts will be revised to read refueling water storage tanks instead of reactor water storage tanks.

Tables 14.2-28, 29 and 30 will be revised by deleting "and flooded" from the first sentence of the Test Summary. Also, the second sentence of the Test Summary paragraph 2 (on Tables 14.2-28 and -29) will be deleted. This will eliminate the existing inconsistencies.

Item 15: "Table 14.2-31, ECCS - Accumulators"

The Test Summary section of Table 14.2-31 will be revised to state that proper operation of the nitrogen fill, vent valves, accumulator drains and accumulator makeup will be verified.

Item 16: "Diesel Generator Ventilation System"

The Diesel Generator Room Ventilation system does not contain filtration or absorption units.

Item 17: "H_2 Recombiners"

Table 14.2-40 has been revised to state the test will be performed to demonstrate the capability of the system to operate properly, at conditions near as possible to those given as standard per the manufacturer.

The hydrogen analyzer monitor will be demonstrated to function properly. See revised Table 14.2-40.

Item 18: "Containment Ventilation System"

Table 14.2-41 has been revised to replace "specialized" with "operated". In addition, the following acceptance criteria has been added to Table 14.2-41: The containment recirculation fan motor current will be demonstrated to be within its design value at accident conditions by measuring air density, temperature, humidity, fan speed, air flow and motor current and making engineering extrapolation to accident conditions. See revised Table 14.2-41.

Item 19: "MSIV's"

Table 14.2-42 has been revised to indicate full travel closure times of each valve and acceptance criteria expanded to include all items in test summary.

Item 21: "Steam Generator Safety & Relief Valves"

Table 14.2-51, Acceptance Criteria, has been revised to include all components identified in the Test Summary.

QUESTION 423.35

"The response to Item 423.14 is inadequate. Modify the initial test program to provide a description of the inspections or tests that will be performed following system operation to assure that all snubbers are operable."

RESPONSE

Following system operation during integrated Hot Functional testing, all snubbers will be inspected to be operable.

QUESTION 423.36

"This response to Item 423.15 is inadequate. Provide or modify test descriptions to assure that tests will be performed to demonstrate that the emergency ventilation systems are capable of maintaining all ESF equipment within its design temperature range with the equipment operating in a manner that will produce the maximum heat load in the compartment. If it is not possible to operate equipment to produce maximum heat loads, describe how the tests performed satisfy the objectives listed above.

"Note that it is not apparent that post-accident design heat loads will be produced in ESF equipment rooms during the power ascension test phase; therefore, simply assuring that area temperatures remain within design limits during this period will not demonstrate the design heat removal capability of these systems. It will be necessary to include measurement of air and cooling water temperatures and flows and the extrapolations used to verify that the ventilation systems can remove the postulated post-accident heat loads."

RESPONSE

Emergency ventilation systems will be demonstrated capable of maintaining ESF equipment within its design temperature range by measuring air and cooling water temperatures and flows and making engineering extrapolations to postaccident design heat loads.

QUESTION 423.38

"The initial test program should verify the capability of the offsite power system to serve as a source of power to the emergency buses. Tests should demonstrate the capability of each starting transformer to supply power (as the alternate supply) to its unit's emergency buses while carrying its maximum load of plant auxiliaries and the other unit's emergency buses (as preferred supply). Tests should also demonstrate the transfer capabilities of the unit's emergency bus feeders upon loss of one source of offsite power. These tests should be performed as early in the test program as the availability of necessary components allows. Provide descriptions of the tests that will demonstrate these capabilities."

RESPONSE

The initial test program will verify the capacity of the system auxiliary transformer (starting transformer) to supply power to its unit's vital buses while carrying its maximum load of plant auxiliaries and the other unit's vital buses. Tests will be conducted to demonstrate transfer capabilities. These tests will be performed as early as the necessary components become available for testing, but not during the period when electrical separation requirements are in effect for Unit 1 operation and Unit 2 construction.

QUESTION 423.39

"The test descriptions are not sufficiently detailed to ascertain if the voltage levels at the safety-related buses are optimized for the full load and minimum load conditions that are expected throughout the anticipated range of voltage variations of the offsite power source by appropriate adjustment of the voltage tap settings of the intervening transformers. We require that the adequacy of the design in this regard be verified by actual measurement and by correlation of measured values with analysis results. Provide a description of the method for making this verification."

RESPONSE

The voltage levels at the vital buses are predicted throughout the anticipated range of voltage variation of the offsite power source by an engineering analysis. The analysis is validated by selected measurements taken during the test program.

QUESTION 423.40

"Verify that sources of water used for long-term core cooling are tested to demonstrate adequate NPSH and the absence of vortexing over range of basin level from maximum to the minimum calculated 30 days following LOCA."

RESPONSE

Test at Byron will demonstrate the adequacy of NPSH and the absence of vortexing over the range of basin levels anticipated in the essential service water cooling towers. Such testing is not feasible at Braidwood but system design has provided a high degree of assurance of acceptable NPSH and vortex minimization.

QUESTION 423.41

"The response to Item 423.18 is not adequate. The intent of this requirement is to determine if any of the startup tests are nonessential, based on the described criteria. List any nonessential tests."

RESPONSE

All listed startup tests are essential.

QUESTION 423.42

"We could not conclude from our review of the startup test abstracts and the responses to Item 423.19 that comprehensive testing is scheduled for several systems and components. Therefore, clarify or expand the startup test phase description to address the following:

1. Table 14.2-62, Initial Core Load. Modify this test abstract, or expand Subsection 14.2.10.1, to address the following:

   a. Commit to a response check of nuclear instruments to a neutron source within 8 hours of fuel loading;

   b. Specify the frequency of determination of boron concentration commensurate with the maximum dilution rate;

   c. Include the maintenance of continuous voice communication between the control room and fuel loading personnel;

   d. Verify the operability of radiation monitors, nuclear instrumentation, manual initiation, and other devices to actuate building evacuation alarm and ventilation control;

   e. Specify criteria for emergency boron injection and containment evacuation.

2. Table 14.2-65, Reactor Trip Circuit. The response to Item 423.19, Sub-item 3, is not totally acceptable. Modify Table 14.2-6, Reactor Protection, to include the information contained in this response.

3. Table 14.2-66, Rod Drop Measurements. Modify the test abstract to address the following:

   a. Revise the Test Objective to reflect the flow and temperature conditions specified in the Test Summary;

   b. The response to Item 423.19, Sub-item 4, is not totally acceptable. Retesting the drop times of the fastest and slowest rods does not guarantee that all rods outside the two-sigma limit will be included. Commit to retesting all rods outside this limit at least three additional times.

4. Table 14.2-70, Reactor Coolant System Flow. The response to Item 423.19, Sub-item 6, is not adequate. Modify the test abstract as follows:

a. Ensure that pump performance, rotational speed, and indicated flow are consistent with performance curves;

b. State that the flow measuring devices are properly calibrated;

c. Provide a description for vibration monitoring.

5. Table 14.2-75, Initial Criticality. The response to Item 423.19, Sub-item 8, is not adequate. Modify this test abstract or Subsection 14.2.10.2 to address the following items from Regulatory Guide 1.68 (Revision 2), Appendix A, Section 3:

   a. Ensure that a neutron count rate of at least 1/2 count per second is indicated on the startup channels before the startup begins, and the signal-to-noise ratio is greater than 2;

   b. Ensure that predictions of boron concentration and control rod positions are provided, as well as criteria and actions to be taken if actual plant conditions deviate from predicted values;

   c. Prescribe the reactivity addition sequence to assure that criticality will not be passed through on a period shorter than approximately 30 seconds.

6. Table 14.2-76, Power Ascension. Provide a table that lists each startup test and denotes each power level where testing will be accomplished.

7. Table 14.2-81, Pseudo Rod Ejection. Modify this test abstract to include your response to Item 423.19, Sub-item 10, as follows:

   a. State that the most reactive RCCA will be withdrawn for this test;

   b. Verify that its worth is conservative with respect to the accident analysis.

8. Table 14.2-82, Power Reactivity Coefficient Measurement. The response to Item 423.19, Sub-item 11, is not adequate. Modify the test abstract to describe how reactor power and associated reactivity changes will be measured.

9. Table 14.2-85, Turbine Trip. The response to Item 423.19, Sub-item 12, is not adequate. Expand the acceptance criteria to ensure that the recorded parameters

and observed transient results will be compared with predicted results for the actual test case, and quantitative values should be provided for the required convergence of actual test results with predicted values.

10. Table 14.2-86, Core Performance Evaluation. The response to Item 423.19, Sub-item 13, is not adequate. Modify the test abstract to show that data will be obtained at locations outside the control room to verify that the plant has achieved hot standby status and that the plant can be maintained at stable hot standby conditions for at least 30 minutes. Also, show that data will be obtained at locations outside of the control room to demonstrate a potential capability for cold shutdown by partially cooling down the plant from the hot standby condition.

    The test should demonstrate that:

    i. The reactor coolant temperature and pressure can be lowered sufficiently to permit the operation of the core decay heat removal system that is to be ultimately used to place the reactor in a refueling shutdown mode.

    ii. Operation of this decay heat removal system can be initiated and controlled.

    iii. A heat transfer path to the ultimate heat sink can be established.

    iv. Reactor coolant temperature can be reduced approximately 50°F using this decay heat removal system at a rate that would not exceed technical specification limits.

11. Table 14.2-87, Loss of Offsite Power. The response to Item 423.19, Sub-item 14, is inadequate. Modify the acceptance criteria to state that the duration of the blackout is at least 30 minutes.

12. Table 14.2-88, 10% Load Swing. The response to Item 423.19, Sub-item 15, is not adequate. Include the response to this item in the test abstract. Also, expand the acceptance criteria to address acceptable overshoot, undershoot, or oscillation.

13. Table 14.2-89, 50% Load Reduction. The response to Item 423.19, Sub-item 16, is not adequate. Include the response to this item in the test abstract."

RESPONSE

Item 1: "Initial Core Load"

Table 14.2-62 has been revised to incorporate the following additions to the Test Summary section:

a. A response check of nuclear instruments to a neutron source will be conducted within 8 hours of fuel loading.

b. Boron samples to determine boron concentration will be taken at least once every 4 hours throughout the one loading program.

c. Continuous voice communication links will be maintained between the control room and fuel loading personnel throughout the core loading program.

d. Prior to core loading the radiation monitoring system and associated ventilation interlocks will be aligned, calibrated and placed in service. Prior to core loading the plant nuclear instrumentation will be calibrated and placed in service. Prior to core loading containment evacuation alarms will be installed and satisfactorily tested, evacuation procedures will be explained and alarms demonstrated to all personnel involved. Throughout core loading containment evacuation alarms will be verified operable at least once per 8 hours.

e. Emergency boron injection and containment evacuation will occur if the background count rate increases by a factor of 5 or a steady positive startup rate is observed.

Item 2: "Reactor Trip Circuit"

Tables 14.2-6 and 14.2-65 are revised to incorporate the response to Q423.19 Sub-item 3. See revised Tables 14.2-6 and 14.2-65.

Item 3: "Rod Drop Measurements"

Table 14.2-66 has been revised to incorporate the following changes:

a. The Test Objective section has been revised to reflect the temperature and flow conditions stated in the Test Summary section.

b. The Test Summary section has been changed such that all rods falling outside of the two-sigma limit in drop times will be retested a minimum of three times each.

Item 4: "Reactor Coolant System Flow"

a. Table 14.2-70 will be revised to state that data will be taken to ensure pump performance, rotational speed and indicated flow are consistent with performance curves.

b. Every test procedure includes a prerequisite that all instrumentation used in the test to measure acceptance criteria must be within current calibration intervals. Therefore, no modification to Table 14.2-70 will be made.

c. Vibration monitoring of the reactor coolant pumps will be done using 2 IRD pickups mounted to the motor supports (90 degrees apart in the horizontal plane). In addition, baseline vibration data on the pumps will be obtained using a portable IRD vibration measurement unit. These will be taken at bearing points on the pump motor (in 3 directions, where possible) during the preoperational test.

Item 5: "Initial Criticality"

Table 14.2-75 has been revised to incorporate the following changes and additions:

a. Source range nuclear instrumentation shall indicate at least 1/2 count per second prior to startup and the source range signal-to-noise ratio will be greater than 2.

b. The NSSS vendor will provide predictions of boron concentration and control rod positions for initial criticality. Rod withdrawal or boron dilution will be terminated if actual values are seen to be deviating from predicted values until the source of the deviation is evaluated.

c. The reactivity addition sequence prescribed per NSSS vendor recommendations to ensure that criticality will not be passed through on a reactor period shorter than 30 seconds.

Item 7: "Pseudo Rod Ejection"

Table 14.2-81 has been revised to incorporate the following additions:

a. The most reactive RCCA will be withdrawn for this test.

b. The worth of the most reactive RCCA will be verified to be conservative with respect to the accident analysis.

Item 8: "Power Coefficient of Reactivity"

Table 14.2-82 has been revised to incorporate the following addition:

Reactor thermal power will be determined using calorimetric data. The asssociated reactivity changes will be determined using the reactivity, computer, T_{avg} recorded, and Delta T recorder.

Item 10: "Shutdown from Outside Control Room"

Table 14.2-86 will be modified to show data will be obtained from outside the control room to verify a plant hot standby condition following shutdown and that the plant can be maintained stable for at least 30 minutes. The Byron/Braidwood safe shutdown is designed for hot standby.

Item 11: "Station Blackout"

Table 14.2-87 has been revised to state that a blackout of at least 30 minutes is an acceptance criteria. See revised Table 14.2-87.

Item 12: "10% Load Swing"

Table 14.2-88 will be revised to include the response to Q423.19 sub-item 15. Additionally acceptance criteria will be included to address overshoot, undershoot, and oscillations.

Item 13: "50% Load Reduction"

Table 14.2-89 will be revised to incorporate the response to Q423.19, sub-item 16.

QUESTION 423.43

"The response to Item 423.20 is not adequate. Modify the acceptance criteria in Table 14.2-90 to assure that the linearity of the ΔT measurements is within the specifications required for the appropriate control systems."

RESPONSE

Table 14.2-90 will be revised to incorporate an acceptance criteria for assuring that the linearity of the delta temperature measurements are within specifications.