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NUCLEAR POWER

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MFN 009-83
JNF 003-83

January 21, 1983

U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, DC 20555

Attention: Mr. D.G. Eisenhut, Director
Division of Licensing

Gentlemen:

SUBJECT: IN THE MATTER OF 238 NUCLEAR ISLAND
GENERAL ELECTRIC STANDARD SAFETY ANALYSIS REPORT (GESSAR II)
DOCKET NO. STN 50-447

Reference: Letter from G.G. Sherwood (GE) to D.G. Eisenhut (NRC) pertaining to draft responses to the Commission's August 25, 1982 request for additional information on GESSAR II, dated November 10, 1982 and December 17, 1982.

Attached please find revised final draft responses to selected questions of the Commission's August 25, 1982 information request. Only modifications (new or revised) to the responses of the referenced letters are provided. Responses are provided in the attachments as indicated below:

Attachment Number	Branch
1	Procedures and Test Review
2	Structural Engineering
3	Radiation Assessment
4	Power Systems

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Limited Dist

Sincerely,

Wilea for.

Glenn G. Sherwood, Manager
Nuclear Safety & Licensing Operation

Attachments

cc: F.J. Miraglia (w/o attachments)
D.C. Scaletti
C.O. Thomas (w/o attachments)
L.S. Gifford (w/o attachments)

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ATTACHMENT NO. 1

DRAFT RESPONSES TO

PROCEDURES AND TEST REVIEW BRANCH

QUESTIONS

CHAPTER 14

INITIAL TEST PROGRAM

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added 5 new major divisions

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add

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SECTION 14.2

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GESSAR II
238 NUCLEAR ISLAND

CHAPTER 14 INITIAL TEST PROGRAM

14.0 INTRODUCTION

This chapter provides information on the initial test program for structures, systems, components, and design features for both the nuclear portion of the plant and the balance of the plant. The information addresses major phases of the test program, including selected acceptance tests, preoperational tests, initial fuel loading and initial criticality, low-power tests, and power-ascension tests. The technical aspects of the initial test program are described in sufficient detail to show that the test program will adequately verify the functional requirements of plant structures, systems, and components. The sequence of testing is such that the safety of the plant is not dependent on untested structures, systems, or components. Also described are the measures taken to ensure that (1) the initial test program will be accomplished with adequate numbers of qualified personnel, (2) adequate administrative controls are established to govern the initial test program, (3) the test program is used, to the extent practicable, to train and familiarize the plant operating and technical staff in the operation of the facility, and (4) the adequacy of plant operating and emergency procedures are verified during the period of the initial test program.

14.1 SPECIFIC INFORMATION TO BE INCLUDED IN PRELIMINARY SAFETY ANALYSIS REPORTS

The initial test program overall test objectives and general prerequisites were previously provided in the PDA GESSAR. THE technical aspects of the initial test program are described in Section 14.2 in sufficient detail to show that the test program adequately verifies the functional requirements of plant structures, systems, and components so that the safety of the plant will not be dependent on untested structures, systems, or components.

14.2 SPECIFIC INFORMATION TO BE INCLUDED IN SAFETY ANALYSIS REPORTS

The initial test program consists of a series of tests categorized as construction, preoperational, or initial startup tests. The construction acceptance tests determine correct installation and functional operability of equipment. Preoperational tests are those tests normally conducted prior to fuel loading to demonstrate the capability of plant systems to meet performance requirements. Initial startup tests begin with fuel loading and demonstrate the capability of the integrated plant to meet performance requirements.

14.2.1 Summary of Test Program and Objectives

14.2.1.1 Initial Test Program Objectives

The objectives of the initial test program are to:

(1) ensure that the construction is complete and acceptable;

(2) demonstrate the capability of structures, components, and systems to meet performance requirements;

(3) effect fuel loading in a safe manner;

(4) demonstrate, where practical, that the plant is capable of withstanding anticipated transients and postulated accidents;

(5) evaluate and demonstrate, to the extent possible, plant operating procedures to provide assurance that the operating group is knowledgeable about the plant and procedures and fully prepared to operate the facility in a safe manner; and

14.2.1.1 Initial Test Program Objectives (Continued)

(6) bring the plant to rated capacity and sustained power operation.

14.2.1.2 Initial Test Program Summaries

The three categories of tests in the initial test program are as follows:

(1) Construction acceptance tests, such as hydrostatic tests, pressure proof tests, pump and valve tests, mechanical actuation to verify proper installation, and electrical continuity verifications, are those tests which demonstrate that components are correctly installed and operational.

(2) Preoperational tests are conducted prior to fuel loading to demonstrate that the plant systems have been properly designed and that they meet performance requirements.

(3) Startup tests consist of fuel loading, precritical tests, low-power tests, and power ascension tests that ensure fuel loading in a safe manner, confirm the design bases, demonstrate where practical that the plant is capable of withstanding the anticipated transients and posulated accidents, and ensure that the plant is safely brought to rated capacity and sustained power operation.

14.2.1.3 Description of Construction Tests*

Typical construction acceptance tests generally include but are not limited to the following:

(1) megger and high potential tests;

(2) electrical equipment test to, and including, energizing, e.g., checking grounding, relay checks, checking circuit breaker operation and controls, continuity checks, megger tests, phasing check, high potential measurements, and energizing of buses;

(3) initial adjustment and bumping of motors;

(4) checking control and interlock functions of instruments, relays, and control device's;

(5) calibrating instruments and checking or setting initial trip setpoints;

(6) pneumatic testing of instruments and service air system and cleanout of lines;

(7) checking and adjusting relief and safety valves;

(8) complete tests of the emergency core cooling system (ECCS) motor-operated valves including adjusting limitorque switches and limit switches, checking all interlocks and controls, measuring motor current and operating speed, and checking leaktightness of stem packing and valve seat during hydrotests; and complete tests of the nuclear steam supply system (NSSS) control systems including checking all interlocks and controls,

*Abstracts of these tests will not be provided as part of the SAR.

14.2.1.3 Description of Construction Tests (Continued)

adjusting limit switches, measuring operating speed, checking leaktightness of pneumatic operators, and checking for proper operation of controllers, pilot solenoids, etc.

14.2.1.4 Description of Preoperational Tests

A listing of the preoperational tests, together with subsection and page references for each is provided in Table 14.2-1. The general objectives of the preoperational test phase are as follows: OK

(1) ensure that test acceptance criteria are met;

(2) provide documentation of the performance and safety of equipment and systems;

(3) provide baseline test and operating data on equipment and systems for future reference;

(4) run-in new equipment for a sufficient period so that any design, manufacturing, or installation defects can be detected and corrected;

(5) ensure that plant systems operate together on an integrated basis to the extent possible;

(6) give maximum opportunity to the permanent plant operating staff to obtain practical experience in the operation and maintenance of equipment and systems;

(7) establish safe and efficient normal, abnormal, and emergency operating procedures to the extent possible;

14.2.1.4 Description of Preoperational Tests (Continued)

(8) establish and evaluate surveillance testing procedures; and

(9) demonstrate that systems and safety equipment are operational and that it is possible to proceed to fuel loading and to the startup phase.

14.2.1.5 Description of Startup Tests

After the preoperational test phase has been completed, the startup phase begins with fuel loading and extends to commercial operation. This phase is subdivided into the following four parts:

(1) fuel loading and shutdown power level tests;

(2) power testing from 0 to 25% of rated output;

(3) power testing from 25 to 100% of rated output; and

(4) warranty demonstration.

The tests conducted during the startup phase consist of major plant transients (Table 14.2-2), stability tests (Table 14.2-4), and a remainder of tests which are directed towards demonstrating correct performance of the nuclear boiler and numerous auxiliary plant systems while at power. Certain tests may be identified with more than one class of test. Table 14.2-3 shows the complete startup test program.

Ok

These numbers need to change to 14.2..?..

14.2.1.5 Description of Startup Tests (Continued)

The general objectives of the startup phase are as follows:

(1) to achieve an orderly and safe initial core loading;

(2) to accomplish all testing and measurements necessary to determine that the approach to initial criticality and subsequent power ascension is safe and orderly;

(3) to conduct low-power physics tests sufficient to ensure that test acceptance criteria have been met;

(4) to conduct initial heatup and hot functional testing so that hot integrated operation of all systems is shown to meet test acceptance criteria;

(5) to conduct an orderly and safe power ascension program, with requisite physics and systems testing, to ensure that the plant operating at power meets test acceptance criteria; and

(6) to conduct a successful warranty demonstration program.

14.2.2 Organization and Staffing

14.2.2.1 Normal Plant Staff

Normal plant staff responsibilities, authorities, and qualifications are given in Chapter 13.

14.2.2.2 General Electric Company (GE)

The General Electric Company (GE) is the supplier of the boiling water reactor (BWR) Nuclear Island. GE is responsible for generic and specific BWR designs and for the supply of the Nuclear Island.

14.2.2.2 General Electric Company (GE) (Continued)

During the construction phase of the plant cycle, the GE resident site manager is responsible for all Nuclear Island equipment disposition. ~~When the construction phase is completed and testing phase of the project begins,~~ At or near fuel load the responsibility for GE-Nuclear Island activities is assigned to the G.E. Operations Manager. ~~Preoperational and Startup Group. The GE Preoperational and Startup staff responsibilities are outlined as follows. Staff qualifications are discussed in Subsection 14.2.7.3.~~

14.2.2.2.1 GE Operations Manager

The GE Operations Manager is the senior Nuclear Island vendor representative onsite at or near official fuel loading and is the official site spokesman for GE for preoperational and startup testing. He coordinates with the Station Superintendent for the performance of his duties which are as follows:

(1) reviewing and approving all test procedures, changes to test procedures, and test results;

(2) providing technical direction to the station staff;

(3) managing the activities of the GE site personnel in providing technical direction to shift personnel in the testing and operation of GE supplied systems;

(4) liaison between the site and the GE San Jose home office to provide rapid and effective solutions for problems which cannot be solved onsite; and

(5) participating as a member of the Startup Coordinating Group.

~~[illegible] organization isn't described in GESSAR. Some general description like the applicant's [illegible] staff responsible for startup [illegible] should be [illegible]~~

14.2.2.3 APPLICANT.

APPLICANT TO SUPPLY.

~~14.2.2.3.2 Construction Program Testing~~

~~Applicant will supply.~~

14.2.2.4 Architect-Engineer

~~14.2.2.4.1 Test Program~~

Applicant will supply.

~~14.2.2.4.2 Construction Program Testing~~

~~Applicant will supply.~~

14.2.2.5 Constructor

Applicant will supply. ~~construction program testing~~

14.2.3 Test Procedures

In general, testing during all phases of the initial test program is conducted using written procedures to control the conduct of each test. Such test procedures include appropriate methods to control test performance (including the sequencing of testing), specify acceptance criteria by which the test is to be evaluated, and provide for or specify the format by which data or observations are to be recorded.

14.2.3.1 Test Procedure Preparation, Review and Approval

APPLICANT WILL SUPPLY.

14.2.3.2 Test Procedure Content and Format

Applicant will supply.

14.2.3.3 Applicant Will Supply Interrelationships and Interfaces

Effective coordination between the various site organizations involved in the test program is achieved through the Startup Coordinating Group (SCG) which is composed of representatives of the Applicant, GE, and others. The duties of the SCG are to review and approve project testing schedules and to effect timely changes to construction or testing in order to facilitate execution of the preoperational and initial startup test programs.

14.2.4 Conduct of Test Program

Applicant will supply. The Test and Startup Instruction Manual prescribes administrative procedures to be followed by the Applicant during the startup phase.

14.2.5 Review, Evaluation, and Approval of Test Results

Applicant will supply. All test results are secured by the Applicant's test results engineer. GE, the Applicant, and AE shall review the results for conformance to predicted behavior and examine all divergent inputs. Resolution of these errant results are forwarded to the SCG. Plans pertaining to approval of test phase and approval of test data at each power test plateau (during the power-ascension phase) before increasing power level will be provided by the Applicant. 14.1

14.2.6 Test Records

Applicant will supply. Test results are stored for the life of the plant by the Applicant.

14.2.7 Conformance of Test Programs to Regulatory Guides (Applicant will Confirm)

14.2.7.1 Conformance with Regulatory Guide 1.68

The test and startup program shall conform to the requirements of Regulatory Guide 1.68, Preoperational and Initial Startup Test Programs for Water-Cooled Power Reactors, except where specifically noted below. This regulatory guide will be reviewed by the Applicant for applicability of individual items in the guide to the specific facility and its systems. The applicability to this plant determines the nature and scope of testing to be performed. Actual exceptions to the testing required by this guide have been specifically addressed and are discussed in Subsection 14.2.7.2. Areas where the guide does not apply are not considered to be exceptions.

14.2.7.2 Exceptions to Regulatory Guide 1.68

The exceptions to Regulatory Guide 1.68 follow with an explanation of the justification for the exception:

(1) Section C.2.b: Operational limitations for the protection of public health and safety are included in the Technical Specification for the plant. Startup instructions contain notes of caution which supplement the Technical Specification. The Technical Specification should be the instrument for describing operational (including testing) limitations. Therefore, the identification of "safety precautions" in test procedures should be limited to those items which, if not observed, could lead to reduction of system safety performance below expected levels and not the minor procedural and test details which would not cause such a reduction.

14.2.7.2 Exceptions to Regulatory Guide 1.68 (Continued)

(2) Section C.2.c: The generic simulation tests appearing in safety analysis reports should appear by reference in preoperational and initial startup test programs where onsite full simulation tests are not possible. The guide wording would change to "...less than full simulation should be provided or referenced for test where full..."

(3) Appendix A, Section C.2.h: The comparison of critical control rod pattern with predicted patterns (Appendix A, Section C.2.d) provides required knowledge of effective over-all rod worth. Individual control rod calibrations cannot be performed in a meaningful manner in a large multi-rodded BWR. Therefore, this part of the guide is not applicable to boiling water reactors.

(4) Appendix A, Section C.2.i: The functional requirement of the reactor head cooling system design is required at operating pressures less than or equal to 135 psig. Therefore, for this paragraph to applicable, "($\leq$135 psig)" should be part of last sentence.

(5) Appendix A, Section D.2.a: A 50% power test is safer than the 25% test, since the water level and core power are less severe.

(6) Appendix A, Section D.2.b: Friction tests are performed on four drives at rated pressure.

(7) Appendix A, Section D.2.f: It is necessary to make more than two calibrations and, therefore, not appropriate to limit the test to 50% and 100% power levels.

14.2.7.2 Exceptions to Regulatory Guide 1.68 (Continued)

(8) Appendix A, Section D.2.g: At least six chemical analyses of fluid system are necessary; therefore, the limitations of 25%, 50%, 75%, and 100% power are not appropriate.

(9) Appendix A, Section D.2.1: Since the current BWR design does not include an emergency condenser, this section is not appropriate.

(10) Appendix A, Section D.2.n: Control rod calibration in a large multirodded BWR has not been found to provide meaningful data. Any safety-related problems associated with control rods would be discovered during safety-related testing and, therefore, this section is not appropriate.

(11) Appendix A, Section D.2.p: Since the main steam valve function tests are conducted at a minimum of six power and flow conditions, the limitations of 25%, 50%, and 75% are not appropriate.

(12) Appendix A, Section D.2.s and t: Turbine trip and generator trip have essentially the same effect on the reactor and safety-related system actuation. Section D.2.s and D.2.t be combined into one test.

(13) Appendix A, Section D.2.y: Minimum Critical Heat Flux Ratio (MCHFR) is an obsolete limit that has been replaced with Minimum Critical Power Ratio (MCPR). Core Performance Evaluation tests must be performed at every test condition.

14.2.7.2 Exceptions to Regulatory Guide 1.68 (Continued)

(14) Appendix A, Section D.2.aa: Comparison tests are made throughout the test program and, therefore, limitations of 25%, 50%, and 100% are not appropriate.

(15) Appendix C, Section B.2.d: Functionally testing the associated control rod immediately following installation of each fuel cell is not appropriate. Functional testing of all control rods after fuel loading and prior to startup to critical procedures is applicable.

(16) Appendix A, Section A.5.a: "Demonstration of water injection for a loss-of-collant accident" is an emergency core cooling system test. Therefore, "Demonstration of water injection for a loss-of-coolant accident" is not within the scope of the reactor coolant makeup system test.

(17) Appendix A, Section C.2.c: "Calibration of intermediate range monitor with power" is not meaningful due to local control rod effects.

(18) Appendix A, Section D.2.w: Feedwater pump trip is performed to check recirculation pump runback.

(19) Appendix C, Section B.1.b: Poison curtains are not applicable.

(20) Appendix C, Section B.2.a: Poison curtains are not applicable.

(21) Appendix C, Section B.3.c: Insertion of locked control rods is excluded in any withdrawal sequences.

14.2.7.3 Conformance with or Exception to Regulatory Guides Other Than RG 1.68

(1) Regulatory Guide 1.9, Selection of Diesel Generator Set Capacity for Standby Power Supplies

Refer to Subsection 14.2.12.1.55, 33 for a description of the ~~emergency~~ diesel generator system preoperational test.

(2) Regulatory Guide 1.20: Vibration Measurements on Reactor Internals

Refer to Subsection 14.2.12.~~1.34~~ .1.31 for a description of the vibration measurements preoperational test.

(3) Regulatory Guide 1.30: Quality Assurance Requirements for Installation, Inspection and Testing of Instrumentation and Electric Equipment

Applicant will supply.

(4) Regulatory Guide 1.33: Quality Assurance Program Requirements (Operations)

Applicant will supply.

(5) Regulatory Guide 1.41: Preoperational Testing of Redundant Onsite Electric Power Systems to Verify Load Group Assignments

Applicant will supply.

14.2.7.3 Conformance with or Exception to Regulatory Guides Other Than RG 1.68 (Continued)

(6) Regulatory Guide 1.52: Design, Testing and Maintenance Criteria for Atmosphere Cleanup System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants

Applicant will supply.

(7) Regulatory Guide 1.58: Qualification of Nuclear Power Plant Inspection, Examination and Testing Personnel

General Electric startup operations personnel qualifications meet the requirements of this guide as follows.

a. General Electric personnel are selected and trained according to the criteria of ANSI N18.1-1971 (NRC Regulatory Guide 1.8) with the exception of NRC Licensing.

b. The Operations Manager meets the equivalent of ANSI N18.1, Paragraph 4.2.2, Operations Manager. The Operations Manager is normally present for preoperational testing and will therefore be qualified at the time that preoperational testing is begun.

c. The Operations Superintendent meets the equivalent of ANSI N18.1, Paragraph 4.3.1, Supervisors Requiring AEC Licenses. The Operating Superintendent will normally be present for preoperational testing and therefore will be qualified at the time preoperational testing is begun.

14.2.7.3 Conformance with or Exception to Regulatory Guides Other Than RG 1.68 (Continued)

d. The Shift Superintendents meet the qualification of ANSI N18.1, Paragraph 4.3.1, Supervisors Requiring AEC Licenses.

e. The Lead Startup Test Design and Analysis Engineer meets the qualifications of ANSI N18.1, Paragraph 4.4.1, Reactor Engineering and Physics and will be qualified at the time of initial core loading or appointment to the position. Onsite responsibilities begin just prior to fuel loading.

f. The Startup Test Design and Analysis Engineers meet the qualifications of ANSI N18.1, Paragraph 3.3, Reactor Technical support personnel. Their onsite responsibilities begin just prior to fuel loading.

g. The Startup Control and Instrumentation Engineer meets the qualifications of ANSI N18.1, Paragraph 4.4.2, Instrumentation and Control and will be qualified at the time preoperational testing is begun.

h. The Startup Chemist meets the qualifications of ANSI N18.1, Paragraph 4.4.3, Radiochemistry, utilizing cumulative experience from several reactor startup programs. He will be qualified at the time of initial core loading.

(8) Regulatory Guide 1.80: Preoperational Testing of Instrument Air Systems

Applicant will supply.

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

Since every reactor/plant in a GE BWR product line is an evolutionary development of the previous plant in the product line (and each product line is an evolutionary development from the previous product line), it is evident that the BWR/6 plants have the benefits of experience acquired with the successful and safe startup of more than 25 previous BWR/1/2/3/4/5 plants. The operational experience and knowledge gained from these plants and other reactor types has been factored into the procedures related to the preoperational and startup test programs.

The Applicant will use available information on operating experience, including reportable occurrences at operating power reactors, as appropriate in the development and execution of the specific test procedures.

14.2.9 Trial Use of Plant Operating and Emergency Procedures

Applicant will supply.

To the extent practicable throughout the preoperational and initial startup test program, test procedures utilize operating, emergency, and abnormal procedures where applicable in the performance of tests. The use of these procedures is intended to do the following:

(1) prove the specific procedure or illustrate changes which may be required;

(2) provide training of plant personnel in the use of these procedures; and

(3) increase the level of knowledge of plant personnel on the systems being tested.

14.2.9 Trial Use of Plant Operating and Emergency Procedures (Continued)

Testing may use these operating, emergency, and abnormal procedures in several ways: it may reference the procedure directly; it may extract a series of steps from the procedure; or it may use a combination of the first two methods.

14.2.10 Initial Fuel Loading and Initial Criticality

14.2.10.1 Fuel Loading and Shutdown Power Level Tests

Fuel loading and initial criticality is conducted in accordance with written procedures after all prerequisite tests are satisfactorily completed and an operating license has been issued. Prior to approving fuel loading, the plant must be verified to load fuel. This verification is accomplished by the following steps, which are performed at the completion of preoperational testing.

14.2.10.1.1 Loss of Power Demonstration - Standby Core Cooling Required

This test demonstrates the capability of each emergency diesel generator to start automatically and assume all of its emergency core-cooling loads in a loss of normal auxiliary power.

14.2.10.1.2 Cold Functional Testing

The cold functional testing defined here is an integrated system operation of various plant systems that can be operated as systems prior to fuel loading. The intent is to observe any unexpected operational problems from either an equipment or a procedural source and to provide an opportunity for operator familiarization with the system-operating procedures under operating conditions.

14.2.10.1.2 Cold Functional Testing (Continued)

Some of the cold functional testing will be accomplished during the preoperational test program. For example, integrated and simultaneous operation of the following systems may take place during the flush of the total system: Condensate System, Condensate Demineralizer System, Low-Pressure Coolant Injection (LPCI) System, Core Spray System, Reactor Water Cleanup System (RWCS), Service Water Systems, Turbine Building Closed Cooling Water (TBCCW) System, Reactor Building Closed Cooling Water (RBCCW) System, and others. As required, additional integrated systems performance will be demonstrated prior to fuel loading.

14.2.10.1.3 Routine Surveillance Testing

Because the interval between completion of a preoperational test on a system and the requirement for that system to be operated may be of considerable length, a number of routine surveillance tests must be performed prior to fuel loading, and must be repeated on a routine basis. The technical specifications (Chapter 16) detail the test frequency. In general, the surveillance test program specified in the technical specifications is instituted prior to fuel loading by the plant operating staff.

14.2.10.1.4 Master Startup Checklist

A detailed list of items that must be complete, including the preoperational tests, work requests, design changes and proper disposition of all exceptions noted during pre-operational testing, is rechecked to verify completion just prior to the final approvals for fuel loading and at each significant new step, such as heat up, opening MSIVs, and power operation.

14.2.10.1.5 Initial Fuel Loading

Fuel loading requires the movement of the full core complement of assemblies from the fuel pool to the core, with each assembly identified by number, before being placed in the correct coordinate position. The procedure controlling this movement is arranged so that shutdown margin and subcritical checks are made at predetermined intervals throughout the loading thus ensuring safe loading increments. Specially sensitive in-vessel neutron monitors that are maintained at the loading face as loading progresses serve to provide indication for the shutdown margin measurements, and they also allow the recording of the core flux level as each assembly is added. A complete check is made of the fully loaded core to ascertain that all assemblies are properly installed, correctly oriented, and occupying their designated positions.

14.2.10.1.6 Zero Power Level Tests

At this point in the program, a number of tests are conducted which are best described as initial zero-power-level tests. Chemical and radiochemical tests are made in order to check the quality of the reactor water before fuel is loaded and to establish base and background levels which will be required to facilitate later analysis and instrument calibrations. Plant and site radiation surveys are made at specific locations for later comparison with the values obtained at the subsequent operating power levels. Shutdown margin checks are repeated for the fully loaded core; and criticality is achieved with each of the two prescribed rod sequences in turn, the data being recorded for each rod withdrawn. Each rod drive is subjected to scram and performance testing. The initial setting of the intermediate range monitors (IRM) is at maximum gain.

14.2.10.2 Initial Heatup to Rated Temperature and Pressure

Heatup follows the satisfactory ~~completion of the~~ fuel loading ~~and~~ zero-power-level tests (Subsections 14.2.10.1.5 and 14.2.10.1.6) and further checks are made of coolant chemistry ~~together with~~ radiation surveys at the selected plant locations. All control rod drives (CRD) are scram-timed at rated temperature and pressure with selected drives timed at two intermediate reactor pressures ~~and for different accumulator pressures~~. Both control rod sequences are further investigated in order to obtain rod pattern versus temperature relationships. The process computer checkout continues as more process variables become available for input. The reactor core isolation cooling RCIC systems will undergo controlled starts at low reactor pressure and at rated conditions followed by [redacted] testing in the quick-start mode. [redacted] Correlations are obtained between reactor vessel temperatures at several locations and the values of other process variables as heatup continues. The movements of nuclear steam supply [redacted] system (NSSS) piping in the drywell, mainly as a function of expansion, are recorded for comparison with design data. An intermediate range monitor (IRM) and average power range monitor (APRM) calibration is made using coolant temperature rise data during nuclear heatup.

14.2.10.3 Power Testing From 25% to 100% of Rated Output

The power test phase comprises the following tests, many of which are repeated several times at the different test levels; consequently, reference should be made to Table 14.2-3 for the probable order of execution for the full series. While a certain basic order of testing is maintained relative to power ascension, there is, nevertheless, flexibility in the test sequence at a particular power level whenever it becomes operationally expedient. In no instance, however, is nuclear safety compromised.

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14.2.10.3 Power Testing From 25% to 100% of Rated Output (Continued)

(1) Coolant chemistry tests and radiation surveys are made at each principal test level in order to preserve a safe and efficient power increase.

(2) Selected CRDs are scram-timed at various power levels to provide correlation with the initial data.

(3) The effect of control rod movement on other parameters (e.g., electrical output, steam flow, and neutron flux level) is examined for different power conditions.

(4) Following the first reasonably-accurate heat balance (25% power) the IRMs are reset.

(5) At each major power level (25%, 60%, and 100%), the local power range monitors (LPRM) are calibrated.

(6) The APRMs are calibrated initially at each new power level and following LPRM calibration.

(7) Completion of the process computer checkout is made for all variables, and the various options are compared with hand calculations as soon as significant power levels are available.

(8) Further tests of the RCIC are made with and without injection into the reactor pressure vessel (RPV).

(9) Collection of data from the system expansion tests is completed for those piping systems which had not previously reached full operating temperatures.

14.2.10.3 Power Testing From 25% to 100% of Rated Output (Continued)

(10) The axial and radial power profiles are explored fully by means of the traversing in-core probe (TIP) system at representative power levels during the power ascension.

(11) Core performance evaluations are made at all test points above the 10% power level and for selected flow transient conditions; the work involves the determination of core thermal power, maximum fuel-rod-surface-heat flux, the minimum critical power ratio (MCPR), and other thermal parameters.

(12) Overall plant stability in relation to minor perturbations is shown by the following group of tests which are made at all test points:

a. core power-void mode response;
b. pressure regulator setpoint change;
c. water level setpoint change;
d. bypass valve opening; and
e. recirculation flow setpoint change.

For the first of these tests, a centrally located control rod is moved and the flux response is noted on a selected LPRM chamber. The next two tests require that the changes made should approximate as closely as possible a step change in demand; while, for the next test, the bypass valve is opened quickly. The remaining test is performed to properly adjust the control loop of the recirculation system. For all of these tests, the plant performance is monitored by recording the transient behavior of numerous process variables, neutron flux being of principal interest. Other imposed transients

14.2.10.3 Power Testing From 25% to 100% of Rated Output (Continued)

are produced by step changes in demanded core flow, ~~simulating~~ loss of a feedwater heater and ~~simulating~~ failure of the operating pressure regulator to permit takeover by the backup regulator. Table 14.2-4 indicates the power and flow levels at which all these stability tests are performed.

Right number needed

(13) The category of major plant transients includes full closure of all the main steam isolation valves, fast closure of turbine-generator control valves, fast closure of turbine-generator stop valves, loss of the main generator and offsite power, tripping a feedwater pump and several trips of the recirculation pumps. The plant transient behavior is recorded for each test and the results may be compared with the acceptance criteria and the predicted design performance. Table 14.2-2 shows the operating test conditions for all the proposed major transients.

(14) A test is made of the relief valves in which leaktightness and general operability are demonstrated.

(15) At near rated core flow, ~~all major power levels~~ the jet pump flow instrumentation is calibrated.

(16) The as-built characteristics of the recirculation system are investigated as soon as operating conditions permit full core flow.

(17) The local control loop performance, based on the drive pump, jet pumps, and control equipment is checked.

~~Test addition for 640.06~~

14.2.11 Test Program Schedule

Applicant will supply.

14.2.12 Individual Test Descriptions

To insure that the tests are conducted in accordance with established acceptance criteria, the Applicant will make the plant startup test specification available to the NRC site inspector.

14.2.12.1 Preoperational Test Procedures

14.07 14.02

The following general descriptions are the specific objectives of each preoperational test. During the final construction phase, it may be necessary to modify the preoperational test methods as operating and preoperational test procedures are developed. Consequently, methods in the following descriptions are general, not specific.

Specific acceptance criteria for each preoperational test are in accordance with the detailed system and equipment specifications for equipment in those systems. The tests demonstrate that the installed equipment and systems perform within the limits of these specifications.

Table 14.2-1 lists the preoperational tests anticipated for this facility. 14.42

Applicant will supply balance-of-plant tests listed in Table 14.2-1. 14.42

14.2.12.1.1 Feedwater Control System Preoperational Test

(1) Purpose

Verify proper operation of the feedwater level control system.

14.2.12.1.1 Feedwater Control System Preoperational Test (Continued)

(2) Prerequisites

The construction tests have been completed and the Startup Coordinating Group (SCG) has reviewed and approved the test procedure and the initiation of testing. Reactor feedwater pump driver control system preoperational test (Subsection 14.2.12.1.3) must be completed. The instrument air system must be available and all feedwater control systems should have an initial calibration in accordance with vendor instructions.

(3) General Test Methods and Acceptance Criteria

Feedwater control system capability is verified by the integrated operation of the following:

a. reactor feed pump (RFP) speed regulation motor and control unit;

b. startup (low flow) valve;

c. feedwater system control response and interlocks; and

d. annunciators.

14.2.12.1.2 Reactor Feedwater System Preoperational Test

Applicant will supply.

14.2.12.1.3 Reactor Feedwater Pump Driver Control System Preoperational Test

Applicant will supply - agreement with Subsection 14.2.12.1.1.

14.2.12.1.4 Reactor Water Cleanup System Preoperational Test

(1) Purpose

Verify the operation of the reactor water cleanup system (RWCS), including pumps, valves, and filter/demineralizer equipment.

(2) Prerequisites

The construction tests have been completed and the SCG has reviewed and approved the test procedure and the initiation of testing. Filter aid and both anion and cation resin should be available. Reactor Building Closed Cooling Water (RBCCW) System and Instrument Air System must have readiness verification.

(3) General Test Methods and Acceptance Criteria

RWCS capability is verified by the integrated operation of the following:

(a) drain flow regulator flow interlocks;

(b) system isolation and logic;

(c) valve-operating sequence;

(d) pump operation (including required head and flow verification) and related control and logic;

Text additions for 640.09 a, b, c, d

14.2.12.1.4 Reactor Water Cleanup System Preoperational Test (Continued)

(e) annunciators; and

(f) filter/demineralizer system operation.

14.2.12.1.5 Standby Liquid Control System Preoperational Test

(1) Purpose

Verify the operation of the Standby Liquid Control (SLC) System including pumps, tanks, control, logic, and instrumentation.

(2) Prerequisites

The construction tests have been completed and the SCG has reviewed and approved the test procedure and the initiation of testing. Valves should be previously bench tested and other precautions relative to positive displacement pumps taken. The reactor vessel should be available for injecting demineralized water.

(3) General Test Methods and Acceptance Criteria

SLC System capability is verified by the integrated operation of the following:

(a) SLC System tank level instrumentation;
(b) heaters;
(c) alarms and logic;
(d) relief valves;
(e) pumps and related controls and logic; ~~and~~
640.09 c&d → (f) flow testing, ~~with different flow paths;~~ in all modes listed in Table 9.3-8;
640.09 a → (g) verification of proper mixing of the neutron absorber solution; and
640.09 b → (h) test firings of the explosive-actuated injection valves

14.10

14.2.12.1.4 Reactor Water Cleanup System Preoperational Test (Continued)

(e) annunciators; and

(f) filter/demineralizer system operation.

14.2.12.1.5 Standby Liquid Control System Preoperational Test

(1) Purpose

Verify the operation of the Standby Liquid Control (SLC) System including pumps, tanks, control, logic, and instrumentation.

(2) Prerequisites

The construction tests have been completed and the SCG has reviewed and approved the test procedure and the initiation of testing. Valves should be previously bench tested and other precautions relative to positive displacement pumps taken The reactor vessel should be available for injecting demineralized water.

(3) General Test Methods and Acceptance Criteria

SLC System capability is verified by the integrated operation of the following:

(a) SLC System tank level instrumentation;
(b) heaters;
(c) alarms and logic;
(d) relief valves;
(e) pumps and related controls and logic; and
(f) flow testing with different flow paths.

14.2.12.1.6 Nuclear Boiler System Preoperational Test

(1) Purpose

Verify proper operation of the nuclear boiler system, including main steam isolation valves (MSIV), safety/relief valves (SRV), and related controls and logic. (MSIV leakage is measured in the containment integrated leak rate test.)

(2) Prerequisites

The construction tests have been completed and the SCG has reviewed and approved the test procedure and the initiation of testing. Verify that all safety/relief valves have been previously bench tested.

(3) General Test Methods and Acceptance Criteria

Functional and capacity tests of safety/relief valves are not performed. The Nuclear Steam Supply System capability is verified by the integrated operation of the following:

(a) system valves and related sensors and logic;

(b) main steam isolation valves;

(c) vacuum breaker in relief valve discharge lines;

(d) automatic isolation function of MSIV, main steam line drain valves, and reactor water sample isolation valves. (MSIV and other valve closing times shall be similarly demonstrated);

Text change for 640.40

14.2.12.1.6 Nuclear Boiler System Preoperational Test (Continued)

(e) isolation and leak detection systems;

(f) automatic depressurization system logic;

(g) SRV and MSIV actuators accumulator capacity test;

(h) safety/relief valves air piston operation;

(i) reactor head seal leak detection; and

(j) alarms and annunciators.

(k) water level instrumentation and system operation will be tested and verified using simulated signals and by variations in actual vessel level.

14.2.12.1.7 Residual Heat Removal System Preoperational Test

(1) Purpose

Verify the operation of the residual heat removal (RHR) system under its various modes of operation: low pressure coolant injection (LPCI), shutdown cooling and vessel head spray, containment spray, suppression pool water cooling, and steam condensing.

(2) Prerequisites

The construction tests have been completed and the SCG has reviewed and approved the test procedure and the initiation of testing. The RHR service water system must have readiness verification. The reactor vessel and recirculation loops shall be intact and capable of receiving water.

Test additions for BAP-19

14.2.12.1.7 Residual Heat Removal System Preoperational Test (Continued)

(3) General Test Methods and Acceptance Criteria

RHR system capability is verified demonstrated by the integrated operation of the following:

(a) system isolation valve control and logic tests;

(b) RHR and RHR service water pump and motor operation, controls, and related logic features;

(c) automatic LPCI initiation logic;

(d) verification of all flow paths (the time from initiation signal to full flow should be similarly verified); and

(e) alarms and annunciators.

Refer to section 5.4.7.4 for additional information

14.2.12.1.8 Reactor Core Isolation Cooling System Preoperational Test

(1) Purpose

Verify the operation of the Reactor Core Isolation Cooling (RCIC) System including turbine, pump, valves, instrumentation, and control.

(2) Prerequisites

The construction tests have been completed and the SCG has reviewed and approved the test procedure and the initiation of testing. The turbine, disconnected from the pump, shall be tested. The turbine instruction

14.2.12.1.8 Reactor Core Isolation Cooling System Preoperational Test (Continued)

manual shall be reviewed in detail in order that precautions relative to turbine operation are followed. Then the system shall be tested within the capability of a temporary steam supply with the pump coupled to the turbine.

(3) General Test Methods and Acceptance Criteria

RCIC system capability is verified by the integrated operation of the following:

(a) all valves and related controls, interlocks, and indicators;

(b) manual and automatic initiation;

(c) automatic isolation, including leak detection system logic;

(d) turbine speed control, trip, mode selection, and test mode;

(e) barometric condenser condensate pump and vacuum pump controls;

(f) flow path verification; ~~and~~

(g) annunciators.

(h) The ability of the RCIC system to start without the aid of AC power with the exception of the RCIC DC/AC inverters will be verified;

(i) Operation of RCIC beyond its design basis will be evaluated during system operation with extended loss of AC power to it and support systems with the exception of the RCIC DC/AC inverters; and

(j) proper operation of RCIC DC components when the non-RCIC station batteries are disconnected will be verified.

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14.2.12.1.9 Reactor Recirculation System and Control Preoperational Test

(1) Purpose

Verify the operation of the reactor recirculation system including pumps and their associated motors, valves, instrumentation, and controls. The rated conditions tests will be conducted during the startup testing program.

(2) Prerequisites

The construction tests have been completed and the SCG has reviewed and approved the test procedure and the initiation of testing. The RBCCW System must receive readiness verification. All required testing of equipment up to the operation of the recirculation pump has been completed including recirculation pump motor (uncoupled) and all control loops.

(3) General Test Methods and Acceptance Criteria

After prerequisite testing, system capability is verified by the integrated operation of the following at flow rates approaching rated volumetric flow:

(a) system valves;

(b) logic and interlocks;

(c) recirculation pumps, valves, and related controls and interlocks;

14.2.12.1.9 Reactor Recirculation System and Control Preoperational Test (Continued)

(d) annunciators; and

(e) vessel internals vibration confirmatory test in conjunction with recirculation system testing.

14.2.12.1.10 Rod Control and Information System Preoperational Test

(1) Purpose

Verify the operation of the rod control and information system including relays, control circuitry, switches and indicating lights, and control valves.

(2) Prerequisites

The construction tests have been completed and the SCG has reviewed and approved the test procedure and the initiation of testing. The control rod drive (CRD) pump will not be operational during this test.

(3) General Test Methods and Acceptance Criteria

Remote manual control system capability is verified by the integrated operation of the following:

(a) rod blocks, alarms, and interlocks for all modes of the reactor mode switch;

(b) rod position information system;

(c) rod drift alarm circuit; and

14.2.12.1.10 Rod Control and Information System Preoperational Test (Continued)

(d) rod directional control valve time sequence for insert and withdraw commands.

14.2.12.1.11 Control Rod Drive Hydraulic System Preoperational Test

(1) Purpose

Verify the operation of the CRD hydraulic system, including CRD mechanisms, hydraulic control units, hydraulic power supply, instrumentation, and controls.

(2) Prerequisites

The construction tests have been completed and the SCG has reviewed and approved the test procedure and the initiation of testing. The CRD manual control system preoperational test must be completed on associated CRDs. The RBCCW System and instrument air system must receive readiness verification.

(3) General Test Methods and Acceptance Criteria

CRD System capability is verified by the integrated operation of the following:

(a) logic and interlocks;

(b) CRD pumps and related controls and interlocks;

(c) flow controller, pressure control valves, and stabilizer valves;

14.2.12.1.11 Control Rod Drive Hydraulic System Preoperational Test (Continued)

(d) scram discharge level switches, and CRD position indication, alarms, and interlocks;

(e) CRDs functional testing including latching and positioning indication;

(f) scram testing of control rods at atmospheric pressure; and

(g) annunciators.

14.2.12.1.12 Fuel-Handling and Vessel Servicing Equipment Preoperational Test

(1) Purpose

Verify the operation of the fuel-handling and vessel servicing equipment, including tools used in the servicing of control rods, fuel assemblies, local power range monitors (LPRM) and dry tubes, and vacuum cleaning equipment.

(2) Prerequisites

The construction tests have been completed and the SCG has reviewed and approved the test procedure and the initiation of testing. Additionally, the refueling platform, fuel preparation machine, and fuel racks must be installed and operational; all slings and lifting devices must be certified at their design load at least by the vendor.

Text addition for 640.11

14.2.12.1.12 Fuel-Handling and Vessel Servicing Equipment Preoperational Test (Continued)

(3) General Test Methods and Acceptance Criteria

The fuel-handling and vessel servicing equipment capability is verified by dry operation of the following equipment:

(a) cell disassembly tools;

(b) channel replacement tools;

(c) instrument handling tools;

(d) vacuum cleaning equipment;

(e) verification of interlocks and logic associated with the refueling and service platform; and

(f) verification of proper operation of refueling and service platforms. Dummy fuel bundle moves will be performed prior to actual fuel loading.

14.2.12.1.13 Low Pressure Core Spray System Preoperational Test

(1) Purpose

Verify the operation of the low pressure core spray system including spray pumps, sparger ring, spray nozzles, controls, valves, and instrumentation.

Text addition (continued) for 640.10

14.2.12.1.13 Low Pressure Core Spray System Preoperational Test (Continued)

(2) Prerequisites

The construction tests have been completed and the SCG has reviewed and approved the test procedure and the initiation of testing. The reactor vessel must be available and ready to receive water.

(3) General Test Methods and Acceptance Criteria

Low pressure core spray system capability is verified by the integrated operation of the following:

(a) logic and interlocks;

(b) low pressure core spray system pumps including auto initiation;

(c) flow path verification;

(d) annunciators;

(e) verification of the time for initiation signal to full flow; and

(f) ~~photographs to prove acceptability of core spray patterns.~~

¶ See Subsection 6.3.4.1 for additional information.

14.2.12.1.14 High Pressure Core Spray System Preoperational Test

(1) Purpose

Verify the operation of the high pressure core spray (HPCS) system including diesel generator and related

14.2.12.1.14 High Pressure Core Spray System Preoperational Test (Continued)

auxiliary equipment, pumps, valves, instrumentation, and control.

(2) Prerequisites

The construction tests have been completed and the SCG has reviewed and approved the test procedure and the initiation of testing. The HPCS diesel generator must be installed and be operational.

(3) General Test Methods and Acceptance Criteria

HPCS system capability is verified by the integrated operation of the following:

(a) valve controls and interlocks;

(b) HPCS electrical system tests including dc and ac;

(c) HPCS diesel generator functional tests, including starting, rated load, load rejection;

(d) pump and motor tests with normal power supply and with diesel generator;

(e) HPCS flow path and flow rate verification;

(f) annunciators;

(g) verification of the time from initiation signal to full flow; and

Text addition (continued) for 640.10

14.2.12.1.14 High Pressure Core Spray System Preoperational Test (Continued)

(h) photographs to prove acceptability of HPCS spray pattern.

14.2.12.1.15 Fuel Pool Cooling and Cleanup System Preoperational Test

(1) Purpose

Verify the operation of the fuel pool cooling and cleanup system including the pumps, heat exchangers, controls, valves, and instrumentation.

(2) Prerequisites

The construction tests have been completed and the SCG has reviewed and approved the test procedure and the initiation of testing. The instrument air, service air, fuel pool emergency makeup, service water, and RHR Systems must be available.

(3) General Test Methods and Acceptance Criteria

Fuel pool system capability is verified by the integrated operation of the following:

(a) logic and interlocks;
(b) interconnection to RHR system;
(c) pump and related controls;
(d) cleanup subsystem; and
(e) annunciators.

¶ See section 6.3.4.1 for additional information.

14.2.12.1.16 Leak Detection System Preoperational Test

(1) Purpose

Summarize the test requirements and verify the leak detection test data for each of the nuclear systems.

(2) Prerequisites

The prerequisites are included in the preoperational test specifications for each of the nuclear systems listed in paragraph (3).

(3) General Test Methods and Acceptance Criteria

As an integral part of each of the following system preoperational tests, the nuclear systems leak detection is verified by operation of the leak detection features of the following nuclear systems:

(a) feedwater control system;
(b) RWCS system;
(c) NSSS;
(d) RHR system;
(e) RCIC system;
(f) recirculation system; and
(g) radwaste system.

14.2.12.1.17 Liquid and Solid Radwaste Systems Preoperational Tests

14.2.12.1.17.1 Liquid Radwaste System

(1) Purpose

(a) Demonstrate the reliable operation of the liquid radwaste system and verify component interconnections and component operation.

(b) Verify that design flow rates through the system can be achieved.

(2) Prerequisites

The following general conditions should be considered:

(a) Construction tests are completed and approved.

(b) All instrumentation calibration sheets are completed and approved.

(c) The following support systems and/or equipment should be available:

1. demineralized water;

2. appropriate discharge path established for effluents;

3. instrument air;

4. service water;

Text changes for SAB.129

14.2.12.1.17.1 Liquid Radwaste System (Continued)

5. electrical power; and

6. laboratory facilities for water analysis.

The following safety precautions should be observed:

(a) Verify that all safety and construction tags have been removed from each portion of the system to be tested.

(b) Do not exceed maximum allowable flow rates through filters and demineralizers.

(c) Verify visually that system components, piping, and pipe hangers do not suffer excessive vibration or movements.

(d) Monitor tank levels to ensure that no tanks will overflow and that intended flow paths are correctly lined up.

(3) General Test Methods and Acceptance Criteria

(a) The system demonstration will verify flow capabilities, control and interlock operations, and overall system operation using demineralized water.

(b) System flow rates shall be within design tolerances.

(c) All interlocks and automatic operations shall function in accordance with design.

(d) All subsystem and/or component operations shall have been successfully demonstrated. P

14.13

 @ add attached

(d) The following subsystems and components shall be tested:

1. Valve tests including pneumatic controls, remote controls, position indication and leakage.
2. Pump Performance
3. Instruments and Controllers
4. Radwaste Filters
5. Radwaste Demineralizer
6. Phase Separators
7. Spent Resin Tank
8. High Conductivity Tank
9. Waste Evaporator

14.2.12.1.17.2 Solid Radwaste System

(1) Purpose

(a) Demonstrate the reliable operation of the solid radwaste system and verify component interconnections.

(b) Verify that design flow rates through the system can be achieved.

(2) Prerequisites

The following general conditions should be considered.

(a) Construction tests are completed and approved.

(b) All instrumentation calibration sheets are completed and approved.

(c) Section 1 of the liquid radwaste handling system preoperational test has been satisfactorily completed.

(d) The following support systems and/or equipment should be available:

1. demineralized water;
2. instrument air;
3. electrical power;
4. service air; and
5. service water.

14.2.12.1.17.2 Solid Radwaste System (Continued)

The following safety precautions should be observed:

(a) Verify that all safety and construction tags have been removed.

(b) Verify visually that system components, piping, and pipe hangers do not suffer excessive vibration or movements.

(c) Monitor tank levels to ensure that no tanks overflow and that intended flowpaths are correctly lined up.

(d) Under no circumstances should actual radioactive materials be used for test.

(3) Test Methods and Acceptance Criteria

(a) Operations will be conducted to verify operation of the spent resin transfer and handling portions of the system.

(b) Operations will be conducted to verify operation of the sludge handling portions of the system.

(c) The solid radwaste processing and drumming will be demonstrated during Steps (a) and (b). Additionally, concentrated waste processing will be demonstrated.

(d) Operations will be conducted to verify operation of the crane(s).

14.2.12.1.17.2 Solid Radwaste System (Continued)

(e) System flow rates and throughputs shall be within design tolerances.

(f) All interlocks and automatic operations functions shall be in accordance with design requirements.

(g) The proper performance of each system component listed in Subsection 11.4.2.2 will be verified. ~~All system components and operations shall be successfully demonstrated.~~ 14.13

(h) Crane location shall be accurate within the prescribed tolerance.

14.2.12.1.18 Reactor Protection System Preoperational Test

(1) Purpose

Verify the proper operation of the reactor protection system (RPS) including sensor logic and respective scram relays, scram reset time delay and the annunciators.

(2) Prerequisites

The construction tests have been completed and the SCG has reviewed and approved the test procedure and the initiation of testing. Additionally, the CRD hydraulic system test should have been completed.

(3) General Test Methods and Acceptance Criteria

RPS capability is verified by the integrated operation of the following.

~~Text addition for 640.13~~

14.2.12.1.18 Reactor Protection System Preoperational Test (Continued)

(a) sensor logic and scram relay logic;

(b) scram reset time delay;

(c) sensors relay-to-scram trip actuator response time;

(d) annunciators;

(e) mode switch tests; and

(f) auxiliary sensor operation.

(g) Response times for applicable logic channels from the process variable (with the exception of neutron sensors) to the de-energization of the Pilot Scram Valve Solenoids will be verified.

The ability of the system to scram the reactor within a specified time must be demonstrated in conjunction with the CRD hydraulic system preoperational test (Subsection 14.2.12.1.11).

14.2.12.1.19 Neutron Monitoring System Preoperational Test

(1) Purpose

Verify the operation of the Neutron Monitoring System (NMS) including startup, intermediate and power range detectors, and related equipment.

(2) Prerequisites

The construction tests have been completed and the SCG has reviewed and approved the test procedure and the initiation of testing. Additionally, all source range monitors (SRM) and pulse preamplifiers, intermediate

14.2.12.1.19 Neutron Monitoring System Preoperational Test (Continued)

range monitors (IRM) and voltage preamplifiers, and average power range monitors (APRM) will have been calibrated per vendor instructions.

(3) General Test Methods and Acceptance Criteria

NMS capability is verified by the integrated operation of the following:

(a) all SRM detectors, their respective insert and retract mechanisms, and cables;

(b) SRM channel including pulse preamp, remote meter and recorder, trip logic, logic bypass and related lamps and annunciators, control system interlocks, refueling instrument trips, and power supply;

(c) all IRM detectors and their respective insert and retract mechanisms and cables;

(d) IRM channels including voltage preamps, remote recorders, RC&IS interlocks, RPS trips, annunciators and lamps, and power supplies;

(e) all local power range monitor (LPRM) detectors, and their respective cables, and power supplies;

(f) all APRM channels including trips, trip bypasses, annunciators and lamps, remote recorders, RC&IS interlocks, RPS trips, and power supplies; and

14.2.12.1.19 Neutron Monitoring System Preoperational Test (Continued)

(g) recirculation flow bias signal including flow unit, flow transmitters, and related annunciators, interlocks, and power supplies.

14.2.12.1.20 Traversing In-Core Probe System Preoperational Test

(1) Purpose

Verify the operation of the traversing in-core probe (TIP) system including the TIP detector, controls and interlocks, containment secure lamp, and containment isolation circuits.

(2) Prerequisites

The construction tests have been completed and the SCG has reviewed and approved the test procedure and the initiation of testing. Additionally, the TIP detector and dummy detector, ball valve time delay, core top and bottom limits, clutch, X-Y recorder, and purge system will have been shown to be operational.

(3) General Test Methods and Acceptance Criteria

With the exception of the shear valve, which is not tested, TIP system capability is verified by the integrated operation of the following:

(a) indexer cross-calibration interlock;

(b) shear valve control monitor lamp; and

14.2.12.1.20 Traversing In-Core Probe System Preoperational Test (Continued)

(c) drive motor manual control and override, automatic control and stop, and low speed control.

14.2.12.1.21 Process Radiation Monitoring System Preoperational Test (NSSS portion)

(1) Purpose

Verify the operation of the process radiation monitoring (PRM) system including the offgas vent, offgas, main steamline, liquid process and effluent, containment ventilation and plant vent radiation monitoring subsystems.

(2) Prerequisites

The construction tests have been completed and the SCG has reviewed and approved the test procedure and the initiation of testing. Additionally, the process radiation monitors and pulse preamplifiers, power supplies, indicator and trip units, and sensors and converters are calibrated according to the vendor instruction manual; insulation resistance and high potentiometer tests will have been completed.

(3) General Test Methods and Acceptance Criteria

PRM system capability is verified by the integrated operation of the following:

(a) vent sensors, preamps, channels, trip points, annunciators and lamps, sample rack, and check source;

14.2.12.1.21 Process Radiation Monitoring System Preoperational Test (NSSS portion) (Continued)

(b) offgas vial sampler, log radiation monitor (LRM) and linear radiation monitoring channels and their related annunciators, lamps, and recorders, timer clutch and holdup valve, sample rack, and high/low flow detector;

(c) main steam gamma detector and LRM channels, trip points, annunciators and lamps, high-high and inop trip, and recorders;

(d) liquid process scintillation detector, preamps, channels, trip points, and annunciators and lamps, and recorders; and

(e) building ventilation system sensors, channels, trip points, and annunciators and lamps, recorders, and standby gas treatment interlock.

14.2.12.1.22 Area Radiation Monitoring System Preoperational Test

(1) Purpose

Verify the operation of the area radiation monitoring (ARM) system including sensors and channels, trip points, alarms, and recorder.

Text revision for 640.14

14.2.12.1.22 Area Radiation Monitoring System Preoperational Test (Continued)

(2) Prerequisites

The construction tests have been completed and the SCG has reviewed and approved the test procedure and the initiation of testing. Additionally, indicator and trip units, power supplies, and sensor/converters are calibrated according to the vendor instruction manual.

(3) General Te ethods and Acceptance Criteria

ARM system capability is verified by the integrated operation of the following:

(a) sensor/converter and associated channels;
(b) channel trip points;
(c) alarm annunciators and lights; and
(d) recorder.

14.2.12.1.23 Performance Monitoring System ~~Process Computer Interface System~~ Preoperational Test

14.15

(1) Purpose

Verify the operation of the Performance Monitoring ~~process computer interface (PCI)~~ System (PMS) including computer inputs and printout.

14.15

(2) Prerequisites

The construction tests have been completed and the SCG has reviewed and approved the test procedure and the initiation of testing. Additionally, computer diagnostic checks and programming are completed.

Test requirements (cont) for 640.14

14.2.12.1.23 Performance Monitoring ~~Process/Computer Interface~~ System Preoperational Test (Continued)

14.1

(3) General Test Methods and Acceptance Criteria

14.1

PMS ~~PCI system~~ capability is verified by operation of the following:

(a) analog input signals;
(b) computer printout;
(c) digital input signals; and
(d) digital output signals.

14.2.12.1.24 Rod Pattern Control System (RPCS) Preoperational Test

(1) Purpose

Verify the operation of the RPCS under its various modes of operation.

(2) Prerequisites

The construction tests have been completed and the SCG has reviewed and approved the test procedure and the initiation of testing. Additionally, the self-test feature of the RPCS is verified.

(3) General Test Methods and Acceptance Criteria

RPCS capability is verified by the proper computer initiation of the following:

(a) low-power setpoint and low-power alarm point tests;
(b) RPCS status displays and annunciators;
(c) reactor mode switch test;

14.2.12.1.24 Rod Pattern Control System (RPCS) Preoperational Test (Continued)

(d) system diagnostic and data quality tests;

(e) rod position data tests;

(f) single rod bypass provision;

(g) rod sequences tests; and

(h) rod group assignment.

14.2.12.1.25 Remote Shutdown Preoperational Test

(1) Purpose

Verify the feasibility and operability of the shutdown functions from the remote shutdown panel.

(2) Prerequisites

The construction tests have been completed and the SCG has reviewed and approved the test procedure and the initiation of testing. Additionally, the control power should be supplied to the remote shutdown panel and the independence of power supply voltage, and fuses should be verified.

(3) General Test Methods and Acceptance Criteria

Remote shutdown system operability is verified by the following tests:

(a) operation of all valves, controls, instruments, pumps, and flow paths on systems available from this panel; and

(b) transfer switch operation from the control room panels to the remote shutdown panel.

Text addition for 640.15

14.2.12.1.26 Offgas System Preoperational Test

(1) Purpose

Verify the operation of the offgas system including valves, recombiner, condensers, coolers, filters, and hydrogen analyzers.

(2) Prerequisites

The construction tests have been completed and the SCG has reviewed and approved the test procedure and the initiation of testing. Additionally, the instrument air system, electrical power, and cooling water should be operational.

(3) General Test Methods and Acceptance Criteria

Offgas system operability is verified by performing the following tests:

(a) valve operation including failsafe and isolation features;

(b) pump operation;

(c) level and temperature control and indication;

(d) recombiner and preheater;

(e) condenser, cooler, and moisture separator;

(f) gas dryer and cooler;

(g) filter efficiency; ~~and~~ 14.14

(h) hydrogen analyzer performance; and

(i) indication and annunciation. 14.14

Text addition for 490.16

14.2.12.1.27 Environs Radiation Monitoring System Preoperational Test

(1) Purpose
Verify the operation of the environs radiation monitoring system including sensors and channels, sampling pump, and filter equipment.

(2) Prerequisites
The construction tests have been completed and the SCG has reviewed and approved the test procedure and the initiation of testing. Additionally, indicator and trip units, power supplies, and sensor/converters are calibrated according to the vendor instruction manual.

(3) General Test Method and Acceptance Criteria
The environs radiation monitoring system capability is verified by the integrated operation of the following:

(a) trip point check;

(b) annunciation;

(c) recorder;

(d) channel calibration; ~~and~~

(e) sample equipment; and

(f) filter equipment.

14.17

14.2.12.1.28 Inclined Fuel Transfer System Preoperational Test

(1) Purpose

Verify the operation of inclined fuel transfer system, including the actual transfer of a dummy fuel assembly configuration.

14.2.12.1.28 Inclined Fuel Transfer System Preoperational Test (Continued)

(2) Prerequisites

The construction tests have been completed and the SCG has reviewed and approved the test procedure and the initiation of testing.

(3) General Test Methods and Acceptance Criteria

Operability of the inclined fuel transfer system is verified by performing the following tests:

(a) mechanical and electrical subsystem checkouts;

(b) containment isolation capability;

(c) leak testing of assembly penetration;

(d) fuel assembly transfer aspects; and

(e) failsafe system which precludes possibility of a person being in fuel transfer valve room during fuel transfer.

14.2.12.1.29 Upper Pool Storage System Preoperational Test

(1) Purpose

Verify the operation of the upper pool storage system, including the actual transfer of inventory fluid to the lower pool.

Text Change for GESSAR

14.2.12.1.29 Upper Pool Storage System Preoperational Test (Continued)

(2) Prerequisites

The construction tests have been completed and the SCG has reviewed and approved the test procedure and the initiation of testing.

(3) General Test Methods and Acceptance Criteria

Verification of the capability to transfer upper pool fluid to the lower pool at the flow desired.

The confirmatory internal vibration test is conducted in accordance with subsection 14.2.12.1.31.

14.2.12.1.30 Plant Process Sampling System (Radwaste) Preoperational Test

Applicant will supply.

14.2.12.1.31 Reactor Vessel Flow-Induced Vibration Preoperational Test 14.38

(1) Purpose

The reactor vessel flow-induced vibration test contains the engineering requirements for the preoperational vibration inspection and flow excitation of reactor internals. These requirements are intended to fulfill provisions of NRC Regulatory Guide 1.20 with respect to the vibration assessment of reactor intervals.

(2) Prerequisites

(a) Recirculation system preoperational testing shall be completed sufficiently to allow safe operation of the recirculation pumps at rated volumetric flow for extended operation.

14.2.12.1.31 Reactor Vessel Flow-Induced Vibration Preoperational Test (Continued)

(b) Capability to maintain the reactor water temperature equal to or greater than 150°F shall be provided throughout the duration of the flow test.

(c) Installation of the steam separator shall be accomplished, prior to RPV heatup, to ensure that a minimum of 50°F delta temperature is achieved following shroud head bolt torquing.

(d) Capability to maintain the reactor vessel pressure equal to or greater than 100 psi above the saturation pressure of the RPV water shall be provided throughout the duration of the flow test.

(e) Capability to bypass the recirculation system cavitation interlock protection shall be provided.

(f) Reactor assembly must include all core support structures and components, jet pumps, spargers, shroud head, and reactor vessel head.

(g) Reactor assembly shall not include any temporary hardware devices, such as blade guides.

(h) Reactor control rod blades must be removed or positioned fully withdrawn in their guide tubes with drive motion valved out of service and hydraulic accumulators vented to atmosphere.

(i) In-core instruments, neutron sources, and fuel shall not be installed throughout the duration of the test.

14.2.12.1.31 Reactor Vessel Flow-Induced Vibration Preoperational Test (Continued)

(j) Reactor vessel surveillance program specimen holders and specimens shall be installed throughout the duration of the test.

(k) Verification of the reactor pressure vessel pretest cleanliness will be established.

(l) Manway access to the reactor vessel bottom head region will be closed using suitably sized steel plating with attached gasket facing and secured into position by a bolted compression beam on the reverse side of the manway access throughout the duration of the flow excitation test.

(m) Inspection of the reactor pressure vessel internals shall require close visual contact of selected areas of the internal structures and component parts. Optical aids such as binoculars, periscopes, and closed circuit TV may be used where access for close inspection is difficult.

(n) Verify that all field modifications required before preoperational testing on this system and interfacing systems and initiated through Field Deviation Disposition Requests (FDDR) and Field Disposition Instructions (FDI) have been implemented satisfactorily.

(o) Performance of the initial inspection shall be conducted upon the completion of the RPV work and just prior to the addition of water to the RPV for the support of the flow excitation testing. Postflow inspection shall be conducted as soon as the RPV

14.2.12.1.31 Reactor Vessel Flow-Induced Vibration Preoperational Test (Continued)

becomes available for entry and prior to the resumption of any RPV associated work. Each of these preflow and postflow inspections shall be performed by two engineers, at least one of which shall participate during inspections.

(3) General Test Methods and Acceptance Criteria

(a) Preflow Vessel Internal Inspection

The internal inspection of the vessel will be required before the recirculation system flow excitation testing. Parts of this preliminary inspection requirements may be met by normal visual fabrication inspection. This inspection will require draining of the RPV, flushing of the bottom head drain piping, installation of the shroud head, and access to the vessel lower plenum region.

Selected areas of the internal structures and component parts of the reactor pressure vessel requiring initial preflow inspection and status documentation are as follows:

1. peripheral control rod drive and in-core guide tubes, housings, and their lower joints;

2. peripheral in-core guide tube stabilizer connections and stabilizer bars;

3. plenum region for evidence of loose and/or failed parts;

14.2.12.1.31 Reactor Vessel Flow-Induced Vibration Preoperational Test (Continued)

4. inside surfaces of the jet pump adapter to shroud support welds and jet pump diffuser to jet pump adapter welds;

5. liquid control and delta pressure line and bracket welds;

6. shroud-to-shroud support welds;

7. jet pump instrument lines and brackets;

8. jet pump annulus for evidence of loose and/or failed parts;

9. jet pump beams, beam bolts, wedges, and locator screws;

10. jet pump riser braces and welds;

11. shroud head and shroud bolt lug welds;

12. shroud and shroud head flange locating pins for evidence of destructive motion marks other than those caused from normal installation;

13. core support plate bolt keepers;

14. steam separators and standpipes cross brackets and supports;

14.2.12.1.31 Reactor Vessel Flow-Induced Vibration Preoperational Test (Continued)

15. shroud head bolt-support ring, support ring brackets, and support welds;

16. feedwater sparger and attachments;

17. core spray lines, brackets, and core spray spargers;

18. reactor vessel surveillance program specimen holders, specimens, and mounting brackets;

19. core plate surface and annulus for loose and/or failed parts;

20. installation of each peripheral single-fuel support casting orifice for latch position and component seating; and

21. installation of each multi-fuel support casting for proper pin positioning and component seating to grid.

(b) Flow Testing

1. The Reactor Recirculation System shall be operated for compliance of the required flow volume and time duration following verification of completion of prerequisites, Para (2) and preflow vessel internal inspection, Para (3).

2. The Reactor Recirculation System shall be operated at rated volumetric core flow (nominal or indicated), two pumps with balanced flow, for a mininum of 35 hours.

14.2.12.1.31 Reactor Vessel Flow-Induced Vibration Preoperational Test (Continued)

3. Each reactor recirculation system loop shall be operated independently for a minimum of 14 hours. During the one-loop operation, the loop drive flow shall be the same as that required for balanced operation at rated volumetric flow, Para (2).

4. The flow testing sequence is not important and the necessary test time may be accumulated at any time between the preflow vessel internal inspection and the postflow vessel internal inspection. The total flow excitation test duration shall require a minimum of 63 hours.

(c) Postflow Vessel Internal Inspection

1. Following the completion of the required flow testing, Para (3)(b), the reactor recirculation pumps shall be shut down and the reactor pressure vessel depressurized.

2. Postflow vessel internal inspection may proceed with access into the RPV following RPV head removal and draining of the reactor water completely from the vessel.

   a. Shroud head shall remain in place until the shroud head bolt support ring brackets and supports have been inspected.

   b. Following removal of the shroud head from the RPV, the completion of the internal inspection will be conducted to include

14.2.12.1.31 Reactor Vessel Flow-Induced Vibration Preoperational Test (Continued)

the bottom head region below the lower core plate. All inspection points identified in the preflow vessel internal inspection, Para (3)(a), shall be reviewed for any evidence of defects, loose parts, or wear.

(d) Acceptance Criteria

1. Any evidence of defects, loose parts, or wear due to specified testing conditions, which are intended to produce vibration excitation comparable to or greater than that experienced in normal modes of reactor operation, shall be reported to GE Operating Plant Engineering.

2. No extraneous material shall be permitted in the jet pump annulus or the plenum region below the lower core plate as a result of the specified flow testing. Accumulation of such materials shall be identified for source location and reported to GE Operating Plant Engineering.

3. A copy of the inspection record shall be provided to GE Operating Plant Engineering. In the event resolution of a discrepancy is required for conditions found following the specified flow testing, GE Operating Plant Engineering shall provide this support.

14.2.12.1.31 Reactor Vessel Flow-Induced Vibration Preoperational Test (Continued)

4. **A minimum accumulation of 35 hours of rated volumetric core flow with two recirculation pumps of balanced flows is required.**

5. **A minimum accumulation of 14 hours of single-loop operation to each individual recirculation loop with the drive flow the same as that required for balanced loop flow at rated volumetric core flow is required.**

14.2.12.1.32 Air Positive Seal (APS) System Preoperational Test

(1) Purpose

Verify the ability of the APS system to supply the design quantities of air at the design pressure for sealing and preventing release of fission products from primary containment to the environment.

(2) Prerequisites

The construction tests have been completed and the Startup Coordinating Group has reviewed and approved the test procedure, schedule, staffing, and plant condition. The following support systems must be available:

(a) electrical power;
(b) condensate;
(c) emergency service water (ESW); and
(d) normal and clean radioactive waste (CRW) drains.

14.2.12.1.32 Air Positive Seal (APS) System Preoperational Test (Continued)

(3) Test Methods and Acceptance Criteria

(a) System component checkout shall be made.

(b) Any temporary instruments needed for safe testing and adequate records shall be installed.

(c) Set ESW and condensate flow rates to post LOCA conditions. Operate compressors to show that cooling requirements are satisfied.

(d) Record time for each compressor to fill the receiver while the receiver leakage is 23 scfm.

(e) Conduct system tests by tripping the automatic controls. Test all safety interlocks.

(f) System flow rates and pressures shall meet design requirements. Interlocks and automatic features shall function according to design. All components shall be successfully tested.

14.2.12.1.33 Cask Decontamination System Preoperational Test

(1) Purpose

Verify the operation of the cask decontamination system in two modes: automatic spray or hand cleaning. Test interfaces with other systems.

14.2.12.1.33 Cask Decontamination System Preoperational Test (Continued)

(2) Prerequisites

The construction tests have been completed and the SCG has reviewed and approved the test procedure schedule, staffing, and plant condition. The following systems must be operational and available.

(a) condensate;
(b) radwaste;
(c) service air;
(d) floor drains;

(3) Test Methods and Acceptance Criteria

(a) Start the decontamination high-pressure pump, vent the discharge pipe, the relief valve will now open. When the decontamination holding tank reaches low level, the low-suction pressure alarm should sound. Shut down the pump.

(b) Refill the holding tank with condensate and open the spray valves and vent valve P48-FF032. Start the decontamination high-pressure pump and booster pump. Close vent valve P48-FF032 and test the automatic spray system.

(c) Test the hand-held lance. As a safety measure, have a standby operator present during this test.

(d) Repeat tests b and c using condensate directly from its supply header.

(e) Repeat tests b and c using demineralized water.

14.2.12.1.33 Cask Decontamination System Preoperational Test (Continued)

(f) Test the transfer pump by pumping water to the dirty radwaste system.

(g) The system is acceptable if all design flows and pressures are met, the automatic spray traverses the full length of track, and all instruments function according to design.

14.2.12.1.34 Reactor Island Chilled Water System Preoperational Test

(1) Purpose

Verify the capability of the Reactor Island nonessential chilled water system to supply design quantities of chilled water at design temperature to air conditioning cooling coils located in the Reactor Building, Auxiliary Building, Fuel Building, and Radwaste Building. The automatic features of the system which are essential shall be tested.

(2) Prerequisites

(a) The construction tests have been completed and the SCG has reviewed and approved the preoperational test procedures, schedule, staffing, and plant condition.

(b) The following systems shall be available.

1. demineralized water;
2. essential service water;
3. service air;
4. instrument air;

14.2.12.1.34 Reactor Island Chilled Water System Preoperational Test (Continued)

5. electrical power;
6. normal, DRW, and CRW drains; and
7. diesel generator heat exchangers.

(3) Test Methods and Acceptance Criteria

(a) Hydrostatic tests, flushing, and cleaning shall be done.

(b) System components shall be checked out.

(c) Temporary instruments, as needed, shall be installed.

(d) Fill the Condensate Cooling Water (CCW) System with demineralized water to correct operating levels, and vent air from all high points. Establish nitrogen blanket in CCW expansion tank at 12 psig. Check high-level, low-level, and low-pressure alarms.

(e) Start one pump and one heat exchanger. Set flow rates to all twelve services at design values. Measure heat load and temperatures.

(f) Conduct vibration tests according to Regulatory Guide 1.68.

(g) Check all instrumentation.

(h) Repeat Steps e, f, and g using the other pump and heat exchanger.

14.2.12.1.34 Reactor Island Chilled Water System Preoperational Test (Continued)

(i) The CCW System is acceptable if all design flows, temperatures, pressures, and heat loads are met and all instruments function according to design specifications.

14.2.12.1.35 Demineralized Water and Condensate Distribution System Preoperational Tests

(1) Purpose

Verify the ability of the demineralized water and condensate system to supply design-specified quantities of water to users. Certain portions of the system located in balance of plant (BOP) are not covered here for the BOP portion.

(2) Prerequisites

(a) The construction tests have been completed and the SCG has reviewed and approved the test procedure, schedule, staffing, and plant condition.

(b) The following systems must be available:

1. HPCS;
2. RWCU;
3. RCIC;
4. CRD;
5. DRW and CRW drains;
6. electrical power;
7. instrument air; and
8. service air.

~~Text modifications for 640.17~~

14.2.12.1.35 Demineralized Water and Condensate Distribution System Preoperational Test (Continued)

(c) It would be desirable to have other user systems available; however, they are not required because the design flow rate is set by the systems listed in Para (b).

(3) Test Methods and Acceptance Criteria

(a) Temporary instruments and devices shall be installed.

(b) Hydraulic tests, flushing, and cleaning shall be done.

(c) Be sure that backwash receiving tank G46-A003 is empty. Line out piping and start the condensate transfer pump. Measure the time to fill tank A003 (about 5 minutes). When the high-level alarm sounds, stop the pump.

(d) Test other parts of the system in a similar manner [Para (c)].

(e) Test fire hose connections for flow rate and pressure. The most remote connection of each branch shall be tested.

INSERT (f) THROUGH (i) ATTACHED.

(j) The system is acceptable when design flow rates and pressures are attained.

3.1.41

Insert after (e) on page 14.2-73

f. Line out demineralized water piping to Expansion Tanks P39-AA001, P44-AA001A&B and P42-AA001. Check total flow rate at BOP supply flow meter. Check pressure at supply line inlet to Auxiliary Building. The supply pressure should be 85 psig minimum at 160 gpm.

g. Line demineralized water piping to Radwaste Building general service outlets to give at least 124 gpm at the BOP supply meter. Check pressure at supply line inlet to Radwaste Building. The supply pressure should be 55 psig minimum at 124 gpm

h. Line condensate piping through HPCS Pump E22-C00[illegible] and Bypass Line 10" HPCS 6-EAB back to Condensate Storage Tank. Check flow at BOP supply meter. Check pressure at HPCS Pump suction. The supply pressure should be 7 psig minimum at 7800 gpm. Shut off HPCS pump.

Start HPCS pump.

(i) Check all isolation valves by closing and opening using normal control instrumentation. During closing tests, check all closing times. See Table 6.2-25 for maximum closing times.

~~640.18~~

Text revision for 640.18

14.2.12.1.36 Clean and Dirty Radwaste Drains Preoperational Tests

(1) Purpose

Verify the ability of the CRW and DRW drains to collect and dispatch waste streams to appropriate processing facilities.

(2) Prerequisites

(a) The construction tests have been completed and the SCG has reviewed and approved the test procedure, schedule, staffing, and plant condition.

(b) The following systems must be available:

1. radwaste;
2. condensate;
3. electrical power; and
4. instrument air.

(3) Test Methods and Acceptance Criteria

(a) Temporary instruments needed for safe and adequate testing shall be installed.

(b) System components such as pumps and valves shall be checked out.

(c) Each sump is to be individually tested as follows:

1. Apply design flow to each drain, one at a time, to verify that the water drains properly. VERIFY THAT EACH DRAIN FLOWS TO THE CORRECT SUMP, AS SHOWN ON FIGURES 11.2-3 ~~a&c~~ through C AND 11.2-4 ~~a&c~~ through C.

14.2.12.1.36 Clean and Dirty Radwaste Drains Preoperational Tests (Continued)

2. Check each sump pump for starting, pumping, and stopping correctly. Adjust level controllers if necessary. ~~Exceed~~ Excessive pump noise or vibration shall be corrected.

3. Check instruments for proper operation.

(d) When testing the drywell sump T13-XX002, and the containment sump T13-XX004, route the water through the heat exchangers P55-BB001 and P55-BB002. At the same time, supply cooling water and record flows and pressure drops.

(e) The system is acceptable when design flow rates are attained and pumps start and stop at proper sump tank levels.

14.2.12.1.37 Detergent Drain System Preoperational Test

(1) Purpose

Verify the ability of the detergent drain system to collect wash water from the cask cleaning area and control rod drive maintenance area, then transport the wash water into sumps.

(2) Prerequisites

(a) The construction tests have been completed and the SCG has reviewed and approved the test procedure, schedule, staffing, and plant condition.

14.2.12.1.37 Detergent Drain System Preoperational Test (Continued)

(b) The following systems must be available:

1. instrument air;
2. electrical power;
3. cask decontamination;
4. condensate; and
5. demineralized water.

(3) Test Methods and Acceptance Criteria

(a) Install temporary instruments and equipment as needed.

(b) Check out system components.

(c) Fill the decontamination holding tank P48-AA002 with condensate. Continue condensate flow, allowing excess to overflow into the drain. Determine flow rate by manually gaging and timing the level rise of the cask cleaning area detergent drain sump.

(d) Check the high/low, start/stop action of sump pumps P56-CC018A and B by adjusting the flow rate of condensate.

(e) Test the CRD maintenance area detergent drain sump in a similar manner [Para (c) and (d)] using flush tank P65-AA001 as a source of drain water.

(f) The system shall be acceptable when all pumps meet the design flow rate, all instruments function, and all drains operate.

14.2.12.1.38 Essential Service Water System Preoperational Test

(1) Purpose

Verify the capability of the ESWS to supply the design quantities of cooling water to NI auxiliary equipment.

(2) Prerequisites

(a) The construction tests have been completed and the SCG has reviewed and approved the test procedure, schedule, staffing, and plant condition.

(b) The following systems must be available:

1. instrument air;
2. normal and DRW drains;
3. water from supply header 24 in. ESW1-ADC and 24 in. ESW41-ADC; and
4. electrical power.

(3) Test Methods and Acceptance Criteria

(a) Install temporary instruments and equipment as needed.

(b) Check out system components.

(c) Slowly fill the system with water, venting from high spots. Avoid water hammer damage by running only one service water pump.

(d) Test one division at a time by balancing the flow rate through each essential service at design values. In some cases the pressure drop is also

14.2.12.1.38 Essential Service Water System Preoperational Test (Continued)

set with balancing values. The total flow at BOP should equal 12,198 gpm for Division 1 and 12,109 gpm for Division 2. Only one service water pump should be running at this time. Measure individual flows and pressures.

(e) Shut off the RHR heat exchangers, then balance out the flow rates to all nonessential services. The total water flow at BOP should be 12,016 gpm for Division 1 and 12,012 gpm for Division 2. Measure individual flows and pressures.

(f) Start the flow through the RHR heat exchangers and start the second service water pump. The total water flow should be 19,316 gpm for Division 1 and 19,312 gpm for Division 2. Excess flows are acceptable. Measure individual flows and pressures.

(g) Conduct vibration tests per Regulatory Guide. 1.68.

(h) Check for leaks by comparing flows in and out of the system.

(i) The systems are acceptable when flows and pressure drops meet design values and all instruments function as designed.

14.2.12.1.39 Fire Alarm System Preoperational Test

(1) Purpose

Verify the capability of the fire alarm system to detect, alarm, and record the presence of combustion, smoke, or fire in the plant.

(2) Prerequisites

(a) The construction tests have been completed and the SCG has reviewed and approved the test procedures, schedule, staffing, and plant condition.

(b) The following systems must be available:

1. electrical power;
2. main control room annunciator;
3. performance monitor
4. carbon dioxide fire protection; and
5. DACOADA computer monitor.

(3) Test Methods and Acceptance Criteria

(a) Fire Department alarm contacts at the main control panel shall be tested and made ready for operation.

(b) Check out and adjust system components including alarms and battery system.

(c) Activate each fire detector per NFPA-76E or by using a smoke generator fueled by a sample of combustible material from that sub-zone. Verify the operation of the pertinent alarms and lights in the sub-zone, the satellite panel, and main panel.

14.2.12.1.39 Fire Alarm System Preoperational Test (Continued)

Verify the computer printout. Verify the alarm silencer. Verify the actuation of the contact used to transmit a signal to the local fire department. Verify the ring back alarms. Reset the alarm and verify its operation.

(d) Repeat the procedure in Para (c) for the manual fire alarm stations, checking to see that the satellite panel indicates a manual alarm.

(e) Simulate a power failure by tripping the breaker in each zone panel. Verify the action of all alarms and lights. Verify the computer printout.

(f) Test the circuits by tripping the breaker in the main fire alarm panel. Verify correct response.

(g) Test the standby power system by simulating a power failure per NFPA Code 72D, article 2036. Restore power and verify the resulting return-to-normal action.

(h) Test the CO_2 system by manual activation.

(i) The system is acceptable when all items perform as designed, the detector sensitivities meet UL-167 standards, and the system remains energized for 90 days without a false alarm.

14.2.12.1.40 Heated Water Distribution System Preoperational Test

(1) Purpose

Verify the ability of the heated water system to provide hot water to maintain design temperatures within the RI buildings.

(2) Prerequisites

(a) The construction tests have been completed and the SCG has reviewed and approved the test procedure, schedule, staffing, and plant condition.

(b) The following systems must be available:

1. heated water from BOP;
2. normal and CRW drains;
3. instrument air; and
4. electrical power.

(3) Test Methods and Acceptance Criteria

(a) Temporary instruments needed for safe and adequate testing shall be installed.

(b) System components shall be checked out.

(c) Close interface valves and line out valves within the system. Set the differential pressure between inlet and outlet headers to 40 psi.

(d) Start the heated water supply pump in BOP. Slowly fill the system with water. Check the temperature of the incoming water; its design value is 195°F.

14.2.12.1.40 Heated Water Distribution System Preoperational Test (Continued)

(e) Adjust the flows to individual units to design values. For lines having control valves, adjust the setpoint to open the valve fully, then adjust flow with the downstream valve. Do a similar action for 3-way valves so that the bypass is completely closed; then adjust flow through the unit with a downstream valve.

(f) Measure all flow rates and pressures.

(g) Attainment of design temperatures will be impractical for many of the units. Therefore, system acceptance is based upon conformance to flow requirements. When all flows meet design values, the system is acceptable.

14.2.12.1.41 HPCS Service Water System Preoperational Test

(1) Purpose

Verify the capability of the HPCS service water system (Division 3) to provide cooling requirements during LOPP and/or LOCA.

(2) Prerequisites

(a) The construction tests have been completed and the SCG has reviewed and approved the test procedures, schedule, staffing, and plant condition.

14.2.12.1.41 HPCS Service Water System Preoperational Test (Continued)

(b) The following systems must be available:

1. BOP service water;
2. DRW drain;
3. electrical power; and
4. diesel generator jacket water.

(3) Test Methods and Acceptance Criteria

(a) Temporary instruments and equipment needed for safe and adequate testing shall be installed.

(b) System components shall be checked out.

(c) Fill the system with service water, venting air and avoiding water hammer damage.

(d) Set discharge balancing valves about one-half open, inlet valves fully open, and then start the HPCS service water pump (in BOP).

(e) Using downstream balancing valves P40-FF002 and P40-FF007, set the flow rates at design values through the diesel generator jacket water cooler and the HPCS pump room cooler.

(f) Measure flow rates, temperatures, and pressures.

(g) Check for vibration per Regulatory Guide 1.68.

(h) The system is acceptable when specified flows, pressure drops, and heat loads are attained.

14.2.12.1.42 Instrument and Service Air Systems Preoperational Tests

(1) Purpose

Verify the ability of the instrument and service air systems to provide the design quantities of clean dry compressed air.

(2) Prerequisites

(a) The construction tests have been completed and the SCG has reviewed and approved the test procedure, schedule, staffing, and plant condition.

(b) Electrical power must be available.

(3) Test Methods and Acceptance Criteria

(a) Install temporary instruments and equipment as needed for safe and adequate testing.

(b) Check out and calibrate instruments.

(c) Check that the service air system provides design flow rates by opening general service connections, test connections, etc. Measure the pressure which must be 100 to 125 psig.

(d) Check for cleanliness by passing a stream of air through a filter cloth for ten minutes. The filter shall be a cotton fabric with 80 to 100 yarns per inch in both directions. The cloth must contain no organic or particulate matter.

14.2.12.1.42 Instrument and Service Air Systems Preoperational Test (Continued)

(e) Observe the service air for moisture. Moderate amounts of moisture are acceptable.

(f) Check the instrument air system by opening several service and test connections until design flow rate is obtained. Measure the pressure which must be 100 to 125 psig.

(g) Check instrument air for cleanliness as in Para (d).

(h) Using a portable hygrometer, check the dew point of the instrument air. The dew point must be below -40°F.

(i) The systems are acceptable when design flows and pressures are attained and moisture and cleanliness requirements are met.

14.2.12.1.43 Pneumatic Supply System Preoperational Test

(1) Purpose

Verify the capability of the pneumatic supply system to furnish design quantities of compressed air to user systems.

(2) Prerequisites

(a) The construction tests have been completed and the SCG has reviewed and approved the test procedure, schedule, staffing, and plant condition.

14.2.12.1.43 Pneumatic Supply System Preoperational Test (Continued)

(b) The following systems must be available:

1. CRW drain;
2. instrument air; and
3. electrical power.

(3) Test Methods and Acceptance Criteria

(a) Install temporary instruments and equipment as needed for safe and adequate testing.

(b) Check out system components.

(c) Test both Division 1 and Division 2 as described hereafter.

(d) Test compressor operation. It must start at 145 psig and stop at 165 psig. The accumulator recharging time must not exceed 40 minutes.

(e) Check for proper operation of all safety-related instrumentation in accordance with Regulatory Guide 1.80.

(f) Check the compressed air for cleanliness in accordance with Regulatory Guide 1.80.

(g) Simulate a LOCA signal and verify that all parts of the system respond according to design.

(h) Simulate low pressure by closing the compressor discharge valve and bleeding off air from the receiver. Note the pressure at which the emergency

14.2.12.1.43 Pneumatic Supply System Preoperational Test (Continued)

supply valves are actuated. Then close the bleed valve and make sure that the pressure does not exceed the design maximum.

(i) Simulate high temperature at the compressor outlet and verify that each compressor trips.

(j) Test for excess vibration per Regulatory Guide 1.68.

(k) Perform a loss-of-air test per Regulatory Guide 1.80.

(l) The system is acceptable when all flow rates, pressures, temperatures, and instrument functions reach design values.

14.2.12.1.44 Nuclear Island Process Radiation Monitoring System Preoperational Test

(1) Purpose

Verify the ability of the Nuclear Island process radiation monitoring system to indicate and alarm abnormal radiation levels and to initiate appropriate isolation and cleanup systems upon detection of high radiation levels.

(2) Prerequisites

(a) The construction tests have been completed and the SCG has reviewed and approved the test procedure, schedule, staffing, and plant condition.

14.2.12.1.44 Nuclear Island Process Radiation Monitoring System Preoperational Test (Continued)

(b) The following systems must be operational and available:

1. main control room annunciator;
2. Radwaste Building annunciator;
3. performance monitoring;
4. electrical power;
5. Standby Gas Treatment System (SGTS);
6. Fuel Building (FB) secondary containment HVAC isolation; and
7. Containment Building (CB) HVAC isolation.

(3) Test Methods and Acceptance Criteria

(a) Since radioactive isotopes will be used as check sources, proper safety precautions shall be followed in accordance with 10CFR30.

(b) Verify the calibration of each radiation detector using a standard radiation source according to specified procedures.

(c) Check each alarm circuit by manual actuation to simulate a high radiation alarm. Observe the resulting action of the associated circuits including the main control room annunciator windows, annunciator horn, and all applicable status lights.

(d) Verify each isolation circuit by manually tripping the appropriate switch. Observe the resulting action of the applicable isolation system.

14.2.12.1.44 Nuclear Island Process Radiation Monitoring System Preoperational Test (Continued)

(e) Check each circuit by manual action to simulate a low radiation alarm. Observe the resulting action of the process status light and the out-of-service annunciator.

(f) For each alarm actuation in Paras (d) and (e), check the operation of the performance monitoring system.

(g) The system is acceptable when all actions conform to specifications.

14.2.12.1.45 Suppression Pool Makeup System (SPMS) Preoperational Test

(1) Purpose

Verify the ability of the SPMS to supply the design quantities of makeup water from the upper containment pool to the suppression pool after a LOCA.

(2) Prerequisites

(a) The construction tests have been completed and the SCG has reviewed and approved the test procedure, schedule, staffing, and plant condition.

(b) The following systems must be operational and available:

1. electrical power,
2. instrument air,
3. condensate, and
4. DRW drain.

14.2.12.1.45 Suppression Pool Makeup System (SPMS) Preoperational Test (Continued)

(3) Test Methods and Acceptance Criteria

(a) Any temporary instruments and equipment needed for safe and adequate testing are to be installed.

(b) System components are to be checked out as follows:

1. manually open and close all valves, then leave in operating mode;

2. check and calibrate instruments;

3. check automatic circuits;

4. with valve mode switch in OFF position and reactor mode switch in NOT IN REFUEL position, test each valve via its radiation monitoring system (RMS) for OPEN and CLOSE (position lights must correctly indicate the valve position); and

5. Repeat step 4 with reactor mode switch in REFUEL position (inoperative valves indicate proper interlock).

(c) Set the suppression pool water level low enough to prevent added water from flowing over the weirwall. Then simulate a LOCA signal (one division at a time) and dump the upper pool manually. The dump time should be close to, but not longer than, 8.8 minutes. Adjust the dump time, if necessary, by changing the size of the restriction orifice.

14.2.12.1.45 Suppression Pool Makeup System (SPMS) Preoperational Test (Continued)

(d) Adjust levels, then simulate a LOCA while having a low-low level in the suppression pool. The SPMS valves must open automatically.

(e) Simulate a LOCA only and verify the time delay.

(f) The system is acceptable when all components, instruments, and interlocks perform according to design specifications.

14.2.12.1.46 Suppression Pool Temperature Monitoring System Preoperational Test

(1) Purpose

Verify the ability of the suppression pool temperature monitoring system to indicate, alarm, and record the suppression pool water temperature during normal and post-LOCA conditions.

(2) Prerequisites

(a) The construction tests have been completed and the SCG has reviewed and approved the test procedure, schedule, staffing, and plant condition.

(b) The following systems must be operational and available:

1. main control room annunciator;
2. performance monitoring computer;
3. electrical power;

14.2.12.1.46 Suppression Pool Temperature Monitoring System Preoperational Test (Continued)

4. condensate; and
5. DRW drain.

(3) Test Methods and Acceptance Criteria

(a) Check out system components.

(b) Fill the suppression pool to the post-LOCA minimum water level.

(c) Verify that the proper suppression pool water temperature is being indicated and recorded by all instruments.

(d) Check the alarm circuits by manually tripping the various alarm switches. Verify the resulting action of the control room status lights, annunciator window, horn, and performance monitoring system.

(e) The system is acceptable when all instruments, circuits, and alarms perform according to design specifications.

14.2.12.1.47 Water Positive Seal System Preoperational Test

(1) Purpose

Verify the ability of the water positive seal system (WPS) to supply design quantities of condensate water to the valve seats of containment isolation valves during post-LOCA conditions.

14.2.12.1.47 Water Positive Seal System Preoperational Test (Continued)

(2) Prerequisites

(a) The construction tests have been completed and the SCG has reviewed and approved the test procedure, schedule, staffing, and plant condition.

(b) The following systems must be operational and available:

1. electrical power;
2. condensate;
3. ESW;
4. air positive seal (APS);
5. normal, CRW, and DRW drains; and
6. containment isolation.

(3) Test Methods and Acceptance Criteria

(a) Any temporary instruments and equipment needed for safe and adequate testing will be installed.

(b) System component checkout shall be made including calibration of instruments.

(c) Fill the sealing water supply tank P60-AA001 to the proper level with condensate or ESW.

(d) Check to see that the Reactor Building fuel storage pool is filled with water to the proper level.

(e) Using the APS System, pressurize to 50 psig the sealing water supply tank P60-AA001.

14.2.12.1.47 Water Positive Seal System Preoperational Test (Continued)

(f) Test each motor-operated valve individually by opening it with its test switch. Observe the valve to see that it opens, then close it.

(g) Test the high flow alarms by opening each header drain valve one at a time.

(h) Test the level control of sealing tank P60-AA001 by draining water from it until the condensate supply valve P60-FF027 opens.

(i) Simulate a LOCA so that all isolation valves close. Then test the entire WPS system by activating both divisions. Verify that all motor-operated WPS valves open.

(j) The system is acceptable when all valves and instruments function according to design specifications.

14.2.12.1.48 CO_2 Fire Protection System Preoperational Test

(1) Purpose

Verify the ability of the CO_2 Fire Protection System to supply the design quantities of carbon dioxide to the diesel generator rooms and day tank vault in the event of fire.

(2) Prerequisites

(a) The construction tests have been completed and the SCG has reviewed and approved the test procedure, schedule, staffing, and plant condition.

14.2.12.1.48 CO_2 Fire Protection System Preoperational Test (Continued)

(b) The following systems must be operational and available:

1. electrical power;
2. carbon dioxide storage;
3. Diesel Generator Rooms and Switchgear Room HVAC; and
4. Diesel generator starting air.

(3) Test Methods and Acceptance Criteria

(a) Actuate the automatic CO_2 flooding system by providing two heat sources at cross zones. The Control Room will note high temperature within Diesel Generator Room and CO_2 flow into affected space. Verify time delay of 30 seconds between alarm and CO_2 flow.

(b) With the CO_2 supply block valve closed, activate the manual CO_2 discharge mode by the local keylock while the starting air compressors are in operation. The compressors will be deenergized and cannot be restarted with the trip signal present.

(c) Verify isolation of the Diesel Generator Room. Check that all H & V fans have stopped, and all louvers and dampers close on CO_2 system actuation.

(d) Check alarm circuits for visual and audible alarms, sound levels and time delay.

(e) Determine the CO_2 flow rates and concentration.

(f) The system is acceptable when all valves, instruments, circuits and alarms function according to design specifications.

14.2.12.1.49 Suppression Pool Cleanup Preoperational Test

(1) Purpose

Verify the system integrity of the Suppression Pool Cleanup (SPCU) System. The demineralizer's effectiveness in removing radioactive ions is not tested as this capability lies beyond the scope of a preoperational test.

(2) Prerequisites

(a) The construction tests have been completed and the SCG has reviewed and approved the test procedure, schedule, staffing, and plant condition.

(b) The following systems must be operational and available:

1. normal and DRW drains;
2. electrical power;
3. service and instrument air; and
4. spent resin storage tank.

(3) Test Methods and Acceptance Criteria

(a) Install any temporary instruments and equipment needed for safe and adequate testing.

(b) System component checkout shall be made including calibration of instruments.

(c) Maintain the suppression pool at the normal water level.

14.2.12.1.49 Suppression Pool Cleanup Preoperational Test (Continued)

(d) Assure a full complement of nuclear grade resin in the SPCU demineralizer. Verify valve operation and flow by simulating resin transfer.

(e) Check pump logic and performance per manufacturer's data. Verify automatic operation of the associated valve. Operate both pumps by simulating transient conditions and trip by simulating high conductivity, low suction pressure, high discharge temperature, LOCA, or manually initiated ECCS conditions.

(f) Test SPCU isolation valves' operation by simulating LOCA signal. Verify indication lights' signal in Control Room.

(g) The system is acceptable when all component equipment, valves, and instruments function according to design specifications.

14.2.12.1.50 Fire Protection Wet Standpipe Preoperational Test

(1) Purpose

Verify the ability of the Fire Protection Wet Standpipe System to supply fire protection water to all portions of the Nuclear Island.

(2) Prerequisites

(a) The construction tests have been completed and the SCG has received and approved the test procedure, schedule, staffing, and plant condition.

14.2.12.1.50 Fire Protection Wet Standpipe Preoperational Test (Continued)

(b) The following systems must be operational and available:

1. electrical power;
2. instrument air;
3. normal and DRW drains;
4. Radioactive Waste System;
5. Balance of Plant (BOP) portion of the Wet Standpipe Fire Protection System; and
6. Essential Service Water System (ESW).

(3) Test Methods and Acceptance Criteria

(a) Any temporary instruments and equipment needed for safe and adequate testing shall be installed.

(b) System component checkout shall be made including calibration of instruments.

(c) Check lineup from fire pumps through the Fuel Building interfaces. Evacuate air from lines and check static pressure.

(d) Check standpipe flow rates and verify alarm setpoints for sprinklers and hose reels by slowly increasing flow rates until switch actuation occurs.

(e) Check sprinkler flow rates and verify that alarm signal is received in the Control Room.

14.2.12.1.50 Fire Protection Wet Standpipe Preoperational Test (Continued)

(f) Test water sprays in the charcoal filter by the manual control switch. There shall be no filters installed at time of testing, and the interior surfaces must be thoroughly dried on conclusion of testing.

(g) Check standpipe flow rate with ESW supply only.

(h) The system is acceptable when all equipment, flows, and pressures perform to design requirements.

14.2.12.1.51 Drywell Chilled Water System Preoperational Test

(1) Purpose

Verify the ability of the Drywell Chilled Water Systems to apply the design quantities of chilled water at specified temperatures to various cooling coils.

(2) Prerequisites

(a) The construction tests have been completed and the SCG has reviewed and approved the test procedure, schedule, staffing, and plant condition.

(b) The following systems must be operational and available:

1. electrical power;
2. demineralized water;
3. Essential Service Water (ESW);
4. Service and instrument air;
5. normal and CRW drains;
6. Chiller Mechanical Room Cooling System; and
7. nitrogen supply.

14.2.12.1.51 Drywell Chilled Water System Preoperational Test (Continued)

(3) Test Methods and Acceptance Criteria

(a) Any temporary instruments and equipment needed for safe and adequate testing will be installed.

(b) System component checkout shall be made including calibration of instruments.

(c) Using the nitrogen supply, establish a 20 psig blanket within the Chilled Water Expansion Tank. Check the high, low, and abnormally low level set points and alarms. Verify that loss of level shuts down operating loop.

(d) Activate the chilled water circulation pump and chiller. Check operating performance.

(e) Test the low flow alarm by shutting down operating pump. Standby loop shall start up.

(f) Test the low flow control by adjusting the service water set point. The operating loop shall stop and the standby chiller and booster pump shall start automatically.

(g) Test the chill water low flow control by adjusting the set point. The operating loop shall start automatically.

(h) Test the return chill water high temperature by adjusting the set point. The alarm will actuate and the loop will shut down.

14.2.12.1.51 Drywell Chilled Water System Preoperational Test (Continued)

(i) Test the essential service water low flow by adjusting the set point. The operating chiller and circulating pump will shut down and the standby chiller loop will start up automatically.

(j) Test the drywell air low temperature by adjusting the set point of the air temperature controllers. A three-way valve will bypass chilled water from the chilled water pump to the return line.

(k) The system is acceptable when all valves, instruments, and alarms function according to design specifications.

14.2.12.1.52 Control Building Chilled Water Preoperational Test

(1) Purpose

Verify the ability of the Control Building Chilled Water System to supply the design quantities of chilled water at specified temperatures to various cooling coils.

(2) Prerequisites

(a) The construction tests have been completed and the SCG has reviewed and approved the test procedure, schedule, staffing, and plant condition.

(b) The following systems must be operational and available:

1. electrical power;
2. demineralized water;

14.2.12.1.52 Control Building Chilled Water Preoperational Test (Continued)

3. Essential Service Water (ESW);
4. service and instrument air;
5. normal and CRW drains;
6. Chiller Mechanical Room Cooling System; and
7. nitrogen supply.

(3) Test Methods and Acceptance Criteria

(a) Any temporary instruments and equipment needed for safe and adequate testing will be installed.

(b) System component checkout shall be made including calibration of instruments.

(c) Establish a 20 psig nitrogen gas blanket within the Chilled Water Expansion Tanks. Check the high, low, and abnormally low level set points and alarms.

(d) Activate the chilled water circulation pump. Check operating performance of both pumps. Verify that loss of level within the Chilled Water Expansion Tanks shuts down pumps.

(e) Activate chiller and check operating performance. Test low flow alarms of chilled water leaving evaporator or service water to condenser; either low flow shall automatically shut down operating chiller and start up the electric switchgear room standby air conditioner. Demonstrate both chillers may operate simultaneously.

14.2.12.1.52 Control Building Chilled Water Preoperational Test (Continued)

(f) Test the auto-start logic. When an operating chilled water pump is deenergized, the standby loop shall automatically energize. When the self-contained air conditioning unit fails, the alternate electric switchgear room chilled water air conditioning unit shall start up.

(g) Test standby loop actuation by adjusting the chilled water pump discharge temperature set point. On high temperature, both loops shall be operating.

(h) Test low flow control by throttling chilled water discharge from an operating pump. The operating loop shall stop and the standby loop shall start.

(i) The system is acceptable when all valves, instruments, pumps, chillers, and alarms function according to design specifications.

14.2.12.1.53 Polar Crane Preoperational Test

(1) Purpose

Verify the ability of the Polar Crane to safely manipulate the drywell head, vessel head, and steam dryer and separator.

(2) Prerequisites

(a) The construction tests have been completed and the SCG has reviewed and approved the test procedure, schedule, staffing, and plant condition.

14.2.12.1.53 Polar Crane Preoperational Test (Continued)

(b) The following systems must be operational and available:

1. electrical power;
2. area lighting; and
3. Reactor Building HVAC.

(3) Test Methods and Acceptance Criteria

(a) Any temporary instruments and equipment needed for safe and adequate testing will be installed.

(b) System component checkout shall be made including calibration of instruments.

(c) Test bridge travel through full circle clockwise and counterclockwise at up to maximum speed. Verify that the two hydraulic brakes perform at several speeds in both directions.

(d) Test trolley travel through entire range at up to maximum speed. Verify brake action at several speeds in both directions. Verify that limit switches prevent overtravel.

(e) Verify operation of limit switches on both main and auxiliary hoist to prevent overspeed and overtravel in either direction.

(f) Verify that the main and auxiliary hoist motors cannot both be energized at the same time.

(g) Confirm that both main and auxiliary hoists brakes are applied automatically upon power interruption or neutral position of controls.

CONTENTS (Continued)

TEXT change for 640.20

14.2.12.1.53 Polar Crane Preoperational Test (Continued)

(h) Check the load sensing instrumentation of the main hoist. Applying known loads, verify that both digital readouts display accurate weights. Verify hoist and alarm operation on high loads.

(i) APPLY A STATIC LOAD OF AT LEAST 125 PERCENT OF THE MAXIMUM OPERATING LOAD, AND HOLD FOR AT LEAST ONE HOUR. 14.21

(j) The system is acceptable when all controls, switches, and alarms function according to design specifications.

14.2.12.1.54 Heating, Ventilation, and Air Conditioning (HVAC) Systems Preoperational Test

See 14.2.12.1.54-1; 14.2.12.1.54-2; 14.2.12.1.54-3; 14.2.12.1.54-4; 14.2.12.54-5; 14.2.12.54.6; 14.2.12.1.54.7; 14.2.12.1.54-8; 14.2.12.1.54-9; attached 14.22

14.2.12.1.55 Electrical Systems Preoperational Tests

See 14.2.12.1.55 through 14.2.12.55.5 attached. 14.22

14.2.12.1.56 Seismic Monitoring System Preoperational Test

Applicant will supply.

~~14.2.12.1.57 RHR Complex Heating and Ventilation System Preoperational Test~~ Deleted 14.22

~~Applicant will supply.~~

14.2.12.1.58 RHR Service Water System Preoperational Test

Applicant will supply.

14.2.12.1.59 Condensate Makeup Demineralizer System Preoperational Test

Applicant will supply.

Text addition for 640.21

14.2.12.1.54 Heating, Ventilation, and Air Conditioning (HVAC) System Preoperational Test.

14.2.12.1.54.1

~~14.2.12.1 Control Building Heating Ventilating and Air Conditioning Systems Preoperational Test.~~

(1) Purpose

To verify the ability of the Control Building Heating Ventilating and Air Conditioning (HVAC) Systems to perform within design specifications.

(2) Prerequisites

(a) The construction tests and the balancing tests have been completed and the SCG has reviewed and approved the test procedures, schedule, staffing and plant conditions.

(b) The following systems must be available:

1. Instrument air.
2. Control building chilled water systems.
3. Preferred electric power source from the division 1 and 2 power distribution system.
4. Normal electric power.
5. Normal drains.

6. Performance monitoring system Computer.

7. Main control room annunciator system

8. Process radiation monitoring system.

(3) Test Methods and Acceptance Criteria

(a) Install temporary instruments and equipment as needed

(b) check out system components

(c) All dampers and valves shall be checked for operability from fully open to fully closed and left in their normal operating position. Verify the operation of dampers and valves by means of remote manual operators and position indicating lights in the main control room.

(d) All fans shall be checked for correct rotation.

(e) All filters shall be in a clean condition.

(f) All components of HVAC equipment controls and instruments shall be checked for completion of piping and wiring

(g) As each HVAC system is checked for compliance with design criteria, the associated instrumentation and control functions shall be tested. Although most testing of control operations and alarm monitoring are carried out in the main control room, all instrumentation including local indicating instruments, sensing elements and final control elements shall be functionally inspected at some time during the test procedure.

Instruments shall be adjusted and calibrated as required.

(h) The test requirements for the control building outdoor air cleanup system are detailed in section 6.5.1.4

(i) Start air conditioning unit X93-ACU01A. Verify fan X93-CC001A starts and inlet dampers X93-FF001A&B automatically open. The unit startup will automatically start both the control room exhaust/return fan X93-CC002A and control equipment room exhaust/return fan X93-CC004A. Verify inlet dampers X93-FF011A and FF012A automatically open. Assume the normal return dampers X93-FF007A and FF009A have automatically opened.

(j) Allow the system to stabilize then verify the following occurs to control air flow.

1. Electric heater X93-BB002A modulates air leaving air conditioning unit X93-ACU01A
2. Differential pressure indicating control switch dPICS-RR601A controls air leaving the control equipment room.
3. Differential pressure indicating control switch dPICS-RR602A controls air leaving the control room.

(k) Start the chiller room exhaust fan X93-CC007, area exhaust fan X93-CC005 and the control building chilled water unit P45-ZZ001. Verify exhaust dampers X93-FF014A&B are open.

(l) Upon completion of preoperational testing, all temporary equipment (piping supports, instruments, etc) shall be removed, and all systems returned to normal operating condition, or placed in lay-up condition, as appropriate.

14.2.12.1.54.2 Auxiliary Building ECCS Area Heating, Ventilating, and Air Conditioning Systems Preoperational Test.

(1) Purpose

To verify the ability of the the ECCS Area Heating, Ventilating and Air Conditioning system to perform within design specifications.

(2) Prerequisites

(a) The construction tests and the balancing test have been completed and the SCG has reviewed and approved the test procedures, schedule, staffing, and plant conditions.

(b) The following systems must be available:

1. Division 1, Division 2, and Division 3 electric power
2. Normal electric power.
3. Essential service water
4. HPCS service water
5. Drywell chilled water
6. Reactor Island chilled water
7. Heated water system
8. Process radiation monitoring system

9. Instrument air system

10. Drain systems

(3) Test Methods and Acceptance Criteria

(a) Install temporary instruments and equipment as required

(b) Check out system components

(c) All dampers and valves shall be checked for operability from fully open to fully closed ~~and left in~~ their normal operating position Verify the operation of dampers and valves by means of remote manual operators and position indicating lights in the main control room.

(d) All fans shall be checked for correct rotation.

(e) All filters shall be in a clean condition.

(f) All components of HVAC equipment controls and instruments shall be checked for completion of piping and wiring

(g) As each HVAC system is checked for compliance with design criteria, the associated instrumentation and control functions shall be tested. Although most testing of control operations and alarm monitoring are carried out in the main control room, all instrumentation including local indicating instruments, sensing elements and final control elements shall be functionally inspected at some time during the test procedure. Instruments shall be adjusted and calibrated as required.

(h) Verify that pressure control system maintains the ECCS area at the design negative pressure and temperature.

(i) Verify that the ECCS and the RWCU pump room coolers respond to automatic initation signal and maintain area temperatures

(j) Verify that the SGTS initation signal shuts down the pressure control system, starts the SGTS and changes the dampers and valve positions as required, and that the design negative pressure requirements are met.

(k) Upon completion of preoperational testing, all temporary equipment (piping supports, instruments, etc) shall be removed, and all systems returned to normal operating condition, or placed in lay-up condition, as appropriate.

14.2.12.1.54.3
Auxiliary Building Electrical Areas Heating, Ventilating and Air Conditioning Systems Preoperational Test.

(1) Purpose
To verify the ability of the Auxiliary Building Electrical Areas Heating, Ventilating and Air Conditioning Systems to perform within design specifications.

(2) Prerequisites
(a) The construction tests and the balancing tests have been completed and the SCG has reviewed and approved the test procedures, schedule, staffing and plant conditions.

(b) The following systems must be available:

1. Instrument air
2. Reactor island chilled water.
3. Reactor island heated water.
4. Essential service water.
5. Division 1 and 2 electrical power
6. Normal electrical power
7. Control building chilled water.
8. Drain systems

(3) Test Methods and Acceptance Criteria

(a) Install temporary instruments and equipment as required

(b) Check out system components

(c) All dampers and valves shall be checked for operability from fully open to fully closed and left in their normal operating position Verify the operation of dampers and valves by means of remote manual operators and position indicating lights [redacted] in the main control room. [redacted]

(d) All fans shall be checked for correct rotation.

(e) All filters shall be in a clean condition.

(f) All components of HVAC equipment controls and instruments shall checked for completion of piping and wiring

(g) As each HVAC system is checked for compliance with design criteria, the associated instrumentation and control functions shall be tested. Although most testing of control operations and alarm monitoring are carried out in the main control room, all instrumentation including local indicating instruments, sensing elements and final control elements shall be functionally inspected at some time during the test procedure. Instruments shall be adjusted and calibrated as required.

(h) Verify that the systems interlocks, trips and controls function within design requirements

(i) Verify that the standby Electric Switchgear Room Coolers start when the operating coolers are taken off the line.

(j) Verify that the standby battery rooms exhaust starts when the operating fans are taken off the line

(k) Verify that the standby steam tunnel cooling unit starts on area high temperature

(l) Verify that the non-safety grade corridor and elevator tower air conditioning units operate, and that the areas are maintained at a positive pressure

(m) Upon completion of preoperational testing, all temporary equipment (piping supports, instruments, etc) shall be removed, and all systems returned to normal operating condition, or placed in lay-up condition, as appropriate.

DATE BY

14.2.12.1.54.4 Containment Heating, Ventilating, Air Conditioning and Pressure Control System Preoperational Test

(1) Purpose
to verify the ability of the Contain Heating, Ventilating, Air Conditioning and Pressure Control System to perform within the design specifications.

(2) Prerequisite
(a) The construction Tests and the balancing tests have been completed and the SCG has reviewed and approved the test procedures, schedule, staffing, and plant conditions.

(b) The following systems must be available

1. Instrument air.
2. Reactor island chilled water system.
3. Heated water system
4. Normal electric power
5. Normal drains
6. Process radiation monitoring system

(3) Test Methods and Acceptance Criteria

(a) Install temporary instruments and equipments as needed

(b) check out system components

(c) All dampers and valves shall be checked for operability from fully open to fully closed and left in their normal operating position. Verify the operation of dampers and valves by means of remote manual operators and position indicating lights ~~have been previously checked~~ in the main control room. ~~[illegible]~~.

(d) All fans shall be checked for correct rotation.

(e) All filters shall be in a clean condition.

(f) All components of HVAC equipment controls and instruments shall ~~be~~ checked for completion of piping and wiring

(g) As each HVAC system is checked for compliance with design criteria, the associated instrumentation and control functions shall be tested. Although most testing of control operations and alarm monitoring are carried out in the main control room, all instrumentation including local indicating instruments, sensing elements and final control elements shall be functionally inspected at some time during the test procedure. Instruments shall be adjusted and calibrated as required.

(h) Verify that the systems interlocks, trips and controls function within design requirements

(i) Verify that the air conditioning system maintains the temperature within design requirements.

(j) Verify the the pressure Control system maintains the containment pressure within design requirements.

(k) Upon completion of preoperational testing, all temporary equipment (piping supports, instruments, etc) shall be removed, and all systems returned to normal operating condition, or placed in lay-up condition, as appropriate.

14.2.12.1.54.5 Drywell Cooling system Preoperational Test.

(1) Purpose

To verify the ability of the drywell cooling system to perform within design specifications

(2) Prerequisite

(a) The construction tests and the balancing tests have been complete and the SCG has reviewed and approved the test procedures, schedule, staffing, and plant conditions

(b) The following systems must be available

1. leak detection system.
2. Drywell chilled water system.
3. Division 1 and 2 electric power.
4. Normal electric power.

(3) Test Methods and Acceptance Criteria

(a) Install temporary instruments and equipment as required.

(b) Check out system components.

(c) All dampers and valves shall be checked for operability from fully open to fully closed and left in their normal operating positic Verify the operation of dampers and valves by means of remote manual operators and position indicating lights in the main control room.

(d) All fans shall be checked for correct rotation.

(e) All components of HVAC equipment controls and instruments sha: be checked for completion of piping and wiring.

(f) As each HVAC system is checked for compliance with design criteria, the associated instrumentation and control functions shall be tested. Although most testing of control operations and alarm monitoring are carried out in the main control room, all instrumentation including local indicating instruments, sensing elements and final control elements shall be functionally inspected at some time during the test procedure. Instruments shall be adjusted and calibrated as required.

(g) Verify that systems interlocks, trips and controls function within design requirement

(h) Verify that any four air handling units operating will maintain the drywell temperature within design requirements

(i) verify operation of units on application of N_1 and N_2 electric power to cooling system

(j) verify operation of controls to change drywell temperature

(k) Upon completion of preoperational testing all temporary equipment (piping, supports, instruments, etc.) shall be removed, and all systems returned to normal operating conditions, or placed in lay-up condition, as appropriate.

14.2.12.1.54.6
Fuel Building Heating, Ventilating and Air Conditioning Systems Preoperational Test.

(1) Purpose
To verify the ability of the Fuel Building Heating, Ventilating and Air Conditioning Systems to perform within design specifications.

(2) Prerequisites

(a) The construction tests and the balancing tests have been completed and the SCG has reviewed and approved the test procedures, schedule, staffing, and plant conditions.

(b) The following systems must be available:

1. Normal electric power.

2. Division 1 and Division 2 electric power.

3. Instrument air.

4. Process radiation monitoring system.

5. Essential service water

6. Reactor island non-essential chilled water

7. Heated water system

8. Standby gas treatment system

9. Shield annulus plant vent

10. Drain systems

(3) Test Methods and Acceptance Criteria

(a) Install temporary instruments and equipment as required.

(b) Check out system components.

(c) All dampers and valves shall be checked for operability from fully open to fully closed and left in their normal operating position. Verify the operation of dampers and valves by means of remote manual operators and position indicating lights in the main control room.

(d) All fans shall be checked for correct rotation.

(e) All filters shall be in a clean condition.

(f) All components of HVAC equipment controls and instruments shall be checked for completion of piping and wiring.

(g) As each HVAC system is checked for compliance with design criteria, the associated instrumentation and control functions shall be tested. Although most testing of control operations and alarm monitoring are carried out in the main control room, all instrumentation including local indicating instruments, sensing elements and final control elements shall be functionally inspected at some time during the test procedure. Instruments shall be adjusted and calibrated as required.

(h) Verify that each pressure control exhaust fan, operating fan X63-CC002A and standby fan X63-CC002B, maintains the design negative pressures within the fuel building.

(i) Verify that the main air conditioning units, X63-ACU01 and X63-ACU02, maintain the area temperatures at the design temperatures specified.

(j) Verify that each of the following individual room coolers maintains the room at the design temperature specified: MG set cooling unit

X63-ECU04A, MG set cooling unit X63-ECU04B, Division 1 Shield Annulus fan room cooling unit X63-ECU03A, Division 2 Shield Annulus fan room cooling unit X63-ECU03B, SGTS room cooling unit X63-ECU01A, SGTS room cooling unit X63-ECU01B, Division 1 FPCCU Pump area cooling unit X63-ECU02A, Division 2 FPCCU Pump area cooling unit X63-ECU02B, and Air Positive Seal Compressor cooling unit X63-ECU05.

(k) Verify that SGTS initiation signal shuts down the pressure control exhaust system and the main air conditioning units, starts the SGTS system, and changes the dampers and valves positions as required. Verify that the design negative pressure requirements for the Fuel building are met for these conditions.

(l) Upon completion of preoperational testing, all temporary equipment (piping supports, instruments, etc) shall be removed, and all systems returned to normal operating condition, or placed in lay-up condition, as appropriate.

14.2.12.1.54.7
Diesel Generator Buildings Heating and Ventilating Systems Preoperational Test.

(1) Purpose
To verify the ability of the Diesel Generator Buildings Heating and Ventilating Systems to perform within design specifications.

(2) Prerequisites

(a) The construction tests and the balancing tests have been completed and the SCG has reviewed and approved the test procedures, schedule, staffing, and plant conditions.

(b) The following systems must be available:

1. Normal electric power.

2. Division 1, Division 2, and Division 3 electric power.

3. Carbon Dioxide Fire Protection system.

(3) Test Methods and Acceptance Criteria

(a) Install temporary instruments and equipment as required.

(b) Check out system components.

(C) All dampers and valves shall be checked for operability from fully open to fully closed and left in their normal operating positio Verify the operation of dampers and valves by means of remote manual operators and position indicating lights in the main control room.

(d) All fans shall be checked for correct rotation.

(e) All filters shall be in a clean condition.

(f) All components of HVAC equipment controls and instruments shal be checked for completion of piping and wiring.

(g) As each HVAC system is checked for compliance with design criteria, the associated instrumentation and control functions shall be tested. Although most testing of control operations and alarm monitoring are carried out in the main control room, all instrumentation including local indicating instruments, sensing elements and final control elements shall be functionally inspected at some time during the test procedure. Instruments shall be adjusted and calibrated as required.

(h) Verify that all the supply, exhaust, recirculation, and fume control fans for the Division 1, 2, and 3 Diesel Generator Rooms are interlocked with the CO_2 Fire Protection system to shut down when their divisional CO_2 system is initiated.

(g) Verify the operation of the divisional supply and recirculating fans under the control of their respective temperature switches.
Verify the interlock of each of the two divisional supply fans with a respective exhaust fan for simultaneous operation.
Verify the interlock of the recirculation fan with its divisional diesel generator

(h) Verify that the heating and ventilating system, supply, recirculation, exhaust and fume control fans, for the Division 1, 2, and 3 Diesel Generator Rooms maintains the room temperature within the design range specified.

(i) Verify that the summer/winter and summer ventilation fans serving the switchgear room and the exhaust fans for the battery room operate when CO_2 system for Division 3 DG Room is initiated.
Verify that the weighted backdraft damper, releasing air from the switchgear room to the generator room, maintains the switchgear room at the design positive pressure when the battery room exhaust fan operates in conjunction with both ventilation fans, and also in conjunction with only the summer/winter ventilation fan.

(j) Verify the operation of the summer ventilation fan under the control of its temperature switch.

(k) Upon completion of preoperational testing, all temporary equipment (piping supports, instruments, etc) shall be removed, and all systems returned to normal operating condition, or placed in lay-up condition, as appropriate.

14.2.12.1.54.8
Shield Annulus Return/Exhaust System Preoperational Test.

(1) Purpose

To verify the ability of the Shield Annulus Return/Exhaust System to perform within design specifications.

(2) Prerequisites

(a) The construction tests and the balancing tests have been completed and the SCG has reviewed and approved the test procedures, schedule, staffing, and plant conditions.

(b) The following systems must be available:

1. Normal electric power.

2. Division 1 and Division 2 electric power.

3. Standby gas treatment system.

4. Process radiation monitoring system.

5. Instrument air

(3) Test Methods and Acceptance Criteria

(a) Install temporary instruments and equipment as required.

(b) Check out system components.

(c) All dampers and valves shall be checked for operability from fully open to fully closed and left in their normal operating positi Verify the operation of dampers and valves by means of remote manual operators and position indicating lights in the main control room.

(d) All fans shall be checked for correct rotation.

(e) All filters shall be in a clean condition.

(f) All components of HVAC equipment controls and instruments sha be checked for completion of piping and wiring.

(g) As each HVAC system is checked for compliance with design criteria, the associated instrumentation and control functions shall be tested. Although most testing of control operations and alarm monitoring are carried out in the main control room, all instrumentation including local indicating instruments, sensing elements and final control elements shall be functionally inspected at some time during the test procedure. Instruments shall be adjusted and calibrated as required.

(h) Verify that the operating fan, T41-CC004A, and the standby fan, T41-CC004B, can each maintain the annulus between the shield building and the containment at the design negative pressure specified Verify the modulation of the recirculating and exhaust dampers by the divisional pressure differential controllers to maintain the negative pressure setting. Verify the alarm operation for low differential pressure (high annulus pressure

(i) Verify the operation of the system on normal electric power and also on each divisional ESF electric power.

(j) Verify that an annulus high radiation signal, and also a LOCA signal

shuts the discharge dampers to the plant vent, opens fully the return/recirculating dampers to the annulus, starts the Standby Gas Treatment System, and opens the annulus shutoff valves to the SGTS.
Verify in addition to the above actions, that, when high radioactivity is detected from the shield annulus only, the pressure control of the SGTS is transferred from the controller set at (-) 2 inches WG to the controller set at (-) 6 inches WG.

(k) Verify that the operation of the flow switch in the discharge duct for each fan will automatically start the other (standby) fan upon indication of operating fan failure to provide the minimum required flow.

(l) Upon completion of preoperational testing, all temporary equipment (piping supports, instruments, etc) shall be removed, and all systems returned to normal operating condition, or placed in lay-up condition, as appropriate.

14.2.12.1.54.9 Radwaste Building Heating, Ventilating, and Air Conditioning Systems Preoperational Test.

(1) Purpose

To verify the ability of the Radwaste Building Heating, Ventilating, and Air Conditioning Systems to perform within design specifications.

(2) Prerequisites

(a) The construction tests and the balancing tests have been completed and the SCG has reviewed and approved the test procedures, schedule, staffing, and plant conditions.

(b) The following systems must be available:

1. Normal electric power.

2. Instrument air.

3. Process radiation monitoring system.

4. Essential service water.

5. Reactor island non-essential chilled water.

6. Heated water system.

7. Drain systems.

(3) Test Methods and Acceptance Criteria

(a) Install temporary instruments and equipment as required.

(b) Check out system components.

(c) All dampers and valves shall be checked for operability from fully open to fully closed and left in their normal operating position. Verify the operation of dampers and valves by means of remote manual operators and position indicating lights in the main control room.

(d) All fans shall be checked for correct rotation.

(e) All filters shall be in a clean condition.

(f) All components of HVAC equipment controls and instruments shall be checked for completion of piping and wiring.

(g) As each HVAC system is checked for compliance with design criteria, the associated instrumentation and control functions shall be tested. Although most testing of control operations and alarm monitoring are carried out in the main control room, all instrumentation including local indicating instruments, sensing elements and final control elements shall be functionally inspected at some time during the test procedure. Instruments shall be adjusted and calibrated as required.

(h) Verify that the air conditioning unit, V41-ACU02, and system serving the Radwaste control room and substation room, maintains the rooms at the design temperatures specified for the normal and off-normal modes of operation. Verify that the A/C unit and the system control dampers maintain the control room at the design positive pressure specified, with respect to the atmosphere, while in each mode of operation.

(i) Verify that the main air conditioning unit serving the remainder of the Radwaste Building, with operating supply fan V41-CC001A and standby supply fan V41-CC001B, maintains the zone temperatures within the design temperature ranges specified.

(i) Verify the interlock and operation of the exhaust fans with the supply fans, operating exhaust fan V41-CC002A and standby exhaust fan V41-CC002B.

(j) Verify that the zone differential pressure controllers modulate their respective control component, supply fan inlet vanes or supply duct modulating control damper, and that they maintain the design negative pressures as specified.

(k) Verify the operation of the filtration unit, with charcoal and HEPA filters and exhaust fan V41-CC005, for the silo, waste filter rooms, oil separator room and the mixing & filling station exhaust air.

(l) Verify that the radiation monitoring system closes the branch isolating dampers as required.

(m) Upon completion of preoperational testing, all temporary equipment (piping supports, instruments, etc) shall be removed, and all systems returned to normal operating condition, or placed in lay-up condition, as appropriate.

· 14.2.12.1.55 Electrical Systems Preoperational Tests

14.2.12.1.55.1 Class 1E 125 Volt D-C System Preoperational Test

(1) Purpose

To verify the capability of each divisional and non-divisional battery to supply its load demand without support of the chargers for a specified time without dropping below minimum battery and cell voltage. To verify the capability of both the normal and alternate battery chargers to restore the battery from the duty cycle discharge state to its fully charged state within an 8 hour period while supplying normal steady state loads. To verify that each Class 1E division's d-c bus can be energized independently of the other division's d-c bus. To verify that the undervoltage, overvoltage, and ground relays and associated alarms operate within the design specification. To verify dc to ac inverted operation and transfer to emergency dc lighting.

(2) Prerequisites

(a) The component testing procedures as required for this test are completed and the data has been reviewed.

(b) All the necessary permanently installed instrumentation properly calibrated and operable.

(c) All the necessary test instrumentation available and properly calibrated.

(d) Appropriate a-c and d-c power sources available.

(e) Fire Protection System is available.

(f) Switchgear and battery room ventilation available.

(g) DC to ac inverters available.

(h) All dc emergency lighting available.

(3) Methods and Acceptance Criteria

(a) Perform a service test by loading each battery with its battery duty cycle and without support of the battery charger, verify that the battery will deliver the design requirements of the d-c system for a specified time without dropping below minimum battery and cell voltage, and verify that the undervoltage relay and the associated alarm operate within the design specification.

(b) With the battery at the duty cycle discharge state, verify that the normal battery charger will fully charge the battery within an 8 hour period while supplying normal steady state load. Verify the tests in (a) and (b) for the alternate battery charger.

(c) Verify that the d-c system load is consistent with battery sizing assumptions.

(d) Demonstrate that each Class 1E division's d-c bus can be energized independently of the other division's d-c bus.

(e) Verify that the ground detection and its associated alarm operate within the design specification.

(f) Deomonstrate that the overvoltage relay and its associated alarm operate with the design specification without actually subjecting the bus to an overvoltage condition.

(g) Demonstrate inverter static transfer switch operation and the ability of the dc to ac inverter to supply normal load within design specification.

(h) Demonstrate that the 125VDC lighting and the self-contained dc lighting will be automatically switched on upon loss of ac power. Demonstrate that the dc self-contained lighting batteries have a minimum 8 hour capacity. Demonstrate the adequacy of lighting level for all emergency lighting.

14.2.12.1.55.2 Emergency AC Power Distribution System

(1) Purpose

To demonstrate electrical independence of the 3 divisional buses, correct power availability, feed isolation, regulation of regulating transformers, to test local and control room controls, bus transfer, load shedding and sequencing on class 1E buses, and standby lighting.

(2) Prerequisities

(a) Individual component tests and complete and have been approved.

(b) Instrument calibration is complete.

(c) The Fire Protection System is operable.

(d) Appropriate d-c sources available.

(e) The class 1E buses are energized.

(f) Switchgear and battery room ventilation available.

(g) Standby diesel generators and associated systems available.

(h) Diesel generator rooms ventilation system available.

(i) Essential service water available.

(3) Test Procedure

(a) Verify all divisional buses preenergized at correct voltages.

(b) Open one Division 1,6.9kv bus feed breaker, verify only associated bus is affected, alarms are correct, alternate feeder will energize bus (as appropriate), and feeders can not be tied (Repeat for Division 2).

(c) Verify trip and close paralleling interlocks.

(d) Verify system redundancy and electrical independence.

(e) Verify all load shedding and sequencing events for Division 1 and 2 buses as described in Section 8.3.1.1.7.

(f) Vary feed voltage to regulating transformers and verify load voltage is within limits for entire load range.

(g) Verify Motor Control Center Voltage.

(h) Test all local and control room controls associated with the tests above.

(i) Verify adequacy of standby lighting systems.

14.2.12.1.55.3 Standby Diesel Generator Preoperational Test

(1) Purpose

(a) To demonstrate the capability of the standby diesel generator power sources

(b) To provide assurance that the system is capable of providing emergency electrical power during normal and simulated accident conditions.

(c) To demonstrate the system's ability to pickup emergency loads during simulated accident conditions.

(d) To demonstrate the operability of the diesel generator auxiliary systems, e.g., diesel fuel oil transfer, diesel-generator starting air supply, jacket water, and lube oil.

(2) Prerequisites

(a) Individual component tests are complete and have been approved.

(b) Instrumentation available and properly calibrated.

(c) The following system and/or components are available:

1. Pneumatic sources.

2. Essential service water.

3. Electrical power, to motors, fans, etc.

4. Fire protection system in diesel generator building.

5. Diesel generator building ventilation.

6. D-c power source.

(d) Sufficient diesel fuel on site to perform test.

(3) Test methods and Acceptence Criteria.

(a) Demonstrate proper manual and automatic operation of the diesel generators and that they can start automatically upon simulated los of a-c voltage and attain the required frequency and voltage withir the specified limits.

(b) Demonstrate proper response and operation for design-basis accident loading sequence to design-basis load requirements, and verify that voltage and frequency are maintained within specified limits.

(c) Demonstrate proper operation of the diesel generator during load shedding, load sequencing, and load rejection. Include a test of the loss of the largest single load while maintaining voltage and frequency within design limits, and a test of the complete loss of load in which overspeed limits are not exceeded.

(d) Demonstrate that a LOCA or LOPP signal will block generator breaker or field tripping by all protective relays except for the generator differential and engine overspeed relays.

(e) Demonstrate that a LOCA signal will initiate termination of parallel operations (test or manual tranfer) and the diesel generator will continue to run unloaded and available.

(f) Demonstrate that the engine speed governor and the generator voltage regulator automatically return to an isochronous (constant speed) mode of operation upon initiation of a LOCA signal.

(g) Demonstrate full-load carrying capability of the diesel generators for a period of not less than 24 hours, of which 22 hours are at a load equivalent to the continuous rating of the diesel generator and 2 hours are at the DEMA STANDARD 2-hour load rating (110 percent of nameplate rating). Verify that the diesel cooling systems function within design limits, and the diesel generator HVAC system maintains the diesel generator room within design limits.

(h) Demonstrate functional capability at operating temperature conditions by reperforming "the automatic response" tests for 1 and 2 above immediately (within 5 minutes) after completion of the 24-hour load test per 4 above.

(i) Demonstrate the ability to:

1 Synchronize the diesel generators with offsite power while connected to the emergency load.

2 Transfer the load from the diesel generators to the offsite power.

3 Isolate the diesel generators and restore them to standby status.

(j) Demonstrate that the rate of fuel consumption while operating at the design-basis accident load is such that the requirements for 7-day storage inventory are met for each diesel generator.

(k) Verify all interlocks, controls, and alarms operate in accordance with design specifications.

(l) Demonstrate starting reliability by means of any 69/n consecutive valid starting test without failure (per plant), where n is equal to the number of diesel generator units of the same design and size

(m) Auxiliary system instrumentation and equipment will be tested using actural or simulated conditions to verify performance within design specification.

(n) Test all Diesel Generator Local and Control Room controls.

14.2.12.1.55.4 ECCS Integrated Initiation With Preferred Source of Offsite Power Available and During a Loss of Offsite Powe Preoperational Test

(1) Purpose

To demonstrate the ability to initiate ECCS load sequencing/shedding when the Class 1E 6.9 kV buses are powered by the preferred offsite source, and during a loss of offsite power (LOPP).

(2) Prerequisites

a. Preoperational/acceptance testing of systems as required for this test is complete and the data has been reviewed.

b. Permanently installed instrumentation properly calibrated and operab

c. Necessary test instrumentation available and properly calibrated.

d. Appropiate a-c and d-c power sources available.

e. The Class 1E buses are energized from the preferred source of offsite power.

f. Class 1E switchgear and battery room ventlation systems available.

g. Class 1E buses are loaded with their normal plant demands.

h. Standby diesel generators and associated systems available.

i. Diesel generator rooms ventilation system available.

j. Emergency pump rooms ventilation systems available.

k. Emergency service water systems available.

l. RHR system available.

m. HPCS system (including HPCS diesel generator) available.

n. LPCS system available.

o. Condensate storage tank and suppression pool water available for ECC operation.

p. Fire protection system is operable.

(3) Test Procedure

a. Intitiate a Class 1E, Division 1, 6.9 kV bus undervoltage and verify the following.

1. Automatic starting of the diesel generator with its associated d- system energized and its automatic connection to a properly cleared bus when the diesel generator reaches rated speed and voltage.

2. Proper operation of all relaying and interlocks involved with th: undervoltage condition including shedding/sequencing of sources and loads.

3. Abilty to manually operate and restore normal loads to the 6.9 kV Class 1E buses.

Repeat the above procedure for Divisions 2 and 3 Class 1E, 6.9 kV buses. Verify the diesel generators start and the load shedding/ sequencing occur within design specification.

b. Initiate a total LOPP and initiate the items in 14.2.12.1.55.4(3)(a) (Items 1 through 3) above for the entire Class 1E system. on total loss of offsite power, diesel generators simultaneously start, load shedding takes place, preferred and/or alternate preferr source breakers are tripped, diesel generators accept the sequenced loads.

c. With normal power available simulate a LOCA signal and test ECCS integrated response by injecting rated flow into the vessel beginnin from a normal system lineup. Integrated ECCS response must show the ability to initiate RHR/LPCI, LPCS,HPCS, and inject rated flow to the vessel within the described period of time following LOCA signal.

d. With Division 1 and 3 electrical systems out-of-service, normal power available to Division 2 and the ECCS manual pressure vessel isolation valves closed, simulate a LOPP followed immediately by a LOCA and verify the following.

1. Automatic starting of the diesel generator with its associated d-c system energized and its automatic connection to a properly cleared bus when the diesel generators reach rated speed and voltage.

2. Proper operation of all relaying and interlocks involved with the undervoltage/LOCA condition, including shedding/sequencing of sources and loads.

3. The Division 2 equipment operating conditions can be stabilized that no adverse conditions develop to Division 2 equipment such as overheating, etc., that there is sufficient instrumentation operable to properly monitor and control Division 2 safety related equipment.

4. Verify that isolated buses remain de-energized.

Repeat the above procedure for Divisons 1 and 3 Class 1E, 6.9 kV buses.

Verify integrated ECCS response in conjunction with simulated LOCA LOPP signals demonstrates the ability of the diesel generators to start simultaneously and maintain ECCS loads while they provide rated flow to the vessel within the prescribed time.

e. Verify that the dc system load is consistent with battery sizing assignments.

14.2.12.1.55.5 Non-divisional AC Power Distribution System

(1) Purpose

To demonstrate the correct power availability, to demonstrate regulation of regulating transformers, to demonstrate adequacy of normal AC lighting, and isolation devices.

(2) Prerequisites

(a) Individual component tests are complete and have been approved.

(b) Instrument calibration is complete.

(c) The Fire Protection System is operable.

(d) Appropriate d-c sources available.

(e) Switchgear and battery room ventilation available.

(f) Normal AC lighting system available.

(3) Test Methods and Acceptance Criteria

(a) Verify buses pre-energized at correct voltage.

(b) Vary feed voltage to regulating transformers and verify load voltage is within limits for entire load range.

(c) Verify Motor Control Center Voltage.

(d) Verify adequacy of normal AC lighting.

(f) Verify that the series isolation breakers feeding the ECCS Sump Pump MCC buses A1-3 and B1-3 are tripped by their associated Division 1 and 2 control signals upon initiation of a LOCA.

14.2.12.1.60 General Service Water System Preoperational Test

Applicant will supply.

14.2.12.1.61 Circulating Water System Preoperational Test

Applicant will supply.

14.2.12.1.62 Main Turbine Electro-Hydraulic Control System Preoperational Test

Applicant will supply.

14.2.12.1.63 Condensate System Preoperational Test

Applicant will supply.

14.2.12.1.64 Condensate Polishing Demineralizer System Preoperational Test

Applicant will supply.

14.2.12.1.65 Condensate Storage System Preoperational Test

Applicant will supply.

additional preoperation tests are 14.2.12.1.66 through 14.2.12.1.76 see Table 14.2-1 & Text 14.2-106 b → j

14.2.12.2 General Discussion of Startup Tests

All those tests comprising the startup test phase (Table 14.2-3) are discussed in this subsection. For each test a description is provided for test purpose, test prerequisites, test description and statement of test acceptance criteria, where applicable. Additions, deletions, and changes to these discussions by the Applicant are expected to occur as the test program progresses.

Text addition for 640.07a

14.2.12.1.66 CLOSED COOLING WATER SYSTEM PREOPERATIONAL TEST

(1) PURPOSE

Verify the capability of the Closed Cooling Water (CCW) System to remove specified amounts of heat from various non-essential systems. Adequacy of circulating pumps, piping, heat exchangers, and instruments shall be determined.

(2) PREREQUISITES

(a) All construction tests shall have been performed. All instruments and controls shall be completely installed, calibrated and checked out so that the system is ready for operation.

THE SCG HAS REVIEWED AND APPROVED THE TEST PROCEDURE, SCHEDULE, STAFFING, AND PLANT CONDITION.

(b) THE FOLLOWING SYSTEMS MUST BE AVAILABLE

1. INSTRUMENT AIR
2. NORMAL AND DRW DRAINS
3. DEMINERALIZED WATER
4. ELECTRICAL POWER

(3) TEST METHODS AND ACCEPTANCE CRITERIA

(a) INSTALL TEMPORARY INSTRUMENTS AND EQUIPMENT AS REQUIRED.

(b) CHECK OUT SYSTEM COMPONENTS

(c) PURGE AIR FROM CCW EXPANSION TANK WITH NITROGEN.

(d) SLOWLY FILL SYSTEM WITH DEMINERALIZED WATER

(e) ESTABLISH 12 PSIG NITROGEN PRESSURE ABOVE WATER IN CCW EXPANSION TANK

(f) START ONE CCW CIRCULATING PUMP. ESTABLISH DESIGN WATER FLOW IN EACH COOLER IN A LOGICAL SEQUENCE, READJUSTING FLOWS AS REQUIRED FOR BALANCE. CHECK PUMP FLOW RATE FREQUENTLY, TO AVOID EXCEEDING DESIGN FLOW.

(g) CHECK AUTOMATIC START OF STANDBY PUMP BY STOPPING OPERATING PUMP. CHECK PRESSURE RECOVERY TIME.

(h) CHECK CLOSING TIME OF ISOLATION VALVES.

(i) CONDUCT VIBRATION TESTS PER REGULATORY GUIDE 1.68.

(j) THE SYSTEM IS ACCEPTABLE IF FLOWS AND PRESSURE DROPS MEET DESIGN VALUES, AND EQUIPMENT AND INSTRUMENTS FUNCTION AS SPECIFIED

~~Text addition for 640.07~~

14.2.12.1.67 Combustible Gas Control Preoperational Test

(1) ~~a.~~ PURPOSE ~~Test Objective~~

To verify the ability of the Combustible Gas Control System to perform within design specifications.

(2) ~~b.~~ Prerequisites

a ~~1.~~ Individual component tests have been completed.

b ~~2.~~ Instrument calibration and loop checks are completed.

c ~~3.~~ Test instruments are available and calibrated.

d ~~4.~~ Electrical power is available.

e ~~5.~~ ESSENTIAL SERVICE WATER ~~Emergency Closed Cooling~~ System is operational.

f ~~6.~~ SHIELD Annulus Exhaust AND RETURN, AND STANDBY Gas Treatment ~~System is operational.~~ SYSTEMS ARE OPERATIONAL.

(3) Test METHODS ~~Procedure~~

a ~~1.~~ Verify MIXING FAN ~~compressor~~, recombiner, analyzer and control functions.

b 2. Verify operation time for isolation valves.

c 3. Verify system response to manual isolation.

d 4. Verify post-LOCA hydrogen monitor operability.

(4) ~~d.~~ Acceptance Criteria

MIXING FAN ~~Compressor~~, recombiner, analyzer, controls, and post-LOCA monitors function within design specification.

~~Test addition for 640.07d~~

14.2.12.1.68 Isolation Valve Function and Closure Time

Refer to Subsections 6.2.4.4 and 6.2.1.6.1.2.

~~Text addition for 640.07e~~

14.2.12.1.69 Containment Penetration Leakage

Criteria for preoperational tests of containment penetrations are given in Subsection 6.2.1.6. A list of penetration and isolation valve leakage tests is given as Table 6.2-29.

~~Text addition for 640.07f~~

14.2.12.1.70 Containment Airlock Leakage

Criteria for preoperational tests of containment AIRLOCKS ~~penetrations~~ are given in Subsection 6.2.1.6. A list of penetration and isolation valve leakage tests is given as Table 6.2-29.

~~Text addition for 640.07g~~

14.2.12.1.71 Integrated Containment Leakage

Criteria for integrated containment leakage tests are given in Subsection 6.2.6.1.

~~Text addition for 640.07i~~

14.2.12.1.72 Containment Air Purification and Cleanup System

~~GE GESSAR~~
~~ROUND 1 QUESTION~~

~~Response to Question 640.07i (14.2.12)~~

The ~~pre~~operational ~~test~~ procedures for the Standby Gas Treatment System (STGS) and the Control Building Outdoor Air Cleanup System~~s~~ (CBOACS) are described in ~~section~~ Subsection 6.5.1.4. ~~of GESSAR II~~. The SGTS and the CBOACS are included in Section 14.2.12 ~~of GESSAR II~~ but the requirements for the preoperational test procedures ~~should be referenced to Section 6.5.1.4.~~ are provided in Subsection 6.5.1.4.

~~Text addition for 640.07j~~

14.2.12.1.73 Bypass Leakage

Table 6.2-24 ~~of GESSAR II~~ lists potential bypass leakage paths, and describes mode of leakage protection where applicable. Test procedures are identical to those used for other penetrations under isolation conditions.

Text addition for 640.07 l

14.2.12.1.74 Emergency Response Information System

~~will be provided in December 1982.~~ Applicant will supply.

Text addition for 640.07 n

14.2.12.1.75 Expansion, Vibration and Dynamic Effects

~~a. Test Objective~~
14.2.12.1.75.1 Expansion Test Objective

The purpose of this test is to verify that the non-NSSS safety-related piping, designated as ASME Class 1, 2, or 3, is free to expand thermally as designed. ~~and that transient-induced pipe motion and steady-state vibrations are within acceptable limits~~.

14.2.12.1.75.1.1 Prerequisites

The system piping to be tested is supported and restrained in conformance with the design drawings. Instrumentation has been installed and calibrated.

14.2.12.1.75.1.2 EXPANSION TEST PROCEDURE

~~Test Procedure~~

~~During preoperational testing, the system piping will be visually inspected for vibration. If visual inspection detects questionable vibration, the system will be checked using a vibration monitor.~~ During initial system heatup, piping thermal movements at selected points will be instrumented, monitored, and recorded. Accessible pipe hangers and snubbers not instrumented will be visually inspected.

14.2.12.1.75.1.3 Acceptance Criteria

1. There shall be no evidence of blocking of thermal expansion of the piping systems or components other than by design.

2. The measured thermal movement shall be within ±25 percent of the analytical value or ±0.25 inch, whichever is greater.

3. Spring hanger movement shall remain within the hot and cold set points, and snubbers shall not become fully extended or retracted.

14.2.12.1.75.2 VIBRATION TEST OBJECTIVE

NRC Regulatory Guide 1.70, Item 3.9.2.1 "Preoperational Vibration and Dynamic Effects Testing on Piping" says the preoperational piping vibration and dynamic effects testing during startup functional testing will be conducted on safety-related ASME Class 1, 2, and 3 piping systems including their supports and restraints. The following test program is intended to comply with that requirement.

14.2.12.1.75.2.1

PREREQUISITES Vibration tests shall not be made before all piping and supports have been inspected and determined to be properly installed and hydrotested.

14.2.12.1.75.2.2 VIBRATION TEST PROCEDURE

~~DESCRIPTION OF THE TEST PROGRAM~~ The vibration test is designed to be run with the reactor and associated system in either the hot or cold condition. The test program is divided into two phases.

(CONTINUED NEXT PAGE)

14.2.12.1.75.2.2 Vibration Test Procedure (Continued)

Phase I - The dynamic response of the system is noted by observation and visual instrument measurement. Piping with less than allowable deflections requires no further evaluation and can be approved to have met the requirements of Section 3.9.2 of Regulatory Guide 1.70. Allowable deflections should be developed after completion of stress analysis. Piping exceeding Phase I acceptance limits will be treated as described in Phase II.

Phase II - Take remedial action (add or relocate supports, etc) or proceed with time history analysis.

Apply time history analysis to determine whether additional corrections are required.

1. PHASE I All safety-related piping shall be subjected to preliminary vibration measurements. These measurements shall be taken during pre-operational tests, with machinery and fluid systems operating under test conditions. Any indication of persistent vibration shall be followed by recorded measurements for subsequent analysis.

~~A.5.1~~ 2. TEST CONDITIONS Special attention shall be given to piping attached to pumps, compressors, and other rotating or reciprocating equipment. Measurements shall be taken near isolation valves, pressure-control valves, and other locations where shock or high turbulence may be present.

Test instruments will be provided by General Electric as a service to the applicant.

~~A.5.2~~ 3. TEST INSTRUMENTATION ~~Table A.5.1 gives a list of recommended test instruments~~. Preliminary measurements may be made with a light-weight portable vibration meter. ~~eg B&K Model 2511~~. From these measurements, the number and location of recorded measurement points shall be determined.

~~A.5.3~~ 4. RECORDED MEASUREMENTS Every measurement record shall be accompanied by a sketch showing the location of the measurement point, plus a description of the system operating conditions at the time of measurement.. Measured data shall include actual deflections and frequencies. Time duration of measurement shall be sufficient to indicate whether the vibration is continuous or transient.

~~A.5.4~~ 5. PHASE II ACTION If the allowables are exceeded, two options are available, whichever is deemed appropriate.

a Take remedial action (add or relocate supports, etc).

b Perform time-history test of the piping system.

(Continued)

6. TIME-HISTORY TEST

a. Establish the time-history of the piping system.

b. Perform stress analysis based on time-history and compare with code allowables.

c. If the allowables are exceeded, take remedial action.

7. REMEDIAL ACTIONS Two basic methods of solving the problems are suggested, one or both of which may be used in a given case.

A. Change in the piping arrangement. This includes a number of possible changes, as -

a Adding and/or relocation of piping supports.

b Rerouting of piping layout to eliminate fluid resonance characteristics.

8. Change in the flow modes of the system by -

a Increasing opening or closing time of valves.

b Addition of a device eg a grid, strainer or damper, which minimizes the forcing function of the vibration source.

These solutions require partial or full reanalysis of the affected piping system.

14.2.12.1.76 Containment Pressure Instrumentation Preoperational Test 14.41

(1) Purpose

Verify the proper connection and tracking of containment pressure instruments, and that the tubing supplying these instruments is not blocked.

(2) Prerequisites

(a) All containment pressure instruments have been calibrated and are valved in service.

(b) Integrated containment leak rate testing is to be performed per Section 6.2.6.1.

(3) General Test Methods and Acceptance Criteria

As containment pressure is increased during the containment integrated leak rate test, all containment pressure instruments must track properly and all affected instrument lines will be verified clear of obstructions.

~~Text addition for 640.40~~

142.-106-K

Text modification for 640.22

14.2.12.2 General Discussion of Startup Tests (Continued)

In describing the purpose of a test, an attempt is made to identify those operating and safety-oriented characteristics of the plant which are being explored.

Where applicable, a definition of the relevant acceptance criteria for the test is given and is designated either Level 1 or Level 2. A Level 1 criterion normally relates to the value of a process variable assigned in the design of the plant, component systems, or associated equipment. If a Level 1 criterion is not satisfied, the plant will be placed in a suitable hold-condition until resolution is obtained. Tests compatible with this hold-condition may be continued. Following resolution, applicable tests must be repeated to verify that the requirements of the Level 1 criterion are now satisfied.

A Level 2 criterion is associated with expectations relating to the performance of systems. If a Level 2 criterion is not satisfied, operating and testing plans would not necessarily be altered.

Investigations of the measurements and of the analytical techniques used for the predictions would be started.

For transients involving oscillatory response, the criteria are specified in terms of decay ratio (defined as the ratio of successive maximum amplitudes of the same polarity). The decay ratio must be less than unity to meet a Level 1 criterion and less than 0.25 to meet Level 2.

14.2.12.3 Startup Test Procedures

The following post-fuel loading tests are exempt from operating license conditions requiring NRC prior approval for major test changes:

14.23

Text modification (cont) for 640.22

Startup Test Number 17 - Core Power-Void Mode Response (14.2.12.3.17)

Startup Test Number 25 - Recirculation Flow Control (14.2.12.3.25) - All sections except that dealing with maximum flow control valve speed.

Startup Test Number 31 - Reactor Water Cleanup System (14.2.12.3.31)

14.23

14.2.12.3.1 Startup Test Number 1 - Chemical and Radiochemical

14.2.12.3.1.1 Purpose

(1) Secure information on the chemistry and radiochemistry of the reactor coolant.

(2) Determine that the sampling equipment, procedures and analytic techniques are adequate to supply the data required to demonstrate that the chemistry of all parts of the entire reactor system meet specifications and process requirements.

Specific objectives of the test program include evaluation of fuel performance, evaluations of demineralizer operations by direct and indirect methods, measurements of filter performance, confirmation of condenser integrity, demonstration of proper steam separator-dryer operation, measurement and calibration of the offgas system, and calibration of certain process instrumentation. Data for these purposes is secured from a variety of sources: plant operating records, regular routine coolant analysis, radiochemical measurements of specific nuclides, and special chemical tests.

14.2.12.3.1.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

14.2.12.3.1.3 Description

Prior to fuel loading, a complete set of chemical and radiochemical samples will be taken to ensure that all sample stations are functioning properly and to determine initial concentrations. Subsequent to fuel loading, during reactor heatup and at each major power level change, samples will be taken and measurements will be

14.2.12.3.1.3 Description (Continued)

made to determine the chemical and radiochemical quality of reactor water and reactor feedwater, amount of radiolytic gas in the steam, gaseous activities leaving the air ejectors, decay times in the offgas lines, and performance of filters and demineralizers. Calibrations will be made of monitors in the stack, liquid waste system, and liquid process lines.

14.2.12.3.1.4 Criteria

Level 1

Chemical factors defined in the Technical Specifications must be maintained within the limits specified.

The activity of gaseous liquid effluents must conform to license limitations.

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

14.2.12.3.2 Startup Test Number 2 - Radiation Measurements

14.2.12.3.2.1 Purpose

(1) Determine the background radiation levels in the plant environs prior to operation for base data on activity buildup;

(2) Monitor radiation at selected power levels to assure the protection of personnel during plant operation.

14.2.12.3.2.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

chg. 14.2.12.3.2.3 Description

A survey of natural background radiation throughout the plant site will be made prior to fuel loading. Subsequent to fuel loading, during reactor heatup and at nominal power levels of 25%, 60%, and 100% of rated power, gamma dose rate measurements and where appropriate, neutron dose rate measurements will be made at specific locations throughout the plant. All potentially high radiation areas will be surveyed. This should specifically include:

a) Drywell to containment building penetrations

b) RWCU system backwash receiver tank resin transfer piping in the area where it exits the containment building and enters the auxiliary building. This should be monitored before, during, and after the transfer of discharged resins from RWCU backwash receiver tank.

c) Utilize the transfer of the gamma pins for the operational sources from the fuel building to the containment building as a means of determining the adequacy of fuel transfer shielding at accessible elevations within the containment building.

d) A complete survey of all accessible floor areas within the containment building prior to fuel loading, at intermediate powers and at full power.

Ensure that proper procedures are in place to monitor containment building environment prior to entry after SRV action. This will specifically include measurements of airborne contamination prior and subsequent to those tests which could add radioactivity to the containment building atmosphere.

14.42

OK 14.2.12.3.2.4 Criteria

Level 1

The radiation doses of plant origin and the occupancy times of personnel in radiation zones shall be controlled consistent with the guidelines of the Standards for Protection Against Radiation outlined in 10CFR20.

14.2.12.3.3 Startup Test Number 3 - Fuel Loading

OK 14.2.12.3.3.1 Purpose

Load fuel safely and efficiently to the full core size.

14.2.12.3.3.2 Prerequisites

~~Prerequisites to fuel loading are established in Subsection 14.2.1.5 and the tests required thereby are implied in those Prerequisites.~~ ~~Also,~~ The following prerequisites will be met prior to commencing fuel loading to assure that this operation is performed in a safe manner. 14.25 14.42

(1) The status of all systems required for fuel loading will be specified and will be in the status required.

(2) Fuel and control rod inspections will be complete. Control rods will be installed and tested.

(3) At least three movable neutron detectors will be calibrated and operable. At least three neutron detectors will be connected to the high flux scram trips. They will be located to provide acceptable signals during fuel loading.

(4) Nuclear instruments will be source checked with a neutron source prior to loading or resumption if sufficient delays are incurred.

(5) The status of secondary containment will be specified and established.

(6) Reactor vessel status will be specified relative to internal component placement and this placement established to make the vessel ready to receive fuel.

14.2.12.3.3.2 Prerequisites (Continued)

(7) Reactor vessel water level will be established and minimum level prescribed.

(8) The standby liquid control system will be operable and in readiness.

14.2.12.3.3.3 Description

Prior to fuel loading, control rods and neutron sources and detectors will be installed and tested. Fuel loading will begin by placing the first four bundles adjacent to an off-center neutron source and preceeding radially outwards. This loading pattern shall continue until the outside face of the loading block will have reached the core periphery. Subsequent loading increments will be performed as a series of crescents proceeding radially outwards. The neutron count rates shall be monitored as the core loading progresses to ensure continuous subcriticality and a shutdown margin demonstration will be performed.

14.42

14.2.12.3.3.4 Criteria

Level 1

The partially loaded core must be subcritical by at least 0.38% $\Delta k/k$ with the analytically determined highest worth rod fully withdrawn.

14.2.12.3.4 Startup Test Number 4- Full Core Shutdown Margin

14.2.12.3.4.1 Purpose

Demonstrate that the reactor will be subcritical throughout the first fuel cycle with any single control rod fully withdrawn.

14.2.12.3.4.2 Prerequisites

~~Prerequisites to full core shutdown margin are established in Subsection 14.2.1.5~~ and ~~the tests required thereby are implied in those prerequisites~~. ~~Also,~~ The following prerequisites will be met prior to performing the full core shutdown margin tests. 14.42

(1) The predicted critical rod position will be available.

(2) The standby liquid control system will be available.

(3) Nuclear instrumentation will be available with neutron count rate of at least two counts per second and signal-to-noise ratio greater than two.

(4) High-flux scram trips are set conservatively low.

14.2.12.3.4.3 Description

This test will be performed in the fully loaded core in the xenon-free condition. The shutdown margin test will be performed by withdrawing the control rods from the all-rods-in configuration until criticality is reached. If the highest worth rod will not be withdrawn insequence, other rods may be withdrawn providing that the reactivity worth is equivalent. The difference between the measured K_{eff} and the calculated K_{eff} for the in-sequence critical will be applied to the calculated value to obtain the true shutdown margin. 14.42

14.2.12.3.4.4 Criteria

Level 1

The shutdown margin of the fully loaded, cold (68°F or 20°C), xenon-free core occuring at the most reactive time during the cycle must be at least 0.38% $\Delta k/k$ with the analytically strongest rod (or its reactivity equivalent) withdrawn. If the shutdown margin is measured at some time during the cycle other than the most reactive time, compliance with the above criterion is shown by demonstrating that the shutdown margin is 0.38% $\Delta k/k$ plus an exposure dependent increment which adjusts the shutdown margin at that time to the minimum shutdown margin. 14.42

14.2.12.3.4.4 Criteria (Continued)

ok Level 2

Criticality should occur within $\pm 1.0\%$ $\Delta k/k$ of the predicted critical (predicted critical to be determined later).

14.2.12.3.5 Test Number 5 - Control Rod Drive System

OK 14.2.12.3.5.1 Purpose

(1) Demonstrate that the control rod drive (CRD) system operates properly over the full range of primary coolant temperatures and pressures from ambient to operating

(2) to determine the initial operating characteristics of the entire CRD system.

OK 14.2.12.3.5.2 Prerequisites

The preoperational tests have been completed. The SCG has reviewed and approved the test procedures and initiation of testing. The control rod drive manual control system preoperational testing must be completed on control rod drives being tested. The reactor vessel, closed cooling water system, condensate supply system and instrument air system must be operational to the extent required to conduct the test.

oky 14.2.12.3.5.3 Description

The CRD tests performed during Phases II through IV of the startup test program are designed as an extension of the tests performed during the preoperational CRD system tests. Thus, after it is verified that all control rod drives operate properly when installed, they are tested periodically during heatup to assure that there is no significant binding caused by thermal expansion of the core components. ~~Reference documents MPL-C11-4010 and A13-3341.~~

14.42

14.2.12.3.5.3 Description (Continued)

binding caused by thermal expansion of the core components. A list of all control rod drive tests to be performed during startup testing follows.

CONTROL ROD DRIVE SYSTEM TESTS

			Reactor Pressure with Core Loaded psig (kg/cm^2)			
Test Description Indication	Accumulator Pressure	Preop Test	0	600 (42.2)	800 (56.2)	Rated
Normal times insert/ withdraw		all	all			4*
Coupling		all	all**			
Friction			all			4*
Scram	Normal	all	all	4*	4*	all
Scram	Minimum		4*			
Scram	Zero					4*
Scram (scram discharge volume high level)	Normal		4 (full core scram)			
Scram		normal				4***

NOTE

Single CRD scrams should be performed with the charging valve closed (do not ride the charging pump head).

*Value refers to the four slowest CRDs as determined from the normal accumulator pressure scram test at ambient reactor pressure. Throughout the procedure, the four slowest CRDs imply the four slowest compatible with rod worth minimizer and CRD sequence requirements.

**Establish initially that this check is normal operating procedure.

***Scram times of the four slowest CRDs will be determined at 25%, 60%, and 100% of rated power during planned reactor scrams.

14.26 See Test 5 Startup Test Program

14.42

14.2.12.3.5.4 Criteria

Level 1

a) Each CRD must have a normal withdraw speed less than or equal to 3.6 inches per second (9.14 cm/sec), indicated by a full 12-foot stroke in greater than or equal to 40 seconds.

b) For vessel pressures between 950 psig and 1050 psig the maximum scram times of individually fully withdrawn CRDs shall comply with the following table: (Note: Performance rated with charging headers at 1750 psig)

The scram insertion time of each control rod from the fully withdrawn position, based on de-energization of the scram pilot valve solenoids as time zero, shall not exceed the following criterion:

Reactor Pressure psig	Maximum Insertion Times (sec) From Opening of Main Scram Contactor to Notch Position*		
	43	29	13
950	0.31	0.81	1.44
1050	0.32	0.86	1.57

If the maximum scram insertion time of one or more control rods exceed criteria b (above) then the following criteria are applicable.

c-1 The individual scram times of a drive exceeding the times of criterion b (above) shall not exceed the following table:

*For intermediate vessel dome pressure, the scram time criteria are determined by linear interpolation at each notch position.

Pressure (psig)	Maximum Insertion Times (sec) From Opening of Main Scram Contactor to Notch Position		
	43	29	13
950	0.38	1.09	2.09
1050	0.39	1.14	2.22

and

c-2 The total number of drives failing criteria but meeting criterion c-1 shall not exceed the values listed below:

Number of CRD's in Core	Total Number of Slow CRD's Allowed
~~145 (624 bundles)~~	~~5~~
177 (748 bundles)	7
~~193 (800 bundles)~~	~~7~~
~~205 (864 bundles)~~	~~8~~

14.2.12.3.5.4 Criteria (Continued)

14.2.12.3.5.4

and

c-3 The average scram times of the remaining (i.e., those that meet criterion b) individual control rod drives shall be less than the following table:

Pressure (psig)	Maximum Insertion Times (sec) From Opening of Main Scram Contactor to Notch Position		
	43	29	13
950	0.30	0.78	1.40
1050	0.31	0.84	1.53

and

c-4 A drive failing criterion b but meeting the criteria under c shall not occupy an adjacent location in any direction, including the diagonal, with another slow or inoperative drive. Note that a drive that fails criterion c-1 is considered to be inoperative.

d) In the continuous ganged rod mode, the rods shall always move together so that all rods are within two notches of all other rods in the gang.

14.4.2

Level 2

a) Each CRD must have a normal insert or withdraw speed of 3.0 ± 0.6 inches per second (7.62 ± 1.52 cm/sec), indicated by a full 12-foot stroke in 40 to 60 seconds. The insert speed of the rods in a gang should be within 10% of all other rods in the gang. The withdraw speed of rods in a gang should be within 10% of all other rods in the gang.

b) With respect to the control rod drive friction tests, if the differential pressure variation exceeds 15 psid (1.1 kg/cm^2) for a continuous drive in, a settling test must be performed, in which case, the differential settling pressure should not be less than 30 psid (2.1 kg/cm^2) nor should it vary by more than 10 psid (0.7 kg/cm^2) over a full stroke.

14.2.12.3.5.4

NOTE: For BWR/6 plants the differential settling pressure should be nominally 5 psid higher at the 00 position than at any other position along the CR due to the proper functioning of the spring actuated buffer piston located at the top of the drive.

c) The CRD's total cooling water flow rate shall be between 0.28 and 0.34 gpm times the total number of drives.

d) For vessel pressures below 950 psig the maximum scram time of individual fully withdrawn CRDs shall comply with the criteria given in Figure ~~4-1~~ 14.2-6. This is the time from the opening of the main scram contactor to notch 11.

e) Buffer time (defined as the pickup of position indicator probe switch "52" to drop out of "52") shall not be less than 11 milliseconds when scram testing at nominal accumulator conditions with the reactor open to the atmosphere and 15 milliseconds at nominal accumulator conditions with the reactor at rated pressure.

oK 14.2.12.3.6 Startup Test Number 6 - SRM Performance and Control Rod Sequence

OK 14.2.12.3.6.1 Purpose

Demonstrate that the operational sources, SRM instrumentation, and rod withdrawal sequences provide adequate information to achieve criticality and increase power in a safe and efficient manner. The effect of typical rod movements on reactor power will be determined.

OK 14.2.12.3.6.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedure and the initiation of testing. The control rod drive system must be operational.]

OK 14.2.12.3.6.3 Description

The operational neutron sources will be installed and source range monitor count-rate data will be taken during rod withdrawals to ok 14.2.12.3.6.3 Description (Continued)

critical and compared with stated criteria on signal and signal count-to-noise count ratio.

A withdrawal sequence has been calculated which completely specifies control rod withdrawals from the all-rods-in condition to the rated-power configuration. Critical rod patterns will be recorded periodically as the reactor is heated to rated temperature.

Movement of rods in a prescribed sequence is monitored by the rod worth minimizer which will prevent out of sequence withdrawal. Also not more than two rods may be inserted out of sequence.

As the withdrawal of each rod group is completed during the power ascension, the electrical power, steam flow, control valve position, and APRM response will be recorded.

14.2.12.3.6.4 Criteria

Level 1

a) There must be a neutron signal count-to-noise count ratio of at least 2:1 on the required operable SRMs.

b) There must be a minimum count rate of 3 counts/second on the required operable SRMs.

14.62

14.2.12.3.7 CONTROL ROD SEQUENCE EXCHANGE

14.2.12.3.7.1 PURPOSE.

The purpose of this test is to perform a representative sequence exchange of control rod patterns at a significant power level.

14.2.12.3.7.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

14.2.12.3.7.3 DESCRIPTION

Rod patterns will be periodically exchanged during plant operations to more nearly equalize fuel assembly exposures. This test is performed as an example of the exchanges which will be made throughout plant life, and is provided to illustrate the principles involved. It is performed as close as possible to 1000 MWD/T core exposure and prior to the commencement of commercial operation. The control rod sequence exchange begins on the 100 percent load line by reducing core flow to minimum and reducing thermal power to between the low power set point of the rod control and information system and the thermal power necessary to keep nodal powers below the PCIOMR threshold. Also, in reducing thermal power, care should be taken to avoid exceeding the design limits of the core total peaking factor. The ensuing steps involve utilizing the system process computer, specifically subprograms OD-2, 3 and P1, followed by APRM data and extensive utilization of the TIP machines. The exchange is performed a row or column at a time, starting at one side of the core and working row by row or column by column across the entire width of the core.

14.2.12.3.7.4 Criteria

Level 1

Completion of the exchange of one rod pattern for the complimentary pattern with continual satisfaction of all licensed core limits constitutes satisfaction of the requirements of this procedure.

Level 2

All nodal powers shall remain below their PCIOMR threshold limit during this test.

delete entire section

14.2.12.3.7 Startup Test Number 7 - Water Level Measurement

14.2.12.3.7.1 Purpose

(1) Check the calibration of the various level indicators,

(2) Measure the reference leg temperature and recalibrate the affected wide-range level instruments if the measured temperature is different than the value assumed during the initial calibration

(3) Collect plant data which can be used to investigate the effects of core flow, carryunder, and subcooling on indicated wide-range level systems.

14.2.12.3.7.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedure and the initiation of testing. All system instrumentation is installed and calibrated. All system controls and interlocks have been checked.

14.2.12.3.7.3 Description

To monitor the reactor vessel water level, four level instrument systems are provided. These are:

(1) shutdown range level system;
(2) narrow range level system;
(3) wide range level system; and
(4) fuel zone level system.

These systems are used respectively as follows:

(1) shutdown range level system - water level measurement in cold, shutdown conditions;

delete entire section

14.42

14.2.12.3.7.3 Description (Continued)

(2) narrow range level system - feedwater flow and water level control functions;

(3) wide range level system - safety functions; and

(4) full zone level system - safety functions.

The test is divided into three parts. The first part will be done at rated temperature and pressure and under steady-state conditions and will verify that the reference leg temperature of the wide range level instrument is the value assumed during initial calibration. If not, the instruments will be recalibrated using the measured value. The second part of the test consists of reading all of the level indicators to verify that they are working properly. The Level 2 criteria will determine whether recalibration is necessary. There should be reasonable agreement between indications at hot standby. The third part of the test will collect data at various operating conditions to help define the effect of core flow velocity, subcooling, and carryunder on indicated wide range level.

14.2.12.3.7.4 Criteria

Level 2

The narrow range level system readings should agree with each other within ±1.5 inches of the average reading.

The wide range level system indicators should agree with each other within ±6 inches of the average reading.

delete in 1 section

14.42

14.2.12.3.8 Startup Test Number 8 - IRM Performance

ok 14.2.12.3.8.1 Purpose

Adjust the Intermediate Range Monitor System to obtain an optimum overlap with the SRM and APRM systems.

ok 14.2.12.3.8.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedures and initiation of testing. All source range monitors and pulse preamplifiers, intermediate range monitors and voltage preamplifiers, and average power range monitors have been calibrated in accordance with vendor's instructions.

ok 14.2.12.3.8.3 Description

Initially, the IRM system is set to maximum gain. After the APRM calibration, the IRM gains will be adjusted to optimize the IRM overlap with the SRMs and APRMs.

14.2.12.3.8.4 Criteria

Level 1

Each IRM channel must be on scale before the SRMs exceed their rod block setpoint. Each APRM must be on scale before the IRMs exceed their rod block setpoint.

Level 2

Each IRM channel must be adjusted so that a half decade overlap with the SRMs and one decade overlap with the APRMs are assured.

14.2.12.3.9 Startup Test Number 9 - LPRM Calibration

ok 14.2.12.3.9.1 Purpose

Calibrate the local power range monitoring system.

ok 14.2.12.3.9.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedures and the initiation of testing. Instrumentation for calibration has been checked and installed.

ok 14.2.12.3.9.3 Description

The LPRM channels will be calibrated to make the LPRM readings proportional to the neutron flux in the water gap at the chamber elevation. Calibration factors will be obtained through the use of either an off-line or a process computer calculation that relates the LPRM reading to average fuel assembly power at the chamber height.

14.2.12.3.9.4 Criteria

okg Level 2 14.4.2

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

14.2.12.3.10 Startup Test Number 10 - APRM Calibration

ok 14.2.12.3.10.1 Purpose

Calibrate the average power range monitor system.

ok 14.2.12.3.10.2 Prerequisites

The preoperational tests have been completed and the SCG has reviewed and approved the test procedures and the initiation of testing. Instrumentation for calibration has been checked and installed.

.2.12.3.10.3 Description

A heat balance will generally be made each shift and after each major power level change. Each APRM channel reading will be adjusted to be consistent with the core thermal power as determined from the heat balance. During heatup a preliminary calibration will be made by adjusting the APRM amplifier gains so that the APRM readings agree with the results of a constant heatup rate heat balance. The APRMs should be recalibrated in the power range by a heat balance as soon as adequate feedwater indication is available.

Recalibration of the APRM system will not be necessary from safety considerations if at least three of the four APRM channels have readings greater than or equal to core power.

14.42

14.2.12.3.10.4 Criteria

Level 1

a) The APRM channels must be calibrated to read equal to or greater than the actual core thermal power.

b) Technical specification and fuel warranty limits on APRM scram and Rod Block shall not be exceeded.

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

14.42

Level 2

If the above criteria are satisfied, then the APRM channels will be considered to be reading accurately if they agree with the heat balance or the minimum value required based on peaking factor MLHGR, and fraction of rated power to within (+7, -0)% of rated power.

14.2.12.3.11 Startup Test Number 11 - NSSS Process Computer

ok 14.2.12.3.11.1 Purpose

Verify the performance of the process computer under plant operating conditions.

ok 14.2.12.3.11.2 Prerequisites

The preoperational tests have been completed and the SCG has reviewed and approved the test procedures and initiation of testing. The computer diagnostic has been test completed. Construction and construction testing on each input instrument and its cabling has been completed.

ok 14.2.12.3.11.3 Description

Computer system program verifications and calculational program validations at static and at simulated dynamic input conditions will be preoperationally tested at the computer supplier's site and following delivery to the plant site. Following fuel loading, during plant heatup and the ascension to rated power, the nuclear steam supply system and the balance-of-plant system process variables sensed by the computer as digital or analog signals will become available. Verify that the computer is receiving correct values of NSSS process variables and that the results of performance calculations of the nuclear steam supply system and the balance-of-plant are correct. At steady state power conditions the Dynamic System Test Case will be performed.

As discussed in Test 19 the BUCLE offline computation system will be used to evaluate core performance until the process computer performance is verified. A manual computation method is available at the site if both the process computer and BUCLE are not available.

14.4.2

ok. 14.2.12.3.11.4 Criteria

Level 2

Programs OD-1, P1, and OD-6 will be considered operational when the following occurs.

14.2.12.3.11.4 Criteria (Continued)

(1) The MCPR calculated by BUCLE and the process computer are either:

(a) in the same fuel assembly and do not differ in value by more than 2%; or

(b) for the case in which the MCPR calculated by the process computer is in a different assembly than that calculated by BUCLE for each assembly, the MCPR and CPR calculated by the two methods shall agree within 2%.

(2) The maximum LHGR calculated by BUCLE and the process computer are either:

(a) in the same fuel assembly and do not differ in value by more than 2%; or

(b) for the case in which the maximum LHGR calculated by the process computer is in a different assembly than that calculated by BUCLE for each assembly, the maximum LHGR and LHGR calculated by the two methods shall agree within 2%.

(3) The MAPLHGR calculated by BUCLE and the process computer are either:

(a) in the same fuel assembly and do not differ in value by more than 2%; or

(b) for the case in which the MAPLHGR calculated by the process computer is in a different assembly than that calculated by BUCLE for each assembly, the ok 14.2.12.3.11.4 Criteria (Continued)

MAPLHGR and APLHGR calculated by the two methods shall agree within 2%.

(4) The LPRM calibration factors calculated by BUCLE and the process computer agree to within 2%.

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

14.2.12.3.12 Startup Test Number 12 - RCIC System

chg 14.2.12.3.12.1 Purpose

~~The purpose of this test is to~~ Verify the proper operation of the Reactor Core Isolation Cooling (RCIC) system over its expected operating pressure and flow ranges, and to demonstrate reliability in automatic starting from cold standby when the reactor is at power conditions.

chg 14.2.12.3.12.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedures and initiation of testing. ~~Initial turbine operation (uncoupled) must be performed to verify satisfactory operation and over-speed trip. The auxiliary steam system is available to supply turbine steam.~~ Instrumentation has been installed and calibrated, and sufficient water is available to meet specified purity requirements. The following systems must be operational to the extent necessary to conduct the test: reactor vessel, suppression pool, condensate supply system, and instrument air.

chg. 14.2.12.3.12.3 Description

The RCIC System is designed to be tested in two ways: (1) by flow injection into a test line leading to the Condensate Storage Tank (CST), and (2) by flow injection directly into the reactor vessel.

14.2.12.3.12.3 Description (Continued)

The earlier set of CST injection tests consist of manual and automatic mode starts at 150 psig and near rated reactor pressure conditions. The pump discharge pressure during these tests is throttled to be 100 psi above the reactor pressure to simulate the largest expected pipeline pressure drop. This CST testing is done to demonstrate general system operability and for making most controller adjustments.

Reactor vessel injection tests follow to complete the controller adjustments and to demonstrate automatic starting from a cold standby condition. "Cold" is defined as a minimum 72 hours without any kind of RCIC operation.

After all final controller and system adjustments have been determined, a defined set of demonstration tests must be performed with that one set of adjustments. Two consecutive reactor vessel injections starting from cold conditions in the automatic mode must satisfactorily be performed to demonstrate system reliability. Following these tests, a set of CST injections are done to provide a benchmark for comparison with future surveillance tests.

After the auto start portion of certain of the above tests is completed, and while the system is still operating, small step disturbances in speed and flow command are input (in manual and automatic mode respectively) in order to demonstrate satisfactory stability. This is to be done at both low (above minimum turbine speed) and near rated flow initial conditions to span the RCIC operating range.

A demonstration of extended opeation of up to 2 hours (or until pump and turbine oil temperature is stabilized) of continuous running at rated flow conditions is to be scheduled at a convenient time during the Startup test program.

chg. 14.2.12.3.12.4 Criteria

Level 1

a) The average pump discharge flow must be equal to or greater than the 100% rated value after 30 seconds have elapsed from autmatic initiation at any reactor pressure between 150 psig (10.5 kg/cm^2) and rated.

b) The RCIC turbine shall not trip or isolate during auto or manual start tests.

NOTE: If any Level 1 criteria are not met, the reactor will only be allowed to operate up to a restricted power level defined by Figure 14.2-1 of the Startup Test Instructions until the problem is resolved. Also consult the plant Technical Specifications for actions to be taken.

14.2.12.3, 12.4 (CONT.)

Level 2

a) In order to provide an overspeed and isolation trip avoidance margin, the transient start first and subsequent speed peaks shall not exceed 5% above the rated RCIC turbine speed.

b) The speed and flow control loops shall be adjusted so that the decay ratio of any RCIC system related variable is not greater than 0.25.

c) The turbine gland seal system shall be capable of preventing steam leakage to the atmosphere.

d) The delta P switches for the RCIC steam supply line high flow isolation trip shall be calibrated to actuate at the value specified in the plant technical specifications (about 300%).

14.J2

chg 14.2.12.3.12.4 Criteria (Continued)

omit

The differential pressure switch for the RCIC steam supply line high flow isolation trip shall be adjusted to actuate at 300% of the maximum required steady state flow.

For small speed or flow changes in either manual or automatic mode, the decay ratio of each recorded RCIC system variable must be less than 0.25 in order to demonstrate acceptable stability.

The margins to avoid the overspeed trip shall be at least 10% of the trip value.

14.4.2

14.2.12.3.13 Startup Test Number 13 - Selected Process Temperatures

14.2.12.3.13.1 VESSEL TEMPERATURE

14.2.12.3.13.1.1 PURPOSE

The purposes of this test are (1) to assure that the measured bottom head drain temperature corresponds to bottom head coolant temperature during normal operations, (2) to identify any reactor operating modes that cause temperature stratification, (3) to determine the proper setting of the low flow control limiter for the recirculation pumps to avoid coolant temperature stratification in the reactor pressure vessel bottom head region, (4) to familiarize the plant personnel with the temperature differential limitations of the reactor system.

14.4.2

14.2.12.3.13.1.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedures and initiation of testing. System and test instrumentation have been calibrated.

14.2.12.3.13.1.3 Description

The adequacy of bottom drain line temperature sensors will be determined by comparing it with recirculation loop coolant temperature when core flow is 100% of rated.

During initial heatup while at hot standby conditions, the bottom drain line temperature, recirculation loop suction temperature and applicable reactor parameters are monitored as the recirculation flow is slowly lowered to either minimum stable flow or the low recirculation pump speed minimum valve position whichever is the greater. The effects of cleanup flow will be investigated as

14.4.2

14.2.12.3.13.1.3 Description (continued)

operational limits allow. Utilizing this data it can be determined whether coolant temperature stratification occurs when the recirculation pumps are on and if so, what minimum recirculation flow will prevent it.

Monitoring the preceeding information during planned pump trips will determine if temperature stratification occurs in the idle recirculation loops or in the lower plenum when one or more loops are inactive.

All data will be analyzed to determine if changes in operating procedures are required.

14.2.12.3.13.1.4 Criteria

Level 1

a) The reactor recirculation pumps shall not be started nor flow increased unless the coolant temperatures between the steam dome and bottom head drain are within 100°F.

b) The recirculation pump in an idle loop must not be started, active loop flow must not be raised and power must not be increased unless the idle loop suction temperature is within 50°F of the active loop suction temperature. If two pumps are idle, the loop suction temperature must be within 50°F of the steam dome temperature before pump startup.

14.42

Level 2

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

14.2.12.3.13.2 WATER LEVEL REFERENCE LEG TEMPERATURE.

14.2.12.3.13.2.1 PURPOSE

The purpose of this test is to measure the reference leg temperature and recalibrate the instruments if the measured temperature is different from the value assumed during the initial calibration.

14.2.12.3.13.2.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedure and the initiation of testing. All system instrumentation is installed and calibrated. All system controls and interlocks have been checked.

14.2.12.3.13.2.3

Description

To monitor the reactor vessel water level, five level instrument systems are provided. These are:

a) Shutdown Range
b) Narrow Range
c) Wide Range
d) Fuel Range
e) Upset Range

These systems are used respectively as follows:

a) Water level measurement in cold, shutdown conditions
b) Feedwater flow and water level control functions
c) Safety functions
d) Post-accident indication
e) Water level measurement during transient conditions

The test will be done at rated temperature and pressure and under steady-state conditions and will verify that the reference leg temperature of the instrument is the value assumed during initial calibration. If not, the instruments will be recalibrated using the measured value.

A special dp sensor will be installed between the wide and upset range condensing chambers to better monitor water level swell during all plant transients.

14.2.12.3.13.2.4 Criteria

Level 1

Not applicable

Level 2

The difference between the actual reference leg temperature(s) and the value(s) assumed during initial calibration shall be less than that amount which will result in a scale end point error of 1% of the instrument span for each range.

14.2.12.3.14 Startup Test Number 14 - System Expansion

14.2.12.3.14.1 Purpose

The purpose of the thermal expansion test is to confirm that the pipe suspension system is working as designed and the pipe is free of obstructions that could constrain free pipe movement caused by thermal expansion.

14.42

14.2.12.3.14.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedures and initiation of testing. Instrumentation has been installed and calibrated.

14.2.12.3.14.3 Description

The thermal expansion tests consist of measuring displacements and temperatures of piping during various operating modes. The first power level used to verify expansion shall be as low as practicable. Thermal movement and temperature measurements shall be recorded at the following test points:

a. Reactor pressure vessel heat up and hold, at least one intermediate temperature before reaching normal operating temperature; at this time the drywell piping and suspension shall be inspected for obstruction or inoperable supports;

b. Reactor pressure vessel heat up and hold at normal operating temperature;

c. Main steam and recirculation piping heat up and hold at normal operating temperature;

d. On three subsequent heat up cool down cycles, measurements will be recorded at the operating and shutdown temperatures to measure possible shake down effects.

The piping considered to be within the boundary of this test are listed below:

a. Main steam: Steam lines including the RCIC piping on line A shall be tested. Those portions within the scope of the test are bounded by the reactor pressure vessel nozzles and the penetration head fittings.

b. Relief valve discharge piping: The piping attached to the main steam lines and bounded by the relief valve discharge flange and the first downstream anchor shall be within the scope of the test.

c. Recirculation piping: The recirculation piping, bounded by the reactor pressure vessel nozzles, is within the scope of the test. The RHR suction line from the branch connection to the penetration head fitting shall also be monitored during the tests.

d. Small attached piping: All small branch piping attached to those portions of piping within the scope of this test are bounded by the large pipe branch connection and the first downstream guide or anchor. Small branch pipes that cannot be monitored because of limited access are excluded from the scope of this test.

14.4.2

14.2.12.3.14.3 Description (Continued)

The thermal expansion acceptance criteria are based upon the actual movements being within a prescribed tolerance of the movements predicted by analysis. Measured movements are not expected to precisely correspond with those mathematically predicted. Therefore, a tolerance is specified for differences between measured and predicted movement. The tolerances are based on consideration of measurement accuracy, suspension free play, and piping temperature distribution. If the measured movement does not vary from the predictions by more than the specified tolerance, the piping is expanding in a manner consistent with predictions and is therefore acceptable. Tolerances shall be the same for all operating test conditions. The locations to be monitored and the predicted displacements for the monitored locations in each plant will be provided later.

14.2.12.3.14.4. Criteria.

Level 1

The Level 1 movement tolerances [redacted] are intended to set bounds on thermal movement, which if exceeded, require that the test be placed on hold. Pipe will not necessarily converge smoothly to predicted movements with increase in operating temperature. During the first part of the test, vessel movements will often move the pipe in a direction opposite of stress report predictions; the pipe may also advance in a stepwise fashion due to friction constraint. Level 1 criteria discounts spurious movement measurements that could result in unnecessary test holds but still maintains safe limits on movement.

To assure that the criteria is applied at relevent test conditions, the criteria cannot be applied before the vessel and piping temperatures are at meaningful values. In addition a voting logic is used to discount spurious movements due to instrument malfunction. If the free thermal expansion of the piping is obstructed, movement discrepancies would occur at multiple locations because of coupling effects; therefore, in specified cases, if only one instrument out of a pair indicates movements are not within level 1 criteria, that measurement will be discounted as spurious.

14.42

14.2.12.3.14.4 Criteria (Continued)

Level 2

~~Correlation of Test Data and Analyses~~ The predicted movements are based on mathematical calculations that are dependent on assumed nozzle movements and temperature distributions. The measured temperatures and nozzle movements must be compared with those assumed in the analysis to determine which analysis condition corresponds to the test condition. Only corresponding conditions can be used to evaluate test results. If the test conditions do not correspond to any of those assumed in the analysis, the evaluating Piping Design Engineer may find it necessary to calculate movements based on measurements and compare the predicted movements with the measured moments to establish acceptability.

14.42

OMIT

~~During the heatup cycle, the trace of the instrumented points shall fall within a range of 150% of the calculated value from the initial cold position in the direction of the calculated value and 50% of the calculated value from the initial position in the opposite direction of the calculated value. Hangers will be in their operating range (between the hot and cold settings).~~

14.2.12.3.15 Startup Test Number 15 - Core Power Distribution

14.2.12.3.15.1 Purpose

TO DETERMINE the reproducibility of the TIP system readings.

14.42

14.2.12.3.15.2 Prerequisites

System installation must be complete and preoperational tests completed and verified. The TIP detector and dummy detector, ball valve time delay, core top and bottom limits, clutch x-y recorder,

14.2.12.3.15.2 Prerequisites (Continued)

and purge system will have been shown to be operational. Instrumentation has been calibrated and installed.

14.2.12.3.15.3 Description

TIP reproducibility consists of a random noise component and a geometric component. The geometric component is due to variation in the water gap geometry and TIP tube orientation from TIP location to location. Measurement of these components is obtained by taking repetitive TIP readings at a single TIP location, and by analyzing pairs of TIP readings taken at TIP locations which are symmetrical about the core diagonal of fuel loading symmetry.

One set of TIP data will be taken at the 50% power level and at least one other set at 75% power or above.

The TIP data will be taken with the reactor operating with an octant symmetric rod pattern and at steady state conditions.

The total TIP reproducibility is obtained by dividing the standard deviation of the symmetric TIP pair nodal ratios by $\sqrt{2}$. The nodal TIP ratio is defined as the nodal BASE value of the TIP in the lower right half of the core divided by its symmetric counterpart in the upper left half. The total TIP reproducibility value that is compared with the test criterion is the average value of the data sets taken.

The random noise uncertainty is obtained from successive TIP runs made at the common hole, with each of the TIP machines making a minimum of six runs. The standard deviation of the random noise is derived by taking the square root of the average of the variances at nodal levels 5 through 22, where the nodal variance is obtained from the fractional deviations of the successive TIP values about their nodal mean value.

The geometric component of TIP reproducibility is obtained by statistically subtracting the random noise component from the total TIP reproducibility.

14.2.12.3.15.4 CRITERIA

Level 2

The total TIP uncertainty (including randon noise and geometrical uncertainties) obtained by averaging the uncertainties for all data sets shall be less than 6.0%.

14.42

14.2.12.3.15.4 Criteria (Continued)

NOTE

~~A minimum of two and up to six data sets may be used to meet the above criteria. If the 7.8% total TIP uncertainty criteria cannot be met by the six sets of data, testing may continue provided the MCPR limit is adapted to reflect the TIP uncertainty.~~

~~Additional data sets may be obtained in order to improve the TIP uncertainty by increasing the TIP data base and the MCPR limit adjusted, accordingly. If the 7.8% total TIP uncertainty becomes satisfied, the MCPR limit can be returned to its original value.~~

~~Level 2~~

~~In the TIP reproducibility test, the TIP traces shall be reproducible in the nonboiling region within ±3.5% relative error, or ±0.15 inch (3.8 mm), the absolute error at each axial position, whichever is greater.~~

14.2.12.3.16 Startup Test Number 16 - Core Performance

OK 14.2.12.3.16.1 Purpose

(1) Evaluate the core thermal power
(2) Evaluate the following core performance parameters:

(a) maximum linear heat generation rate (MLHGR);
(b) minimum critical power ratio (MCPR); and
(c) maximum average planar linear heat generation rate (MAPLHGR).

OK 14.2.12.3.16.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedures and initiation of testing. System instrumentation has been installed and calibrated and test instrumentation calibrated.

chg 14.2.12.3.16.3 Description

The core performance evaluation is employed to determine the principal thermal and hydraulic parameters associated with core behavior. These parameters are:

Core flow rate
Core thermal power level
Maximum linear heat generation rate (MLHGR)
MCPR
MAPLHGR

The core performance parameters listed above will be evaluated by manual calculation techniques ~~described in Startup Test Instruction 19~~ or may be obtained from the process computer.

If the process computer is used as a primary means to obtain these parameters, it must be proven that it agrees with BUCLE within 2% on all thermal parameters (see Startup Test Number ~~19~~ 11).

If both BUCLE and the process computer are not available, the manual calculation techniques ~~described in Startup Test Instruction 19~~ can be used for the core performance evaluation.

14.42 & 14.29.

x 14.2.12.3.16.4 Criteria

Level 1

@ The maximum linear heat generation rate (MLHGR) ~~of any rod~~ during steady-state conditions shall not exceed the limit specified by the Plant Technical Specifications. 14.42

14.2.12.3.16.4 Criteria (Continued)

b) The steady-state Minimum Critical Power Ratio (MCPR) shall exceed the minimum limit specified by the Plant Technical Specifications.

c) The Maximum Average Linear Heat Generation Rate (MAPLHGR) shall not exceed the limits specified by the Plant Technical Specifications.

d) Steady-state reactor power shall be limited to the rated MWT and values on or below the minimum of either rated thermal power or the 105% steam flow design flow control line.

e) Core flow shall not exceed its rated value.

14.2.12.3.17 Startup Test Number 17 - Core Power-Void Mode Response

14.2.12.3.17.1 Purpose

Measure the stability of the core power-void dynamic response and to demonstrate that its behavior is within specified limits.

14.2.12.3.17.2 Prerequisites

The preoperational tests have been completed, the Startup Coordinating Group has reviewed and approved the test procedures and initiation of testing. System instrumentation is installed and calibrated and test instrumentation calibrated.

14.2.12.3.17.3 Description

The core power void loop mode, that results from a combination of the neutron kinetics and core thermal hydraulic dynamics, is least stable near the natural circulation end of the rated 100 percent power rod line. A fast change in the reactivity balance is obtained by a pressure regulator step change (see Test ~~20~~ 18) and by moving a high worth rod one or two notches. Both local flux and total core response will be evaluated by monitoring selected LPRM's during the transients.

14.2.12.3.17.3 Description (Continued)

OMIT ~~placed on the flux signals and dome pressure to emphasize this area as well as to suppress noise in the signal background.~~ 14.42

14.2.12.3.17.4 Criteria

Level 1

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

Level 2

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

14.42

14.2.12.3.18 Startup Test Number 18 - Pressure Regulator

14.2.12.3.18.1 Purpose

~~The purposes of this test are~~ (1) ~~to~~ Determine the optimum settings for the pressure control loop by analysis of the transients induced in the reactor pressure control system by means of the pressure regulators, (2) ~~to~~ Demonstrate the backup capability of the pressure regulators via simulated failure of the controlling pressure regulator, (3) ~~to~~ Demonstrate smooth pressure control transition between the turbine control valves and bypass valves when the reactor steam generation exceeds the steam flow used by the turbine, and (4) ~~to~~ Demonstrate that other affected parameters are within acceptable limits during pressure regulator induced transient maneuvers.

14.2.12.3.18.1 Purpose (Continued)

omit

(2) Demonstrate the takeover capability of the backup pressure regulator upon failure of the controlling pressure regulator and to set spacing between the setpoints at an appropriate value.

(3) Demonstrate smooth pressure control transition between the control valves and bypass valves when reactor steam generation exceeds steam used by the turbine.

14.42

ok 14.2.12.3.18.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

14.2.12.3.18.3 Description

The pressure setpoint will be decreased and then increased rapidly by about 10 psi (0.7 kg/cm^2) and the response of the system will be measured in each case. It is desirable to accomplish the set point change in less than 1 second. At specified test conditions the load limit setpoint will be set so that the transient is handled by control valves or bypass valves. The regulators will be tested by simulating a failure of a selected pressure regulator so that the other regulator will take over control. The response of the system will be measured and evaluated and regulator settings will be optimized.

14.42

14.2.12.3.18.4 Criteria

Level 1

The transient response of any pressure control system related variable to any test input must not diverge.

Level 2

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

The pressure response time from initiation of pressure setpoint change to the turbine inlet pressure peak shall be ≤10 seconds.

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

se

For all pressure regulator transients the peak neutron flux and/or peak vessel pressure shall remain below the scram settings by 7.5% and 10 psi respectively (maintain a plot of power versus the peak variable values along the 100% rod line).

The variation in incremental regulation (ratio of the maximum to the minimum valve of the quantity, "incremental change in pressure control signal/incremental change in steam flow", for each flow range) shall meet the following:

% of Steam Flow Obtained With Valves Wide Open	Variation
0 to 90	≤4:1
90 to 97%	≤2:1
90 to 99%	≤5:1

14.42

14.2.12.3.19 Startup Test Number 19 - Feedwater System

14.2.12.3.19.1 Water Level Setpoint, Manual Feedwater Flow Changes

14.2.12.3.19.1.1 Purpose

~~The purpose of this test is to~~ Verify that the feedwater system has been adjusted to provide acceptable reactor water level control.

14.2.12.3.19.1.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

14.2.12.3.19.1.3 Description

Reactor water level setpoint changes of approximately 3 to 6 inches (8 to 15 cm) will be used to evaluate (and adjust if necessary) the feedwater control system settings for all power and feedwater pump modes. The level setpoint changes will also demonstrate core stability to subcooling changes.

14.2.12.3.19.1.4 Criteria

Level 1

The transient response of any level control system-related variable to any test must not diverge.

Level 2

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

- The open loop dynamic flow response of each feedwater actuator (turbine or valve) to small (<10%) step disturbances shall be:

(1) Maximum time to 10% of a step disturbance	≤1.1 sec
(2) Maximum time from 10% to 90% of a step disturbance	≤1.9 sec
(3) Peak overshoot (% of step disturbance)	≤15%
(4) Settling time, 100% ± 5%	≤14 sec

- The average rate of response of the feedwater actuator to large (>20% of pump flow) step disturbances shall be between 10% and 25% rated feedwater flow/second. This average response rate will be assessed by determining the time required to pass linearly through the 10% and 90% response points.

14.2.12.3.19.2. Loss of Feedwater Heating 14.30

14.2.12.3.19.2.1 Purpose

~~The purpose of~~ This test is to demonstrate adequate response to a feedwater temperature loss.

14.2.12.3.19.2.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

14.2.12.3.19.2.3 Description

The condensate/feedwater system will be studied to determine the single failure that will cause the largest loss in feedwater heating. This event will then be performed at between 80% and 90% power with the recirculation flow near its rated value.

14.2.12.3.19.2.4 CRITERIA

Level 1

For the feedwater heater loss test, the maximum feedwater temperature decrease due to a single failure case must be $\leq 100^{\circ}F$. The resultant MCPR must be greater than the fuel thermal safety limit.

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

Level 2

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

14.2.12.3.19.3. Feedwater Pump Trip

14.2.13.3.19.3.1 Purpose

~~The purpose of this test is to~~ Demonstrate the capability of the automatic core flow runback feature to prevent low water level scram following the trip of one feedwater pump.

14.4.2

14.4.2

14.2.12.3.19.3.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

14.2.12.3.19.3.3 Description

One of the normally operating feedwater pumps will be tripped and the automatic recirculation runback circuit will act to drop the power to within the capacity of the remaining feedwater pump. Prior to the test a simulation of the feedwater pump trip will be done to verify the runback capability of the recirculation system. This test should be performed after ~~Test 23B~~ Section 14.2.12.3.13.4 (limiting pump speeds). For the BWR/6, the recirculation system can be adjusted to allow runback to a lower power (~65% NBR). This will help meet the Level 2 criterion.

14.2.12.3.19.3.4 Criteria

Level 2

The reactor shall avoid low water level scram by three inches margin from an initial water level halfway between the high and low level alarm setpoints.

14.2.12.3.19.4. Maximum Feedwater Runout Capability 14.30

14.2.12.3.19.4.1. Purpose

~~This test~~ Calibrates the feedwater flow and determines if the maximum feedwater runout capability is compatible with the licensing.

14.2.12.3.19.4.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

14.42

14.2.12.3.19.4.3 Description

The test is divided into two parts, first, the initial calibration of the speed controller and second, verification of calibration by measured data which includes a verification that the maximum feedwater flows do not exceed the flows (different flows at different vessel pressures) in the FSAR.

1. The speed controller calibration is done by first obtaining vendor pump performance curves. The pump performance curves are then used to determine the turbine speed corresponding to the maximum allowable flow at rated vessel pressure specified by the FSAR and the minimum speed which corresponds to 0% flow at 865 psia. Additionally, for good level control system performance it's desirable to be able to reach 115% NBR flow at 1080 psia and 80% NBR flow at 1024 psia in the one pump tripped condition. Adjustable equipment (i.e., feedpump turbine speed loops, mechanical limiters, feedwater control system function generator, etc.) are set to prevent the feedwater pumps from exceeding their maximum allowed output, and yet allow the desirable performance.

2. During the data collection and verification of calibration portion of the test, pressure, flow and controller data will be collected between 60-100% power. Measured data will be compared against expected values to ensure proper calibration. The measured maximum flow will be adjusted to the FSAR pressures using the measured data. The maximum flows stated in the FSAR are used as licensing assumptions, therefore, the FSAR maximum flows should not be exceeded. If, however, the FSAR maximum flows are exceeded there exist two options. The system can be adjusted so that the licensing assumption is not exceeded or an additional penalty can be applied to the ΔCPR. The ΔCPR can be revised by applying a .01 adder for each five percent of rated feedwater flow difference (between the determined actual maximum flow and the FSAR maximum flow).

14.2.12.3.19.4.4 Criteria

Level 1

Maximum speed attained shall not exceed the speeds which will give the following flows with the normal complement of pumps operating.

130% flow at 1080 psia
130 + 0.2 (1080 - P rated)% NBR at P rated psia

Level 2

The maximum speed must be greater than the calculated speeds required to supply:

With rated complement of pumps - 115% NBR at 1080 psia
One feedwater pump tripped condition - 80% NBR at 1024 psia

14.2.12.3.19.4 Criteria

Level 1

The decay ratio must be less than 1.0 for each process variable that exhibits oscillatory response to feedwater system changes. The maximum feedwater temperature decrease for the feedwater heater loss test must be less than or equal to 100°F.

(1) Heat flux increases shall be ≤2% of prediction.

(2) Feedwater runout capability must not exceed the Final Safety Analysis Report value.

Level 2

The decay ratio is expected to be less than or equal to 0.25 for each process variable that exhibits oscillatory response to feedwater system changes when the plant is operating above the lower limit of the master flow controller.

The automatic core flow runback feature will prevent a scram from low water level following a trip of one of the operating feedwater pumps.

With the condensate system operating normally, the control system shall prevent pump damage due to cavitation.

(1) Increase in heat flux cannot exceed prediction.

(2) Dynamic flow response to small (10%) change will be defined later.

(3) Average rate of feedwater actuator defined for large step disturbances will be supplied later.

14.42

14.2.12.3.20 Startup Test Number 20 - Turbine Valve Surveillance

14.2.12.3.20.1 Purpose

Demonstrate the acceptable procedures and maximum power levels for surveillance testing of the main turbine control, stop, and bypass valves without producing a reactor scram.

14.2.12.3.20.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

14.2.12.3.20.3 Description

Individual main turbine control, stop and bypass valves are tested routinely during plant operation as required for turbine surveillance testing. At several test points the response of the reactor will be observed. It is recommended that the maximum possible power level for performance of these tests along the 100% load line be established. First actuation should be between 45 and 65% power, and used to extrapolate to the next test point between 75 and 90% power and ultimately to the maximum power test condition with ample margin to scram. Note proximity to APRM flow bias scram point and PCIOMR envelope. Each valve test will be manually initiated and reset. Rate of valve stroking and timing of the close-open sequence will be such that the minimum practical disturbance is introduced and that PCIOMR limits are not exceeded.

14.42

14.2.12.3.20.4 Criteria

Level 2

Peak neutron flux must be at least 7.5% below the scram trip setting. Peak vessel pressure must remain at least 10 psi below the high pressure scram setting. Peak heat flux must remain at least 5.0% below its scram trip point.

14.42

Peak steam flow in each line must remain 10% below the high flow isolation trip setting.

14.2.12.3.20.4 Criteria (Continued)

Level 2

OMIT

(1) Peak neutron flux must be at least 7.5% below the scram trip setting. Peak vessel pressure must remain at least 10 psi below the high pressure scram setting.

(2) Peak steam flow in each line must remain 10% below the high flow isolation trip setting.

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

14.2.12.3.21 Startup Test Number 21 - Main Steam Isolation Valves 14.32

14.2.12.3.21.1 MSIV Function Tests

14.2.12.3.21.1.1 Purpose

~~[illegible]~~ (1) Functionally check the main steam line isolation valves (MSIVs) for proper operation at selected power levels, (2) Determine isolation valve closure times (3) Determine a maximum power at which full closures of a single valve can be performed without a scram.

14.42

14.2.12.3.21.1.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

14.2.12.3.21J.3 Description

At, 5% and greater reactor power levels, individual fast closure of each MSIV will be performed to verify their functional performance and to determine closure times. The times to be determined are a) the time from de-energizing the solenoids until the valve is 100% closed (t_{sol}) and b) the valve stroke time (t_s). Time t_{sol} equals the interval from de-energizing the solenoids until the valve reaches 90% closed plus 1/8 times the interval from 10% to 90% closure. Time t_s equals the interval from when the valve starts to move until it is 100% closed, and is based on the interval from 10% to 90% closure and linear valve travel from 0% to 100% closure.

To determine the maximum power level at which full individual closures can be performed without a scram first actuation will be performed between 40 and 55% power and used to extrapolate to the next test point between 60 and 85% power, and ultimately to the maximum power test condition with ample margin to scram.

14.2.12.3.21J.4 Criteria

14.42

Level 1

The MSIV stroke time (t_s) shall be no faster than 3.0 seconds (average of the fastest valve in each steam line) and for any individual valve 2.5 seconds $\leq t_s \leq 5$ seconds. Total effective closure time for any individual MSIV shall be t_{sol} plus the maximum instrumentation delay time as determined in the Nuclear Boiler System pre-operational test ~~OB-4~~ (14.2.12.1.6) and shall be ≤ 5.5 seconds.

Level 2

The reactor shall not scram or isolate.

During full closure of individual valves peak vessel pressure must be 10 psi (0.7 kg/cm^2) below scram, peak neutron flux must be 7.5% below scram, and steam flow in individual lines must be 10% below the isolation trip setting. The peak heat flux must be 5% less than its trip point.

14.2.12.3.21.2 [redacted] Full Reactor Isolation

14.2.12.3.21.2.1 Purpose

[redacted] Determine the reactor transient behavior that results from the simultaneous full closure of all MSIV's.

14.2.12.3.21.2.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

14.2.12.3.21.2.3 Description

A test of the simultaneous full closure of all MSIVs will be performed at >95% of rated thermal power. Correct performance of the RCIC and relief valves will be shown. Reactor process variables will be monitored to determine the transient behavior of the system during and following the main steam line isolation.

The operation of the safety grade low-low pressure relief logic system will be monitored. A comparison between the reactor pressure behavior and SRV actuations will be made to confirm open/close setpoints and containment load mitigation through the prevention of subsequent simultaneous SRV actuations.

14.2.12.3.21.2.4 Criteria

Level 1

Reactor must scram to limit the severity of the neutron flux and simulated fuel surface heat flux transient.

Feedwater system settings must prevent flooding of the steam lines.

The recorded MSIV full closure times must meet the previously stated timing specifications [redacted] (14.2.12.3.21.1.4)

The positive change in vessel dome pressure occurring within 30 seconds after closure of all MSIV valves must not exceed the Level 2 criteria by more than 25 psi. The positive change in simulated heat flux shall not exceed the Level 2 criteria by more than 2% of rated value.

If any safety/relief valves open, no more than one valve shall reopen after the first blowdown.

Level 2

The temperature measured by the thermocouples on the discharge side of the safety/relief valves must return to within 10°F of the temperature recorded before the valve was opened. If pressure sensors are available, they shall return to their initial state upon valve closure.

14.2.12.3.21.2.4 (CRITERIA Continued)

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

Initial Conditions		Criteria	
Power (%)	Dome Pressure (psia)	Increase In Heat Flux (%)	Increase In Dome Pressure (psi)
100	1040	*	*

Initial action of RCIC and HPCS shall be automatic if low water level (L2) is reached, and system performance shall be within specification.

Recirculation pump trip shall be initiated if low water level (L2) is reached. Recirculation pump power will shift to the Low Frequency Motor Generators if low water level (L3) is reached.

The total number of safety/relief valve opening cycles of the "low-low" set valve after initial blowdown shall not exceed three times during the initial five minutes following isolation.

If the low-low pressure relief logic functions, the open/close actions of the SRV's shall occur within $\pm$15 psi and $\pm$20 psi of their design setpoints, respectively.

*Later

14.4.2

14.2.12.3.21.3 Main Steamline Flow Venturi Calibration

14.2.12.3.21.3.1 **Purpose**

Calibrate the main steam flow venturis at selected power levels over the entire core flow range, the final calibration taking place with the data accumulated along the 100% rod line.

14.2.12.3.21.3.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

14.2.12.3.21.3.3 **Description**

Beginning at approximately 40% core thermal power pertinent plant data will be taken along the 75% rod line at selected power levels. The same process will be repeated along the 100% rod line. The accumulated data will then be compared against the calibration curves and a known flow source to verify that acceptable steam flow measurements have been made.

14.2.12.3.21.3.4 **Criteria**

~~Level 1~~

~~Not Applicable~~

Level 2

The accuracy of the MSL flow venturi relative to the calibrated feedwater flow shall be at least ±5 percent of rated flow at flow rates between 20 and 120% of rated. The repeatability/noise shall be within ±5 percent of rated flow.

14.42

14.2.12.3.21.4 Main Steamline Elbow Tap Calibration

14.2.12.3.21.4.1 **Purpose**

The purpose of this test is to investigate the performance of the main steamline elbow taps at selected power levels over the entire core flow range. With the accumulated data the main steamline elbow tap instrumentation will be calibrated to accurately reflect the process flows. If the steam flow measurement used by the reactor water level control system is from the flow venturis instead of the elbow taps, Section 14.2.12.3.21.4 need not be performed.

14.2.12.3.21.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

14.2.12.3.21.4.3

Description

Beginning at approximately 40% core thermal power pertinent plant data will be taken along the 75% rod line at selected power levels. The same data collection process will be repeated along the 100% rod line. Using the accumulated data a calibration curve will be constructed and compared against a known flow source.

14.2.12.3.21.4.4

Criteria

~~Level 1~~

~~[illegible]~~

Level 2

The accuracy of the elbow tap relative to the calibrated feedwater flow shall be at least ±5 percent of rated flow at flow rates between 20 and 120% of rated. The repeatability/noise shall be within ±5 percent of rated flow.

14.42

14.2.12.3.22 Startup Test Number 22 - Relief Valves

14.2.12.3.22.1 Purpose

(1) Verify that the relief valves can be opened and closed manually.

(2) Verify that the relief valves reseat properly after operation.

(3) Verify that there are no major blockages in the relief valve discharge piping.

14.2.12.3.22.2 Prerequisites

The preoperational tests have been completed,the SCG has reviewed and approved the test procedures and initiation of testing. All controls and interlocks are checked and instrumentation calibrated.

14.2.12.3.22.3 Description

A functional test of each safety/relief valve (SRV) shall be made as early in the startup program as practical. This is normally the first time the plant reaches 250 psig. The test is then repeated at rated reactor pressure. Bypass valve (BPV) response is monitored during the low pressure test and the electrical output response is monitored during the rated pressure test. The test duration will be about 10 seconds to allow turbine valves and tailpipe sensors to reach a steady state.

The tailpipe sensor responses will be used to detect the opening and subsequent closure of each SRV. The BPV and MWe responses will be analyzed for anomolies indicating a restriction in an SRV tailpipe. In addition lead boiling water reactor (BWR) plants will measure SRV tailpipe backpressure on the longest and shortest tailpipes.

Valve capacity will be based on certification by ASME Code stamp and the applicable documentation being available in the onsite records. Note that the nameplate capacity/pressure rating assumes that the flow is sonic. This will be true if the back pressure is

14.2.12.3.22.3 Description (Continued)

not excessive. A major blockage of the line would not necessarily be offset and it should be determined that none exists through the BPV response signatures.

Vendor bench test data of the SRV opening responses will be available on-site for comparison with design specifications.

14.2.12.3.22.4 Criteria

Level 1

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

Level 2

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

The temperature measured by thermocouples on the discharge side of the safety/relief valves shall return to within 10°F of the temperature recorded before the valve was opened. If pressure sensors are available they shall return to their initial state upon valve closure. 14.4.33 14.4.2

During the 250 psig functional test the steam flow through each relief valve, as measured by the initial and final bypass valve position, shall not differ by more than 10% from the average relief valve steam flow as measured by bypass valve position.

During the rated pressure test the steam flow through each relief valve, as measured by change in MWe, shall not differ more than 0.5% of rated MWe from the average of all the valve responses.

Discharge line back pressure shall be compatible with information presented on the Nuclear Boiler Process Flow Diagrams.

14.2.12.3.22.3 Criteria (Continued)

If pressure sensors are available, they shall return to their initial state upon valve closure.

(3) During the 250 psig functional test, the steam flow through each relief valve, as measured by the initial and final bypass valve position, shall not be less than 10% under the average of all valve responses.

(4) During the rated pressure test, the steam flow through each relief valve, as measured by MWe shall not be less than 5% of rated MWe under the average of all the valve responses.

omit

(5) If the SRVs have not been previously tested on a reactor, three valves shall be monitored and the total of the delay and stroke times shall be compatible with the design specification.

The sum of capacity measurements from all relief valves will be equal to or greater than rated, corrected for inlet pressure of 103% of the spring setpoint.

Level 2

(1) Relief valve leakage will be low enough that the temperature measured by the thermocouples in the discharge side of the valves returns to within 10°F (5.6°C) of the temperature recorded before the valve was opened. The thermocouples are expected to be operating properly.

(2) The pressure regulator must satisfactorily control the reactor transient and close the control valves or bypass

14.2.12.3.22.3 Criteria (Continued)

valves by an amount equivalent to the relief valve discharge. The valve transients recorder signatures for each valve must be returned to San Jose for relative system response comparison.

(3) Each relief valve will have a capacity between 90% and 122.5% of its rated flow <u>at 103%</u> of the spring setpoint.

(4) No more than 25% of the relief valves may have an individual corrected flow rate that is less than expected.

(5) The transient recorder signatures for each valve must be analyzed for relative system response comparison.

14.2.12.3.23 Startup Test Number 23 - Turbine Trip and Generator Load Rejection

14.2.12.3.23.1 Purpose

Demonstrate the response of the reactor and its control systems to protective trips in the turbine and generator.

14.2.12.3.23.2 Prerequisites

The preoperational tests have been completed,the SCG has reviewed and approved the test procedures and initiation of testing. All controls and interlocks are checked and instrumentation calibrated.

14.2.12.3.23.3 Description

Turbine Trip (closure of the main turbine stop valves within ~0.1 second) and Generator Trip (closure of the main turbine control valves in about 0.1 to 0.2 seconds) will be performed at selected power levels during the Startup Test Program. At low power levels, reactor protection following the trip is provided by high neutron flux and vessel high pressure scrams. For the protective trips occurring at intermediate and higher power levels, reactor will scram by relays, actuated by stop/control valve motion.

A generator trip will be performed at low power level such that nuclear boiler steam generation is just within the bypass valve capacity to demonstrate scram avoidance.

For the trips performed at intermediate power range, reactor scram is most important in controlling the transient peaks.

Above 40% power, the recirculation pump circuit breakers are both automatically tripped and subsequent transient pressure rise will be limited by the opening of the bypass valves initially, and the safety relief valves, if necessary.

The operation of the safety grade low-low set pressure relief logic system will be monitored. A comparison between the reactor pressure behavior and SRV actuations will be made to confirm open/close setpoints and containment load mitigation through the prevention of subsequent simultaneous SRV actuations.

For the turbine trip, the main generator breakers remain loaded for a time so there is no rise in turbine generator speed, whereas, in the generator trip, the main generator breaker opens and the residual turbine steam will cause a momentary rise in the generator speed. Specific plant designs, however, may be different from this general description.

14.2.12.3.23.4 Criteria

Level 1

For Turbine and Generator trips at power levels greater than 50% NBR, there should be a delay of less than 0.1 seconds following the beginning of control or stop valve closure before the beginning of bypass valve opening. The bypass valves should be opened to a point corresponding to greater than or equal to 80 percent of their capacity within 0.3 seconds from the beginning of control or stop valve closure motion.

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

14.2.12.3.23.4 Criteria (Continued)

The two pump drive flow coastdown transient during the first three seconds must be bounded by the criteria specified in ~~Test 33B~~ Startup Test Number 26 RECIRCULATION SYSTEM.

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

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

If any safety/relief valves open, no more than one valve shall reopen after the first blowdown.

Level 2

There shall be no MSIV closure during the first three minutes of the transient and operator action shall not be required during that period to avoid the MSIV trip. (The operator may take action as he desires after the first three minutes, including switching out of run mode. The operator may also switch out of run mode in the first three minutes if he confirms from measured data that this action did not prevent MSIV closure.)

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

(Predicted values will be referenced to actual test conditions of initial power level and dome pressure and will use BOL (Beginning of Life) nuclear data. Worst case design or technical specification values of all hardware performance shall be used in the prediction, with the exception of control rod insertion time and the delay from beginning of turbine control valve or stop valve motion to the generation of the scram signal. The predicted pressure and heat flux will be corrected for the actual measured values of these two parameters.)

For the Generator trip within the bypass valves capacity, the reactor shall not scram for initial thermal power values within that bypass valve capacity.

The measured bypass capacity (in percent of rated power) shal be equal or greater than that used for the FSAR analysis.

Recirculation LFMG sets shall take over after the initial recirculation pump trips and adequate vessel temperature difference shall be maintained.

Feedwater level control shall avoid loss of feedwater due to possible high level (L8) trip during the event.

Low water level total recirculation pump trip, HPCS and RCIC shall not be initiated.

14.2.12.3.23.4 CRITERIA (CONTINUED)

If the low-low set pressure relief logic functions, the open/close actions of the SRV's shall occur within ± 15 psi and ± 20 psi of their design setpoints, respectively.

The temperature measured by thermocouples on the discharge side of the safety/relief valves must return to within $10^{o}F$ of the temperature recorded before the valve was opened. If pressure sensors are available, they shall return to their initial state upon valve closure.

14.2.12.3.24 Startup Test Number 24 - Shutdown from Outside the Main Control Room

14.2.12.3.24.1 Purpose

Demonstrate that the reactor can be brought from a normal initial steady-state power level to the point where cooldown ir initiated and under control with reactor vessel pressure and water level controlled from outside the main control room.

14.2.12.3.24.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

14.2.12.3.24.3 Description

The test will be performed at a low power level and will consist of demonstrating the capability to scram and initiate controlled cooling from outside the Control room. The reactor will be scrammed and isolated from outside the control room after a simulated control room evacuation. Reactor pressure and water level will be controlled using SRVs, RCIC, and RHR from outside control room during the subsequent cooldown. The cooldown will continue until RHR shutdown cooling mode is placed in service from outside the control room. All other operator actions not directly related to vessel water level and pressure will be performed in the main control room. The RHR system operation from outside the control room will be demonstrated by operating the system in the suppression pool cooling mode and then shifting to the shutdown cooling mode. The system will be operated in the shut down cooling mode to lower coolant temperature at least 50°F. The plant will be maintained in hot standby condition for at least 30 minutes during the performance of this test.

14.2.12.3.24.4 Criteria

Level 2

During a simulated main control room evacuation, the reactor must be brought to the point where cooldown is initiated and under

14.2.12.3.24.4 Criteria (Continued)

control. The reactor vessel pressure and water level are controlled with equipment and controls outside the main control room.

14.2.12.3.25 Start up Test 25 - Recirculation Flow Control

14.2.12.3.25.1 - Valve Position Control

14.2.12.3.25.1.1 Purpose

~~The purpose of this test is~~ To demonstrate the recirculation flow control systems capability while in the valve position (POS) mode.

14.2.12.3.25.1.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedures and initiation of testing. All controls are checked and instrumentation calibrated.

14.2.12.3.25.1.3 Description

The testing of the Recirculation Flow Control System follows a "building block" approach while the plant is ascending from low to high power levels. Components and inner control loops are tested first, followed by drive flow control and plant power maneuvers to adjust and then demonstrate the outer loop controller performance. Preliminary component and valve position loop tests will be run when the plant is in cold shutdown in order to visually observe the hydraulic cylinder response. While operating at low power with the pumps using the low frequency power supply small step changes will input into the position controller and the response recorded.

14.2.12.3.25.1.4 CRITERIA.

Level 1

The transient response of any Recirculation system-related variables to any test input must not diverge.

Level 2

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

b) Maximum rate of change of valve position shall be 10 ± 1% sec.

During TC-3 and TC-6 while operating on the high speed (60 HZ) source, gains and limiters shall be set to obtain the following response.

c) Delay time for position demand step shall be:

14.2.12.3.25.1.4 CRITERIA (Continued)

For step inputs of 0.5% to 5% ≤0.15 sec.

For step inputs of 0.2% to 0.5% (see Figure 14.3-?)

4 Response time for position demand step shall be:

For step inputs of 0.5% to 5% ≤0.45 sec

For step inputs of 0.2% to 0.5% (see Figure 14.3-?)

5 Overshoot after a small position demand input (1 to 5%) step shall be <10% of magnitude of input.

14.2.12.3.25.2 Recirculation Flow Control

14.2.12.3.25.2.1 Purpose

~~The purposes of this test are~~ (1) ~~to~~ Demonstrate the core flow system's control capability over the entire flow control range, including core flow neutron flux and load following modes of operation, ~~and~~ (2) ~~to~~ Determine that all electrical compensators and controllers are set for desired system performance and stability.

14.2.12.3.25.2.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedures and initiation of testing. All controls are checked and instrumentation calibrated.

14.2.12.3.25.2.3 DESCRIPTION

Following the initial position mode tests of Section 14.2.12.3.25.1 the final adjustment of the position loop gains, flow loop gains, and preliminary values of the flux loop adjustments will be made on the midpower line. This will be the most extensive testing of the recirculation control system. The core power distribution will be adjusted by control rods to permit a broad range of maneuverability with respect to PCIOMR. In general, the controller dials and gains will be raised to meet the maneuvering performance objectives. Thus the system will be set to be the slowest that will perform satisfactorily, in order to maximize stability margins and minimize equipment wear by avoiding controller overactivity.

Because of PCIOMR power maneuvering rate restrictions, the fast flow maneuvering adjustments are performed along a mid power rod line, and an extrapolation made to the expected results along the 100 percent rod line.

14.2.12.3.25.2.3 DESCRIPTION (CONTINUED)

The utility has the option to decide to:

a. Perform the faster power changes on the 100 percent rod line that are greater than what the PCIOMR allow, or

b. To accept the mid power load line demonstrations as acceptable proof of maneuverability.

For immediate commercial operation, the flux loop and automatic load following loop will be set slower, and the operator will limit his actions in the manual mode. If PCIOMR's are ever withdrawn the tested faster Auto settings can be inserted onto the controller with only a brief dynamic test, rather than a full startup test.

14.2.12.3.25.2.4 CRITERIA.

14.2.12.3.25.2.4.1 Flow Loop Criteria

Level 1

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

Level 2

a) The decay ratio of the flow loop response to any test inputs shall be <0.25.

b) The flow loops provide equal flows in the two loops during steady state operation. Flow loop gains should be set to correct a flow imbalance in less than 25 sec.

c) The delay time for flow demand step (≤5%) shall be 0.4 seconds or less.

d) The response time for flow demand step (≤5%) shall be 1.1 seconds or less.

e) The maximum allowable flow overshoot for step demand of ≤5% of rated shall be 6% of the demand step.

f) The flow demand step settling time shall be 6 sec.

14.2.12.3.25.2.4.2 Flux Loop Criteria

Level 1

The flux loop response to test inputs shall not diverge.

14.2.12.3.25.2.4.2 FLUX LOOP CRITERIA (CONTINUED)

Level 2

a) Flux overshoot to a flux demand step shall not exceed 2% of rated for a step demand of ≤20% of rated.

b) The delay time for flux response to a flux demand step shall be ≤0.9 sec.

c) The response time for flux demand step shall be ≤2.5 sec.

d) The flux setting time shall be ≤15 sec. for a flux demand step ≤20% of rated.

14.2.12.3.25.2.4.3 Load Following Loop Criteria

Level 1

The load following loop response to test inputs shall not diverge.

Level 2

a) The decay ratio of the load following response shall be ≤.25.

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

c) When a load demand step of greater than 10% is applied (N%), the load demand error must be within 10% of the magnitude of the step within N seconds. If PCIOMR restrictions apply this test can be performed at a lower rod line and extrapolated to the rated rod line

14.2.12.3.25.2.4.4 Scram Avoidance and General Criteria

Level 1

Not applicable

Level 2

For any one of the above loops' test maneuvers, the trip avoidance margins must be at least the following:

a) For APRM ≥7.5%

b) For simulated heat flux ≥5.0%

c) The load following loop response shall produce steam flow variations no larger than 0.5% of rated steam flow.

14.2

14.2.12.3.25.2.4.5 Flux Estimator Test Criteria.

Level 2

a. Switching between estimated and sensed flux should not exceed 5 times/5 minutes at steady state.

b. During flux step transient there should be no switching to sensed flux or if switching does occur, it should switch back to estimated flux within 20 seconds of the start of the transient.

14.2.12.3.25.2.4.6 Flow Control Valve Duty Test Criteria

Level 2

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

$$\frac{\text{Integrated valve movement in percent}}{2 \times \text{time span in seconds}} \ (\%\ \text{hz})$$

4.2.12.3.26 Startup Test #26 – Recirculation System

4.2.12.3.26.1 One Pump Trip

14.2.12.3.26.1.1 Purpose

~~The purposes of this test are~~ (1) ~~to~~ Obtain recirculation system performance data during the pump trip, flow coastdown, and pump restart, ~~and~~ (2) ~~to~~ Verify that the feedwater control system can satisfactorily control water level without a resulting turbine trip/scram.

14.2.12.3.26.1.2 Prerequisites

The preoperational tests have been completed and the SCG has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

14.2.12.3.26.1.3 Description

The reactor coolant recirculation system consists of the reactor vessel and two piping loops. Each loop contains a constant speed centrifugal recirculation pump, a flow control valve, and two isolation valves located in the drywell; and ten jet pumps in parallel, situated in the reactor downcomer. Each recirculation pump takes suction from the reactor downcomer and discharges through a manifold system to the nozzles of the ten jet pumps. Here the flow is augumented by suction flow from the downcomer and delivered to the reactor inlet plenum.

A potential threat to plant availability is the high water level turbine trip scram caused by the level upswell that results after an unexpected recirculation one pump trip. The change in core flow and the resultant power decrease causes void formation which the level sensing system senses as a rise in water level. The one pump trip tests are to prove that the water level will not rise enough to threaten a high level trip of the main turbine or the feedwater pumps.

priate stops which will run back the recirculation flow from the possible cavitation region. It will be verified that these limits are sufficient to prevent operation where recirculation pump or jet pump cavitation occurs.

14.2.12.3.26.1.4

Criteria

Level 1

The reactor shall not scram during the one pump trip recovery.

Level 2

The reactor water level margin to avoid a high level trip shall be ≥3.0 inches during the one pump trip.

NOTE

Margin to trip is defined as:
Margin = (Hi Level Trip L8 Setpoint) - (Maximum water level reached during test) - (Hi Level Alarm L7 setpoint - Initial water level)

The simulated heat flux margin to avoid a scram shall be ≥ 5.0 percent during the one pump trip recovery.

The APRM margin to avoid a scram shall be ≥7.5% during the one pump trip recovery.

The time from zero pump speed to full pump speed shall be greater than 3 seconds.

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14.2.12.3.26.2 RPT Trip of Two Pumps

14.2.12.3.26.2.1 Purpose

~~[illegible]~~ Record and verify acceptable performance of the recirculation two pump circuit trip system.

14.2.12.3.26.2.2 Prerequisites

The preoperational tests have been completed and the SCG has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

14.2.12.3.26.2.3 Description

In case of higher power turbine or generator trips, there is an automatic opening of circuit breakers in the pump power supply. The result is a fast core flow coastdown that helps reduce peak neutron and heat flow in such events. This two pump trip test verifies that this flow coastdown is satisfactory prior to the high power turbine/generator trip tests and subsequent operation.

14.2.12.3.26.2.4 Criteria

Level 1

The two pump drive flow coastdown transient during the first 3 seconds must be bounded by the limiting curves.

(The limiting curves will be determined based upon measurement of the recirculation flowdelta P using the elbow flow meters, transmitter time delay, and time constant).

14.2.12.3.26.3 System Performance

14.2.12.3.26.3.1 Purpose

~~[illegible]~~ Record recirculation system parameters during the power test program.

14.2.12.3.26.3.2 Prerequisites

The preoperational tests have been completed and the SCG has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

14.2.12.3.26.3.3 Description

Recirculation system parameters will be recorded at several power-flow conditions and in conjunction with single pump trip recoveries and internals vibration testing (if applicable). (14.2.12.3.29),

Criteria

14.2.12.3.26.3.4

~~Level 1~~

~~Not applicable~~

Level 2

The core flow shortfall shall not exceed 5% at rated power.*

The measured core ΔP shall not be >0.6 psi above prediction.*

The calculated jet pump M ratio shall not be < 0.2 points below prediction*.

The drive flow shortfall shall not exceed 5% at rated power.*

The measured recirculation pump efficiency shall not be >8% points below the vender tested efficiency.

The nozzle and riser plugging criteria shall not be exceeded.

*The G.E. Steam Generation System Design Unit will provide predictions for the comparisons for these criteria.

14.2.12.3.26.4 Recirculation Pump Runback

14.2.12.3.26.4.1 Purpose

~~The purpose of this test is to~~ Verify the adequacy of the recirculation runback to mitigate a scram upon the loss of one feedwater pump.

14.2.12.3.26.4.2 Prerequisites

The preoperational tests have been completed and the SCG has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

14.42

14.2.12.3.26.4.3

Description

While operating at near rated recirculation flow a loss of a feedwater pump will be simulated. The transient and final condition will be studied to determine the adequacy of the system in preventing a scram during the scheduled loss of a single feedwater pump test (14.2.12.3.19.3).

14.2.12.3.26.4.4

Criteria

~~Level 1~~

~~Not applicable~~

Level 2

The recirculation flow control valves shall runback upon a trip of the runback circuit.

14.2.12.3.26.5 Recirculation System Cavitation

14.2.12.3.26.5.1

Purpose

~~The purpose of this test is to~~ Verify that no recirculation system cavitation will occur in the operable region of the power-flow map.

14.2.12.3.26.5.2 Prerequisites

The preoperational tests have been completed and the SCG has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

14.42

14.2.12.3.26.5.3

Description

Both the jet pumps and the recirculation pumps will cavitate at conditions of high flow and low power where NPSH demands are high and little feedwater subcooling occurs. However, the recirculation flow will automatically runback upon sensing a decrease in subcooling (as measured by the difference between the steam and recirculation loop temperature), to lower the reactor power. The maximum recirculation flow is limited by appropriate stops which will run back the recirculation flow away from the possible cavitation region. It will be verified that these limits are sufficient to prevent operation where recirculation pump or jet pump cavitation is predicted to occur.

The recirculation system flow control valves will cavitate at conditions of high differential pressure and low power (low subcooling). The recirculation flow will automatically runback upon sensing a decrease in subcooling (as measured by a low feedwater flow). This limit will be verified to insure that operation is prevented where flow control valve cavitation may occur.

In both the above cases, flow runback is caused by a shift in the power supply to the recirculation pump motors from normal power to the low frequency motor generators.

14.2.12.3.26.5.4

Criteria

~~Level 1~~

~~Not applicable~~

Level 2

Runback logic shall have settings adequate to prevent operation in areas of potential cavitation.

14.2.12.3.27 Startup Test Number 27 - Loss of Turbine Generator and Offsite Power

14.2.12.3.27.1 Purpose

Determines electrical equipment and reactor system transient performance during a loss of auxiliary power.

14.2.12.3.27.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedures and initiation of testing. All controls and interlocks are checked and instrumentation calibrated.

14.2.12.3.27.3 Description

The loss of auxiliary power test will be performed at 20% to 30% of rated power and at least 10% of rated generator load. The proper response of the reactor plant equipment, automatic switching equipment and the proper sequencing of the diesel generator loads will be verified. Appropriate reactor parameters will be recorded during the resultant transient. The plant will be maintained isolated from off-site power for at least 30 minutes.

14.2.12.3.27.4 CRITERIA

Level 1

a) Reactor protection system actions shall prevent violation of fuel thermal limits.

b) All safety systems, such as the Reactor Protection System, the diesel-generators, and HPCS must function properly without manual assistance, and HPCS and/or RCIC system action, if necessary, shall keep the reactor water level above the initiation level of Low Pressure Core Spray, LPCI, and Automatic Depressurization systems, and MSIV closure. Diesel generators shall start automatically.

c) The turbine steam bypass valves shall meet the fast opening requirement stated in Test 23 after turbine/generator trips and remain operable until the MSIV's are closed or until the low condenser vacuum signal closes the bypass valves.

d) If any safety/relief valves open, no more than one valve shall reopen after the first blowdown.

14.2.12.3.27.4 Criteria (Continued)

Level 2

a. Proper instrument display to the reactor operator shall be demonstrated, including power monitors, pressure, water level, control rod position, suppression pool temperature and reactor cooling system status. Displays shall not be dependent on specially installed instrumentation.

g. If the low-low set pressure relief logic functions, the open/close actions of the SRV's shall occur within ±15 psi and ±20 psi of their design setpoints, respectively.

h. If safety/relief valves open, the temperature measured by thermocouples on the discharge side of the safety/relief valves must return to within 10°F of the temperature recorded before the valve was opened. If pressure sensors are available, they shall return to their initial state upon valve closure.

~~exceed the Level 2 criteria by more than 2% of rated value.~~

~~(5) Pressure and heat flux must be within 25 psi and 2% of prediction.~~

~~Level 2~~

~~(1) There shall be no MSIV closure during the first three minutes of the transient and operation action shall not be required during that period to avoid the MSIV trip.~~

~~(2) The positive change in vessel dome pressure and in simulated heat flux which occur within the first 30 seconds after the initiation of either generator or turbine trip must not exceed the predicted values.~~

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14.2.12.3.27.4 Criteria (Continued)

~~(Predicted values will be referenced to actual test conditions of initial power level and dome pressure and will use beginning of life (BOL) nuclear data. Worst-case design or technical specification values of all hardware performance shall be used in the prediction with the exception of control rod insertion time and the delay from beginning of turbine control valve or stop valve motion to the generation of the scram signal. The predicted pressure and heat flux will be corrected for the actual measured values of these two parameters.)~~

~~(3) For the generator trip within the bypass valves capacity, the reactor shall not scram for initial thermal power values within that bypass valve capacity.~~

14.42

14.2.12.3.28 Startup Test Number 28 - Drywell Piping Vibration

14.2.12.3.28.1 Purpose

(1) Verify that the main steam, recirculation and RCIC steam piping vibration is within acceptable limits. (2) Verify that during operating transient loads that pipe stresses are within code limits.

14.42

14.2.12.3.28.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

14.2.12.3.28.3 Description

This test is an extension of Test 14, system expansion, and the preoperational vibration tests. Consult the specification of Test 14 for piping considered to be within the scope of testing.

Because of limited access due to high radiation levels, no visual observation is required during the startup phase of the testing. Remote measurements of piping vibrations shall be made during the following steady state conditions:

a. Main steam flow at 25% of rated;

b. Main steam flow at 50% of rated;

c. Main steam flow at 75% of rated;

d. Main steam flow and recirculation flow at 100% of rated;

e. RCIC turbine steam line flow at 100% of rated;

f. RHR suction piping at 100% of rated flow in the shutdown cooling mode;

g. Recirculation at minimum flow and coincident temperature;

h. Recirculation flow at 50% ± 5% of rated and at operating temperature;

i. Recirculation flow at 75% ± 5% of rated and at operating temperature.

During the operating transient load testing the amplitude of displacement and number of cycles per transient of the main steam and recirculation piping will be measured, and the displacements compared with acceptance criteria. Remote vibration and deflection measurements shall be taken during the following transients:

a. Recirculation pump start;

b. Recirculation pump trip at 100% of rated flow;

c. Turbine stop valve closure at 100% power;

d. Manual discharge of each SRV valve at 1,000 psig and at planned transient tests that result in SRV discharge.

The locations to be monitored and predicted displacements for the monitored locations in each plant will be provided later.

1.2.12.3.28-4 CRITERIA

Level 1

Operating Transients: Level 1 limits on piping ~~[illegible]~~ displacements are ~~[illegible]~~ based on keeping the loads on piping and suspension components within safe limits. If any one of the transducers indicates that these movements have been exceeded, the test shall be placed on hold.

Operating Vibration: Level 1 limits on piping acceleration and displacement are ~~[illegible]~~ based upon keeping piping stresses and pipe mounted equipment accelerations within safe limits. If any one of the transducers indicate that the prescribed limits are exceeded, the test shall be placed on hold.

Level 2

Operating Transients: Transducers have been placed near points of maximum anticipated movement. Where movement values have been predicted, tolerances are prescribed for differences between measurements and predictions. Tolerances are based on instrument accuracy and suspension free play. Where no movements have been predicted, limits on displacement have been prescribed. ~~[illegible]~~

Operating Vibration: ~~[illegible]~~ The evaluation criteria takes two forms: limits on vibratory displacement and limits on acceleration. The limits have been set based on consideration of analysis, operating experience and protection of pipe mounted components.

14.2.12.3.29 Startup Test Number 29 - RPV Internals Vibration

A unique RPV internal vibration monitoring program is specified for each reactor size and type.

14.2.12.3.29 Startup Test Number 29 - RPV Internals Vibration (Continued)

A prototype internal vibration test is scheduled for Perry Unit I. This plant will therefore have a prototype vibration test only if Perry is delayed. As presently scheduled, this plant will require only a confirming test conducted during the preoperational test program. "(section 14.2.13.1.31)".

14.2.12.3.30 Startup Test Number 30 - Recirculation System Flow Calibration

14.2.12.3.30.1 Purpose

Perform complete calibration of the installed recirculation system flow instrumentation.

14.2.12.3.30.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

14.2.12.3.30.3 Description

During the testing program at operating conditions which allow the recirculation system to be operated at rated flow at rated power, the jet pump flow instrumentation will be adjusted to provide correct flow indication based on the jet pump flow. After the relationship between drive flow and core flow is established, the flow biased APRM/RBM system will be adjusted to match this relationship.

14.2.12.3.30.4 Criteria

Level 2

Jet pump flow instrumentation shall be adjusted so that the jet pump total flow recorder will provide a correct core flow indication at rated conditions.
The APRM/RBM flow-bias instrumentation shall be adjusted to function properly at rated conditions.
The flow control system shall be adjusted to limit maximum core flow to 102.5% of rated by limiting the flow control valve opening position.

14.2.12.3.31 Startup Test Number 31 - Reactor Water Cleanup System

14.2.12.3.31.1 Purpose

Demonstrate specific aspects of the mechanical operability of the reactor water cleanup system (RWCS). (This test, performed at rated reactor pressure and temperature, is actually the completion of the preoperational testing that could not be done without nuclear heating.)

14.2.12.3.31.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

14.2.12.3.31.3 Description

With the reactor at rated temperature and pressure, process variables will be recorded during steady state operation in three modes as defined by the System Process Diagram: Hot Shutdown with loss of RPV recirculation pumps, Normal, and Blowdown. A comparison of the bottom head flow indicator and the RWCU inlet flow indicator will be made. The RWCU system sample station shall be tested at hot process conditions.

14.2.12.3.31.4 Criteria

Level 2

a) The temperature at the tube side outlet of the non-regenerative heat exchangers shall not exceed 130°F (54°C) in the blowdown mode and shall not exceed 120°F in the normal mode.

b) The pump available NPSH will be 13 feet or greater during the hot shutdown with loss of RPV recirculation pumps mode defined in the process diagrams.

c) The cooling water supplied to the non-regenerative heat exchangers shall be less than 6% above the flow corresponding to the heat exchanger capacity (as determined from the process diagram) and the existing temperature differential across the heat exchangers. The outlet temperature shall not exceed 180°F.

d) Recalibrate bottom head flow indicator [redacted] against RWCU flow indicator [redacted] if the deviation is greater than 25 gpm.

e) Pump vibration shall be less than or equal to 2 mils peak-to-peak (in any direction) as measured on the bearing housing and 2 mils peak-to-peak shaft vibration as measured on the coupling end.

14.2.12.3.32 Startup Test Number 32 - Residual Heal Removal System

14.2.12.3.32.1 Purpose

Demonstrate the ability of the Residual Heat Removal (RHR) System to: (1) remove heat from the reactor system so that the refueling and nuclear system servicing can be performed, and (2) condense steam while the reactor is isolated from the main condenser.

14.2.12.3.32.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

14.2.12.3.32.3 Description

With the reactor at a convenient thermal power, the condensing mode of the RHR system will be tuned and demonstrated. Condensing heat exchanger performance characteristics will be demonstrated. Final demonstration of the condensing mode will be done from an isolated condition. During the first suitable reactor cooldown, the shutdown cooling mode of the RHR system will be

14.2.12.3.32.3 Description (Continued)

demonstrated. Unfortunately the decay heat load is insignificant during the startup test period. Use of this mode with low core exposure could result in exceeding the 100°F/hr cooldown rate of the vessel if both RHR heat exchangers are used simultaneously. Late in the test program after accumulating significant core exposure, this demonstration would more adequately demonstrate the heat exchanger capacity. The RHR heat exchangers will also be tested in the suppression pool cooling mode.

14.4.2

14.2.12.3.32.4

Criteria

Level 1

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

Level 2

The RHR system shall be capable of operating in the steam condensing, suppression pool cooling and shutdown cooling modes (with both one and two heat exchangers) at the heat exchanger capacity determined by the flow rates and temperature differentials indicated on the process diagrams.

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

14.4.2

~~The RHR System shall be capable of operating in the steam condensing, suppression pool cooling, and shutdown cooling modes (with both one and two heat exchangers) at the flow rates and temperature differentials indicated on the process diagrams. System-related variables may contain oscillatory modes of response.~~

14.2.12.3.32.4 Criteria (Continued)

~~In these cases, the decay ratio for each controlled mode of response must be less than or equal to 0.25.~~

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

14.2.12.3.33 Startup Test Number 33 - Drywell Atmosphere Cooling System

14.2.12.3.33.1 Purpose

Verify the ability of the drywell atmosphere cooling system to maintain design conditions in the drywell during operating conditions and post-scram conditions.

14.2.12.3.33.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

14.2.12.3.33.3 Description

During heatup and power operation, data will be taken to ascertain that the drywell atmospheric conditions are within design limits.

14.2.12.3.33.4 Criteria

Level 2

The drywell cooling system shall maintain drywell air temperatures and humidity at or below the design values (Section 3.11) as specified for the Nuclear Island equipment.

14.2.12.3.34 Start-up Test Number 34 - Cooling Water Systems

14.2.12.3.34.1 Purpose

Verify that the performance of the Reactor Building Closed Cooling Water (RBCCW), the Turbine Building Closed Cooling Water (TBCCW), and Service Water Systems are adequate with the reactor at rated temperature.

14.2.12.3.34.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

14.2.12.3.34.3 Description

With the reactor at rated pressure, following initial heatup, data will be obtained to verify that the flow rates in the RBCCW and TBCCW heat exchangers are adequate and properly balanced and that the heat exchanger outlet temperatures are balanced within design values. Flow rate adjustments will be made as necessary to achieve satisfactory system performance. The test will be repeated at selected power levels to verify continued satisfactory performance with higher plant heat loads.

14.2.12.3.34.4 Criteria

All instrumentation indications and controls operate properly and system flow meets the requirements of design specifications.

14.2.12.3.35 Startup Test Number 35 - Offgas System

14.2.12.3.35.1 Purpose

Verify the proper operation of the offgas system over its expected operating parameters ~~and determine the performance of the activated carbon adsorbers~~. 14.42

14.2.12.3.35.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate. The carbon adsorber vault refrigeration system is available to the extent necessary to conduct the test.

14.2.12.3.35.3 Description

The Off-Gas System is designed to provide for hold up and decay of radioactive gases in the off-gas from the air ejector system before discharge to the atmosphere. The Off-Gas System further minimizes the release of radioactive particulate matter into the atmosphere and also minimizes the explosion potential in the off-gas through recombination of radiolytic hydrogen and oxygen under controlled conditions.

The Off-Gas system consists of preheaters, catalytic recombiners, condensers, gas coolers, desiccant dryers, high efficiency filters, activated carbon adsorbers, refrigerated glycol solution storage and pumping equipment, vault refrigerators and the necessary piping, valves, monitoring equipment, process instrumentation, and controls. The driving force for the system flow is provided by the last stage air ejector of the main condenser air ejector assembly. In the event of a low dilution steam flow, a valve in the process off-gas line between the main condenser and the steam jet air ejector closes automatically and remains closed until proper steam flow has been established. An air purge is provided for drying out the system at startup and for purging gas mixtures prior to maintenance. Throughout most of the Off-Gas system, there are two parallel lines of piping and equipment, the second line to be used as standby equipment should the first line malfunction or require maintenance.

14.42

System Flow/Pressure - At startup flow the pressures at selected locations will be recorded and checked to see that they are within design specifications. Pressure recordings will again be taken at normal operating flow.

The following Off-Gas system tests will be done at various power levels throughout plant startup while at steady-state conditions:

14.2.12.3.35.3 Description (Continued)

Hydrogen Analyzer - Check that the hydrogen analyzer is functioning and record the level of hydrogen in the recombiner effluent.

Relative Humidity - Check that the relative humidity in the off-gas system complies with design specifications.

Temperature - Monitor the temperature of the charcoal vault, charcoal beds, active and standby catalytic recombiner, the glycol tank and the cooler-condenser discharge to see that the specified limits are met.

Recombiner Performance - As the recombiner performance is least efficient in the 10% to 20% power range, it should be inspected closely in this range for correct initial operation. This is done by comparing the percentage of H_2 dry discharge (as a function of the catalyst bed temperature) to expected performance values.

Dilution Steam Flow - Readings of the off-gas dilution steam flow are taken to ensure that a hydrogen concentration of less than or equal to 4% is maintained in the recombiner feed.

Radionuclide Residence Times - Provided that reasonable and sufficient fission gases are present in the off-gas, measurements should be made of at least one radionuclide to determine the decontamination factor(s) across one or several charcoal beds.

After Filters - If sufficient particulate fission gas daughter products are present, measurements of decontamination factors across the after filters should be made. This is to confirm that the filters are operating properly during normal operating conditions.

Radiolytic Gas Production - Calculate the radiolytic gas production rate based on recombiner differential temperatures and verify that the production rate is within the design valve.

Desiccant Dryer Performance - Monitor the effluent dewpoint of a desiccant bed during its operating cycle to verify that discharge limits are met.

14.42

14.2.12.3.35.4 Criteria

Level 1

The release of radioactive gaseous and particulate effluents must not exceed the limits specified in the site technical specifications.

Flow of dilution steam to the noncondensing stage must not fall below 92% of the specified normal value when the steam jet air ejectors are pumping.

14.42

14.2.12.3.35.4 Criteria (Continued)

Level 2

The system flow, pressure, temperature, and dewpoint shall comply with the Process Data sheets supplied to the site.

The catalytic recombiner, the hydrogen analyzer, the desiccant dryers, the activated carbon beds, and the filters shall be working properly during operation, i.e., there shall be no gross malfunctioning of these components.

14.42

14.2.12.3.36 Startup Test Number 36 - Suppression Pool Makeup System

14.2.12.3.36.1 Purpose

Verify the capability of the suppression pool makeup system under simulated accident conditions to transfer the required fluid quantity from the upper containment pool to the suppression pool within a time period prescribed to ensure equal to or greater than two feet of fluid above the upper suppression pool vents.

Delete

14.2.12.3.36.2 Prerequisites

Apply test procedures reviewed and approved by the Startup Coordinating Group (SCG) using instrumentation which has been checked and calibrated to accomplish the required preoperational tests. Periodic tests shall confirm the operational capability of the suppression pool makeup system.

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14.2.12.3.36.3 Description

The periodic tests shall consist of the means to verify the operational status of all system components. During reactor shutdown, the HPCS pump shall be started after positioning valves of the HPCS System to pump water from the suppression pool to the condensate storage tank. The lowering of the water in the suppression

14.2.12.3.36.3 Description (Continued)

pool shall actuate the low-low suppression pool level alarm and not cause actuation of any dump valve. Observation of the suppression pool makeup system piping outlets over the suppression pool shall confirm there is no release of fluid from the upper containment pool. Next, these valves shall be opened manually one at a time to confirm there is no discharge of fluid. Follow this by opening the two-series Division 1 dump valves in less than 30 seconds from full closed to full open and continue to measure the time to release the required quantity of fluid from the upper containment pool to the suppression pool. Prior to this flow rate test, the upper containment pool gates must be in their proper positions for the test. The required water for transfer shall be contained in the upper containment pool above the top of the suppression pool makeup system inlets to preclude the need to rely on the reduced flow rate that occurs when air is introduced or when upper containment pool level is below the top of the inlets. The anti-vortex forming devices shall be in place for the test as well as during reactor operation. Following this portion of the test, water shall be pumped back up to the upper containment pool in order to repeat the timed transfer rate for the Division 2 two-in-series dump valves.

The allowable dump time shall be established for the test procedure and shall be less than the minimum full ECCS pump runout flow-start time and shall allow for the following: 30-second dump-valve-opening time, fluid-acceleration time to full gravity flow, reduced flow with reduction in head due to drop of upper containment pool water level, any cavitation effects in dump line, reduced flow caused by any vortex effects at inlets, and loss of inlet submergence. The quantity of fluid required to be transferred shall be equal to, or greater than, that established by the test procedure and shall include the following: required makeup volume inside the drywell below the weir wall, the added volume to fill the vessel above the normal level to the dome, volume in the steamlines to

delete

14.4.2

14.2.12.3.36.3 Description (Continued)

~~the inboard isolation valves on three lines and to the outboard isolation valve on the fourth, and the allowance for containment spray hold up on equipment and structural surfaces. The draw-down volume of the ECCS system operating at runout flow shall also be considered. It shall be necessary to determine how low the suppression pool must be lowered to contain the test fluid volume without overflowing the weir wall and measuring the fluid transferred.~~

~~14.2.12.3.36.4 Criteria~~

~~The test results shall confirm that the suppression pool makeup system is capable of transferring the required fluid volume within the allowed time period prescribed in the test procedures.~~

delete

14.X2

14.2.12.3.37 Startup Test Number 37 - Inclined Fuel Transfer System

14.2.12.3.37.1 Purpose

Verify the operability of the inclined fuel transfer system.

14.2.12.3.37.2 Prerequisites

The operational tests have been completed and the SCG has reviewed and approved the test procedures and initiation of testing. Instrumentation and mechanical control devices have been checked or calibrated as appropriate.

14.2.12.3.37.3 Description

Transfer fuel assemblies into and out of containment in accordance with the requirements of the operation and maintenance manual.

14.2.12.3.37.4 Criteria

(1) New ~~and spent~~ fuel assemblies shall be transferred without physical damage. 14.42

(2) The safeguard system shall preclude personnel being in the fuel transfer valve room during transfer of fuel.

Text addition for 640.23

14.2.12.3.38 Startup Test Number 38 - Concrete Temperature Survey

14.2.12.3.38.1 Purpose

The purpose of this test is to demonstrate the ability of natural convection to cool the concrete surrounding selected pipe penetrations in the containment wall.

14.2.12.3.38.2 Prerequisites

The preoperational tests have been completed, the SCG has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

14.2.12.3.38.3 Description

The penetration concrete temperature survey test consists of measuring concrete temperatures surrounding selected main steam and reactor water cleanup discharge piping penetrations in the containment and auxiliary buildings. Measurements from temperature sensors on the concrete will be recorded at various steady-state operating power levels. The measured temperatures will be compared, and proven to be acceptable with respect to the design criteria.

Temperatures will be recorded during initial heatup and at each major power level during the power ascension test phase.

14.2.12.3.38.4 Criteria

Level 1

The concrete temperature adjacent to the selected containment penetrations shall not exceed 200° F.

14.2-173

Table 14.2-1

PREOPERATIONAL TESTS

Subsection	Test Title	Page
14.2.12.1.1	Feedwater Control System	14.2-27
14.2.12.1.2	Reactor Feedwater System	*
14.2.12.1.3	Reactor Feedwater Pump Driver Control System	*
14.2.12.1.4	Reactor Water Cleanup System	14.2-28
14.2.12.1.5	Standby Liquid Control System	14.2-29
14.2.12.1.6	Nuclear Boiler System	14.2-30
14.2.12.1.7	Residual Heat Removal System	14.2-31
14.2.12.1.8	Reactor Core Isolation Cooling System	14.2-32
14.2.12.1.9	Reactor Recirculation System and Control	14.2-34
14.2.12.1.10	Rod Control and Information System	14.2-35
14.2.12.1.11	Control Rod Drive Hydraulic System	14.2-36
14.2.12.1.12	Fuel Handling and Vessel Servicing Equipment	14.2-37
14.2.12.1.13	Low Pressure Core Spray System	14.2-38
14.2.12.1.14	High Pressure Core Spray System	14.2-39
14.2.12.1.15	Fuel Pool Cooling and Cleanup System	14.2-41
14.2.12.1.16	Leak Detection System	14.2-42
14.2.12.1.17	Liquid and Solid Radwaste Systems	14.2-43
14.2.12.1.18	Reactor Protection System	14.2-47
14.2.12.1.19	Neutron Monitoring System	14.2-48

*Applicant will supply.

Table 14.2-1

PREOPERATIONAL TESTS (Continued)

Subsection	Test Title	Page
14.2.12.1.20	Traversing In-Core Probe System	14.2-50
14.2.12.1.21	Process Radiation Monitoring System (NSSS Portion)	14.2-51
14.2.12.1.22	Area Radiation Monitoring System	14.2-52
14.2.12.1.23	Process Computer Interface System	14.2-53
14.2.12.1.24	Rod Pattern Control System (RPCS)	14.2-54
14.2.12.1.25	Remote Shutdown	14.2-55
14.2.12.1.26	Offgas System	14.2-56
14.2.12.1.27	Environs Radiation Monitoring System	14.2-57
14.2.12.1.28	Inclined Fuel Transfer	14.2-57
14.2.12.1.29	Upper Pool Storage System	14.2-58
14.2.12.1.30	Plant Process Sampling System (Radwaste)	*
14.2.12.1.31	Reactor Vessel Flow-Induced Vibration	14.2-59
14.2.12.1.32	Air Positive Seal (SPD) System	14.2-67
14.2.12.1.33	Cask Decontamination	14.2-68
14.2.12.1.34	Nuclear Island Chilled Water	14.2-70
14.2.12.1.35	Demineralized Water and Condensate Distribution	14.2-72
14.2.12.1.36	Clean and Dirty Radwaste Drains	14.2-74
14.2.12.1.37	Detergent Drain System	14.2-75
14.2.12.1.38	Essential Service Water System	14.2-77
14.2.12.1.39	Fire Alarm System	14.2-79
14.2.12.1.40	Heated Water Distribution System	14.2-81

*Applicant will supply.

Table 14.2-1

PREOPERATIONAL TESTS (Continued)

*Applicant will supply.

Table 14.2-1
PREOPERATIONAL TESTS (Continued)

Subsection	Test Title	Page
14.2.12.1.62	Main Turbine Electro-Hydraulic Control System	*
14.2.12.1.63	Condensate System	*
14.2.12.1.64	Condensate Polishing Demineralizer System	*
14.2.12.1.65	Condensate Storage System	*
14.2.12.1.66	Closed Cooling Water System	
14.2.12.1.67	Combustible Gas Control System	
14.2.12.1.68	Isolation Valve Function and Closure Time	
14.2.12.1.69	Containment Penetration Leakage	
14.2.12.1.70	Containment Airlock Leak Rate	
14.2.12.1.71	Integrated Containment Leakage	
14.2.12.1.72	Containment Air Purification and Cleanup System	
14.2.12.1.73	Bypass Leakage	
14.2.12.1.74	Emergency Response Information System	
14.2.12.1.75	Expansion, Vibration and Dynamic Effects	
14.2.12.1.76	Containment Pressure Instrumentation Preoperational Test	

*Applicant will supply

Table 14.2-2

MAJOR PLANT TRANSIENTS

Test Title	Test Condition: Approximate Power (% Rated) / Approximate Core Flow (% Rated)	25 / 37	50 / 100	75 / 100	80 / 70	100 / 100
Feedwater Pump Trip						X
MSIVs (One Valve)			X		X	
MSIVs (All Valves)						X
T-G Stop Valve Fast Close						X*
T-G Control Valve Fast Close		X				X*
Recirc Pump Trip (One)			X			X
Loss of Generator and Offsite Power		X				

*One, but not both, of these cases will be performed.

Table 14.2-3

~~Table II~~

STARTUP TEST PROGRAM

TEST NUMBER 1 - CHEMICAL & REACTOR CHEMICAL MONITORING

Action
1. Reactor Water Chemistry & Radiochemistry, Gaseous and liquid efflents activity monitor.

Test Conditions
A. Prior to fuel loading
B. During heatup
C. Subsequent to major changes in power level

TEST NUMBER 2 - RADIATION MEASUREMENT

Action
1. Background radiation level survey
2. Monitor radiation level periodically during the startup

Test Conditions
A. Prior to fuel loading
A. Fuel loading
B. Reactor heatup
C. Steady state operation at 25%, 60%, and 100% of rated power.

TEST NUMBER 3 - FUEL LOADING

Action
1. Subcritical check, Shutdown margin demonstration, Control rod functional test

Test Conditions
A. During fuel loading
B. Control rod, neutron sources detectors are installed and tested

TEST NUMBER 4 - FULL CORE SHUTDOWN MARGIN

Action
1. Shutdown margin demonstration at beginning of cycle

Test Conditions
A. Xenon-free fully loaded core
B. All the control rods in their full-in configuration

TEST NUMBER 5 - CONTROL ROD DRIVE SYSTEM

Action	Test Conditions Reactor Pressure with Core Loaded psig (kg/cm^2) 0	600(42.2)	800(56.2)	Rated
Position Indication	all			
Insert/Withdraw a) Single CRD Notch & Continuous Modes	all			
b) Gang Groups Notch & Continuous Modes	all			
Coupling	all			
Friction	all			all
Cooling Water Flow Rates (Total)				1
Individual CRD Scram	all	4*	4*	all
Individual CRD Scram				4**

NOTE: Single CRD scrams should be performed with the charging valve closed. (Do not ride the charging pump head).

*Refers to four CRDs selected for continuous monitoring based on slow normal accumulator pressure scram times as determined from pre-operational testing, or unusual operating characteristics. The "four selected CRDs" must be compatible with the requirements of both the withdrawal sequence and the installed rod movement limitation systems.

**Scram times of the four slowest CRDs will be determined at Test Condition numbers 2, 3, and 6 before or during planned reactor scrams (see Test 25B, 27, 28).

TEST NUMBER 6 - SRM PERFORMANCE AND CONTROL ROD SEQUENCE

Action
1. Rod withdraw in prescribed sequence

Test Conditions
A. After fuel loading
B. Operational neutron sources installed
C. SRM min signal to noise count ratio and minimum count rate criteria satisfied.

TEST NUMBER 7 - DELETED

TEST NUMBER [illegible] - CONTROL ROD SEQUENCE EXCHANGE

USE 2 Test No 7.

415 TEST EEIX D E D D

Action
1. Demonstrate the rod sequence exchange procedure.

Test Conditions
A. Reduce to min. flow and highest possible core power that is above the low power set point and still results in all nodal powers remaining within their preconditioning threshold.
B. Core exposure should be near 1000 MWD/T and before commercial operation.

TEST NUMBER ~~10~~ - IRM PERFORMANCE

Action
1. Verify IRM-SRM overlap.
2. Verify IRM response to neutron flux.
3. Adjust IRM gain, if necessary, for proper IRM-APRM overlap.

Items 1 & 2 when flux

Test Conditions
A. ~~Flux~~ level sufficient for IRM response during first ascension to TC-1.
A. After first APRM calibration based on a heat balance.

TEST NUMBER ~~11~~ - LPRM CALIBRATION

Action
1. Verify LPRM flux response. (This test may be done in conjunction with rated pressure scram testing (see Test 5).
2. Take data and calibrate LPRM system

Test Conditions
A. Hot standby

A. TC1, 3 and 6.
B. All systems in NORM mode.

TEST NUMBER ~~12~~ - APRM CALIBRATION

Action
1. Calibrate APRM system based on heat balance data.

Test Conditions
A. Constant rate of heatup below rated pressure.

TEST NUMBER ~~12~~ 10 - APRM CALIBRATION

Action	Test Conditions
2. Calibrate APRM system based on steady state heat balance data.	A. Approximately 25% power at TC-2, TC-3,5 and 6 and repeated as necessary.

TEST NUMBER ~~13~~ 11 - PROCESS COMPUTER

Action	Test Conditions
1. Computer/TIP interface.	A. Items 1 and 2 do not require reactor operation.
2. Simulated Dynamic Input Test.	
3. Dynamic System Test Case.	A. To be completed between TC-1 and TC-3
4. Obtain data for transmittal to San Jose.	A. Reactor power greater than 80% of rated. B. Core flow at 100% of rated. C. Sequence A control rod pattern. D. A full core LPRM calibration (OD1) must be completed immediately prior to the data taking.

TEST NUMBER ~~14~~ 12 - RCIC

Action	Test Conditions
1. Condensate storage tank injection First Phase Manual start	A. For all RCIC testing; Recirc in POS mode and all other controllers in NORM mode. B. Optional demonstration prior to controller adjustments at 150 psig reactor pressure. C. Rated Reactor Pressure RCIC discharge 100 psi above RPV.
2. Condensate storage tank injection, step changes in flow ~~for controller adjustments.~~	A. Immediately after 1C with RCIC discharge to condensate storage tank. Manual and automatic control modes
3. Condensate storage tank injection, Extended Operation Demonstration.	A. In conjunction with 24.
4. Condensate Storage Tank Injection, Second Phase. Hot quick start ~~followed by stability demonstration.~~	A. Rated reactor pressure, RCIC discharge 100 psi above RPV. B. 150 psig reactor pressure RCIC discharge 100 psi above RPV.
5. Reactor vessel injection, manual start, step changes for controller adjustments, if necessary.	A. Rated reactor pressure. Manual and automatic modes.

TEST NUMBER ~~14~~ 13 - RCIC (cont'd)

Action	Test Conditions
6. Reactor vessel injection hot quick start.	A. Rated reactor pressure, automatic mode.
7. Reactor vessel injection, hot or cold quick start followed by stability demonstration.	A. 150 psig reactor pressure, manual and automatic modes.
8. Confirmatory reactor vessel injection, cold quick start.	A. Rated reactor pressure. Final RCIC controller settings.
9. Second consecutive confirmatory reactor vessel injection, cold quick start.	A. Same as 8A
10. Condensate storage tank injection for surveillance test base data, cold quick start.	A. Rated reactor pressure, final controller settings, RCIC discharge approximately 100 psi above RPV. B. 150 psig reactor pressure, final controller settings, RCIC discharge approximately 100 psi above RPV.

TEST NUMBER ~~16~~ 15 - SELECTED PROCESS TEMPERATURES

~~16A~~ 15A Vessel Temperature

Action	Test Conditions
1. Monitor vessel temperatures	A. During heatup B. At 100% core flow (TC3) C. After recirculation pump trips (natural circulation)

~~16B~~ 15B Water Level Reference Leg Temperature

Action	Test Conditions
1. Monitor drywell temperature	A. Hot standby with steady drywell temperatures.

TEST NUMBER ~~17~~ 14 - SYSTEM EXPANSION

Action	Test Condition
1. Visual inspection and hanger readings.	A. All control systems NORM mode. B. At approximately 250°F at accessable locations.
2. Record displacement sensor readings.	A. At approximately 250°F. B. At rated recirculation temperature. C. Repeat after MSIV are first opened if they were closed for B above. D. Repeat Item 1 after 3 to 5 complete heatup and cooldown cycles. E. At rated feedwater temperature.

TEST NUMBER ~~18~~ 15 - CORE POWER DISTRIBUTION

Action

1. Traversing In-core probe overall uncertainty.

Test Conditions

A. Octant symmetric control rod pattern.

B. At steady state.

C. TC-3 and 6.

TEST NUMBER ~~19~~ 16 - CORE PERFORMANCE

Action

1. Evaluate core thermal power flow and compute the thermal and hydraulic parameter associated with core behavior. Use plant process computer, offline computer system or manual calculations.

Test Conditions

A. TC-1, 2, 3, 4, 5 and 6 are necessary for documentation.

B. Additional points as necessary to assure compliance with technical specifications.

~~TEST NUMBER 20 - STEAM PRODUCTION~~

Action

~~1. Demonstrate steam quality and flow under steady conditions.~~

Test Conditions

~~A. At conditions prescribed in the Nuclear Steam System Warranty (TC-6)~~

~~B. Operate continuously for 100 hours.~~

TEST NUMBER ~~21~~ 17 - CORE POWER-VOID MODE RESPONSE

Action

1. Move high worth control rod 1 to 2 notches.

2. In conjunction with pressure regulator step changes (Test 22)

Test Conditions

A. TC-4 natural circulation.

B. Low power region of ~~xxxx~~ TC-5 with recirculation flow control valves at minimum position.

C. Low power region of TC-5 with LFMG power and minimum valve position.

D. High power region of TC-5

A. TC-4 and 5.

TEST NUMBER ~~21~~ 18 - PRESSURE REGULATOR

Action Operating Mode	Test Conditions Input	Test Condition 1	2	3	4	5	6
CV	Setpoint	No	Yes	Yes	Yes	Yes	Yes**
CV	Fail to Backup	No	Yes	Yes	Yes	Yes	Yes
BPV	Setpoint	Yes	Yes	No	Yes	Yes	Yes
BPV	Fail to Backup	Yes	Yes	No	Yes	No	Yes**
	Recirculation Modes	MAN	MAN	MAN FLX and ALF	MAN	MAN	MAN* FLX and ALF

*Either POS or FLO
**Perform only downward pressure transient in ALF mode at TC-6.

TEST NUMBER 23 - FEEDWATER SYSTEM 19

~~23A~~ 19A - Water Level Setpoint, Manual Feedwater Flow Changes

Action Operating Mode	Input	Test Conditions 1	2	3	4	5	6
3-Element	Setpoint	No	Yes	Yes	Yes	Yes	Yes
1-Element	Setpoint	No	Yes	Yes	Yes	Yes	Yes
NORM	Manual Flow Steps**	No	Yes	Yes	No	No	Yes
	Recirculation Modes	MAN*	MAN	MAN	MAN	MAN	MAN

*Either POS or FLO
**Manual Flow Steps to be done on each pump only when two pumps or more are on, with one or more in Automatic mode and the pump to be tested in Manual mode.

~~23B~~ 19C - Loss of Feedwater Heating

Action
1. Single event that causes largest decrease in feedwater temperature.

Test Condition
A. During TC-6 reduce power to between about 80 and 90 percent thermal power, and near 100 percent core flow.

~~23C~~ 19F - Feedwater Pump Trip

Action
1. Trip Feedwater Pump to demonstrate recirculation system runback scram avoidance (Test 23D and 30D must have already been done.)

Test Condition
A. TC-6.
B. All systems in NORM mode.

~~22D~~ 11C - Maximum Feedwater Runout Capability

Action	Test Condition
1. Record master controller output, feedwater pump suction, discharge, and reactor pressures, feedwater flow rate, turbine speed, and actual locations of the high and low speed stops.	A. Four equally spaced feedwater flow points. This can be done at TC-3 or any high power achieved prior to commercial operation. B. All systems in NORM mode. C. Maximum number of condensate and feedwater pumps normally operated at 100% power shall be running.
2. Determine sensitivity of feedwater flow to reactor pressure over a 30 psi range in 5 psi increments.	A. Reactor power between 80 and 90% rated. B. All systems in NORM mode. C. Maximum number of condensate and feedwater pumps normally operated at 100% power shall be running.

TEST NUMBER ~~24~~ 21 - TURBINE VALVE SURVEILLANCE

Action	Test Condition
1. Individually close turbine stop valves.	A. Between 45 and 65 percent power, and again between 75 and 90 percent power, perform third test at chosen maximum power level for all subsequent surveillance tests along the 100% rod line (non-equilibrium xenon). B. Mode of Recirculation System to be determined by testing (to minimize flux peak it is recommended that FLX mode be utilized); all others in NORM mode.
2. Individually close turbine control valves.	A. Perform the same 3-step power optimization procedure as in the above Stop Valve test (NOTE: For partial arc plants the effect of bypass valve sequence must be determined along the 100 percent load line.
3. Individually open turbine bypass valves.	A. Verify that special considerations are not necessary by testing at maximum power determined in 1A and 2A above.

TEST NUMBER 25 21 - MAIN STEAM ISOLATION VALVES

25A 21A - MSIV Functional Tests

Action	Test Conditions
1. Individually close each MSIV, fast mode.	A. Heatup and between TC-1 and 3, close each MSIV to measure valve timing only. B. Recirculation system in POS mode; other systems in NORM mode.
2. Close fastest MSIV, fast mode.	A. Close one valve between 40 and 55 percent power (TC-2 or 3) and again between 60 and 85 percent power (TC-3 or 5). Perform third test at chosen maximum power condition for all subsequent surveillance tests. B. Recirculation system in POS mode at TC-2 and 3 and FLX mode at TC-5. Other systems in NORM mode.
3. Slow MSIV closure to 90 percent.	A. To be done at powers where fast closure would result in scram. B. Recirculation system in FLX mode. Other systems in NORM mode.

25B 21B - Full Isolation

Action	Test Conditions
1. Close of all MSIV (Test 5 and 33A are to be done in conjunction with this test).	A. On the first plant to startup, perform at TC-6. For the second plant, the test must be performed at ≥75 percent power, and prior to the 100 percent turbine/generator trip. B. All systems in NORM mode.

25C 21C - Main Steamline Flow Venturi Calibration

Action	Test Conditions
1. ~~A.~~ Record data while increasing and while decreasing power.	A. Between TC-2 and 3 B. Between TC-5 and 6 C. All systems in NORM mode

25D 21D - Main Steamline Elbow Tap Calibration

Action	Test Conditions
1. Record data while increasing and while decreasing power.	A. Between TC-2 and 3 B. Between TC-5 and 6 C. All systems in NORM mode

TEST NUMBER ~~26~~ - RELIEF VALVES

Action	Test Conditions
1. Ten second Manual opening for functional check of valve and sensor response.	A. Heat Up. B. Recirculation system in FLO mode. Other systems in NORM mode.
2. Manual opening for plant response and valve reseating checks. (Test 33 is to be done in conjunction with this test).	A. Between the load lines defining TC-2 and 3. If any valve is readjusted, repeat test. B. Recirculation system in FLO mode. Other systems in NORM mode.

TEST NUMBER ~~27~~ - TURBINE STOP VALVE TRIP AND GENERATOR LOAD REJECTION

Action	Test Conditions
1. Generator Load Rejection, main breaker trip. (Test 33A to be done in conjunction with this test).	A. At TC-2 just within bypass system capacity. B. Recirculation system in FLO mode. Other systems in NORM mode. C. Manual intervention permissible to prevent high or low water level trip.
2. Main Turbine Trip Scram. (Test 33A is to be done in conjunction with this test.)	A. 60-80% power at ≥95% core flow. B. All systems in NORM mode.
3. Main Turbine or Generator Trip Scram. (Test 5 and 33A are to be done in conjunction with this test.	A. Choice of one or the other at TC-6. B. All systems in NORM mode.

TEST NUMBER ~~28~~ - SHUTDOWN FROM OUTSIDE THE CONTROL ROOM

Action	Test Conditions
1. To shutdown and cooldown an operating reactor from outside the control room.	A. Steady state power operation at TC-2. B. Reactor initially critical C. T-G on line

TEST NUMBER ~~29~~ - RECIRCULATION FLOW CONTROL SYSTEM

25A
~~29A~~ - Valve Position Control

Action	Test Conditions
1. Small and large step changes input into position controller.	A. Prior to plant heatup, reactor shutdown, recirc. pumps off. (Preop testing results may be used to satisfy this testing requirements.)

29A - Valve Position Control (cont'd)

Action	Test Conditions
2. Small step changes input into position controller.	A. Before or at TC-1 with pumps using low frequency power supply; at TC-3; between TC-5 and TC-6. B. Recirculation system in POS mode. Other systems in NORM mode.

29B - Recirculation Flow Loop Control

Action	Test Conditions
1. Large and small step and ramp inputs.	A. Between TC-2 and 3. B. Recirculation system in POS, FLO, FLX, and ALF modes. Other systems in NORM mode. C. Both normal and low frequency power sources to be used as applicable.
2. Step and ramp input changes to demonstrate satisfactory response.	A. Between TC-5 and 6. B. Recirculation system in POS, FLO, FLX, and ALF modes. Other systems in NORM mode.

TEST NUMBER 30 - RECIRCULATION PUMPS

30A - One Pump Trip

Action	Test Conditions
1. Trip one pump. (Test 33B can be done in conjunction with this test.)	A. At TC-3 with core flow ≥95% of rated. B. All systems in NORM mode.
2. Restart pump.	A. Between TC-2 and 3 (with as high a control rod line as possible). B. All systems in NORM mode.
3. Trip other pump. (Test 33B can be done in conjunction with this test.)	A. At TC-6. B. All systems in NORM mode.
4. Restart pump using procedures developed during earlier low power restart (Item 2).	A. On 100% load line. B. All systems in NORM mode.

26B
~~30B~~ - RPT Trip of Two Pumps

Action

1. Simulate T/G initiated RPT to trip all four RPT breakers simultaneously. (Test 33B can be done in conjunction with this test.)

Test Conditions

A. At TC-3 above 50% rated power and at 95% or more of rated core flow but before Test 27.
B. All systems in NORM mode. Water level may be lowered to avoid possible turbine trip scram.

26C
~~30C~~ - System Performance

Action

1. Record steady state operating data.

Test Conditions

A. At TC-2, 3, 4 and 6.
B. During recovery from single pump trips of Test 30A.
C. Between TC-2 and 3 and between TC-4 and 6 in conjunction with the Internal Vibration Testing, Test 34.

~~30D~~ - Recirculation Pump Runback

Action

1. Simulate loss of feedwater pump to initiate recirculation runback mode.

Test Conditions

A. At TC-3 with core flow ≥95% of rated.
B. All systems in NORM mode.

26D
~~30E~~ - Recirculation System Cavitation

Action

1. Insert control rods until cavitation occurs or a cavitation interlock initiates recirculation pump runback, whichever occurs first.

Test Conditions

A. At TC-2 and 3.
B. All systems in NORM mode.

TEST NUMBER 27 ~~31~~ - LOSS OF TURBINE-GENERATOR AND OFFSITE POWER

Action

1. After transferring auxiliary loads to the Unit Auxiliary Transformer and starting main and feedwater turbine's D.C. oil pump use trip relay to trip main generator. (Test 33A can be done in conjunction with this test).

Test Conditions

A. At TC-2.
B. Recirculation system in POS mode. All other systems in NORM mode.

TEST NUMBER ~~25~~ 28 - DRYWELL PIPING VIBRATION

~~33A~~ 28A - Main and RCIC Steam Lines

Action

1. Record steam line vibration.

Test Conditions

A. At 25, 50, 75, and at approximately 100% of rated main steam flow.

B. In conjunction with turbine/generator trip (Test 27) at TC-2, 3 and 6 and relief valve checks (Test 26) between TC-2 and 3.

C. RCIC turbine steam line at 100% of rated flow during TC-1 testing.

D. All systems in NORM mode.

~~33B~~ 28B - Recirculation Loops and RHR Piping

Action

1. Record recirculation loop vibration.

Test Conditions

A. Recirc at minimum flow at TC-1.

B. At 50, 75, and at approximately 100% of rated recirculation flow on 100% load line.

C. In conjunction with recirculation pump starts and trips (Tests 30A and B) at TC-3 and 6.

2. RHR Suction Piping.

A. In conjunction with Test 71 while at 100% of rated RHR flow in the shutdown cooling mode.

29 SEE ATTACHED

TEST NUMBER ~~25~~ 30 - RECIRCULATION SYSTEM FLOW CALIBRATION

Action

1. Take recirculation system data and recalibrate instrumentation.

Test Conditions

A. At TC-3.

B. At TC-6.

TEST NUMBER ~~70~~ 31 - REACTOR WATER CLEANUP SYSTEM

Action

1. Take heat balance and pressure data.

Test Conditions

A. Reactor at rated temperature and pressure during heatup.

B. Cleanup system operate in hot standby, normal, and blowdown modes.

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TEST NUMBER ~~12~~ 32 - RESIDUAL HEAT REMOVAL SYSTEM

Action	Test Conditions
1. Controller Adjustments based on subsystem perturbations.	A. Reactor not isolated and above 10% rated power. B. RHR system in steam condensing mode. C. RCIC flow to CST.
2. Demonstration of steam condensing mode.	A. Reactor at hot standby and isolated. B. RCIC flow to RPV.
3. Take heat exchanger capacity data.	A. RHR in shutdown cooling mode. B. After trip or cooldown from TC-6 in order to provide sufficient decay heat. C. RHR in suppression pool cooling mode.

33 34 SEE ATTACHED

TEST NUMBER ~~26~~ 35 - OFFGAS SYSTEM

Action	Test Conditions
1. Record system parameters and verify proper operation.	A. TC-1, 2, 3, and 6 B. All systems in NORM mode.

SEE ATTACHED

7 SEE ATTACHED

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TEST NUMBER 29 - RPV INTERNALS VIBRATION

1. Not applicable A. Not applicable

TEST NUMBER 33 - DRYWELL ATMOSPHERE COOLING

1. Record drywell temperature data. A. Prior to initial heating
B. During initial heating [illegible]
C. At TC-2 [illegible] TC-6.

TEST NUMBER 34 - COOLING WATER SYSTEM

1. Record CCW, TBCW, and Service Water System temperatures and flows. A. At rated [illegible]

2. Make flow rate adjustments. B. After [illegible] A. [illegible]

3. Record CCW, TBCW, and Service Water System temperatures and flows. C. At [illegible] 75% [illegible] rated power.

TEST NUMBER 36 - DELETED

14.39

TEST NUMBER 37 - INCLINED FUEL TRANSFER

1. Transfer fuel assemblies between containment pool and fuel building pool A. Prior to [illegible] fuel [illegible]

Table 14.2-4

STABILITY TESTS

Test Title	Approximate Power (% Rated) / Approximate Core Flow (% Rated)	Test Condition									
	Approximate Power (% Rated)	5-20	25-55		40-75			37	70-75		95-100
	Approximate Core Flow (% Rated)	37	30	50	80-100			NC	55-60		95-100
Core Power - Void Mode Response		X	X	X	X	X	X	X	X	X	X
Pressure Regulator Setpoint		X	X	X	X	X	X	X	X	X	X
Pressure Regulator Backup Reg		X		X			X				X
Feedwater System Setpoint		X	X	X	X	X	X	X	X	X	X
Feedwater System Drop Heater											X
Bypass Valve		X	X	X	X	X	X	X	X	X	X
Flow Control		X	X	X	X	X	X		X	X	X

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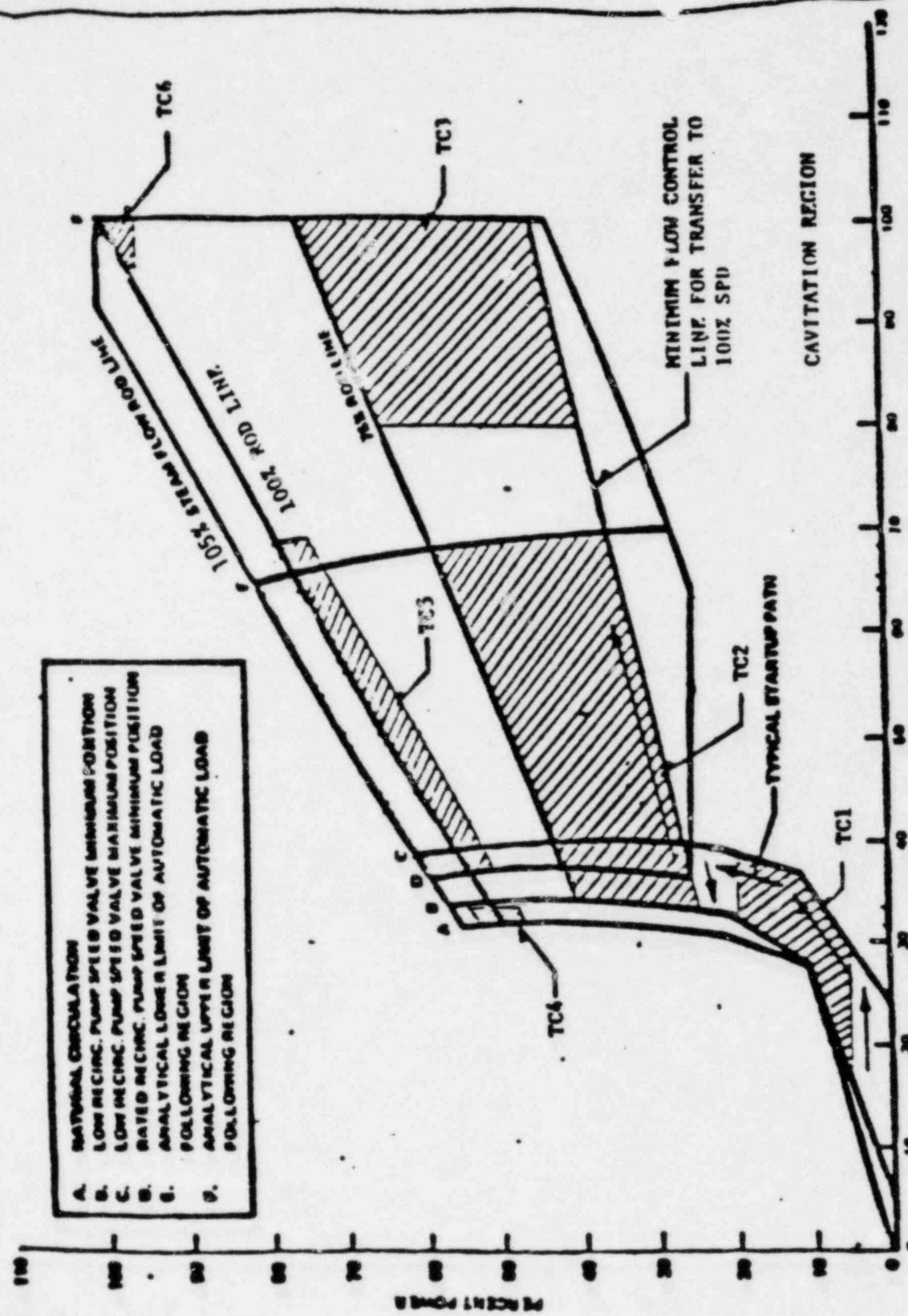
Figure revision for 640.01 and 640.02



14-02
14-03

Figure 14.2-1 Power-Flow Operating Map

(Revised)

Figure 14.2-1 (Continued)

Test Condition (TC)	Power Flow Map Region and Notes
1	Before or after main generator synchronization from 5 to 20 percent thermal power and operating on recirculation pump low frequency power supply
2	After main generator synchronization from 50 to 75 percent control rod lines, at or below the analytical lower limit of Master Flow Control mode and with the lower power corner within bypass valve capacity.
3	From 50 to 75 percent control rod lines above 80 percent core flow, and within maximum allowed recirculation control valve position.
4	On the natural circulation core flow line within ± 5 percent of the intersection with the 100 percent power rod line.
5	From the 100 percent loadline to 5 percent below the 100 percent loadline and between minimum flow at rated recirculation pump speed (minimum valve position) to 5 percent above the analytical lower limit of the automatic flow control range.
6	Within 0 to -5 percent of rated 100 percent thermal power, and within 0 to -5 percent of rated 100 percent core flow rate.

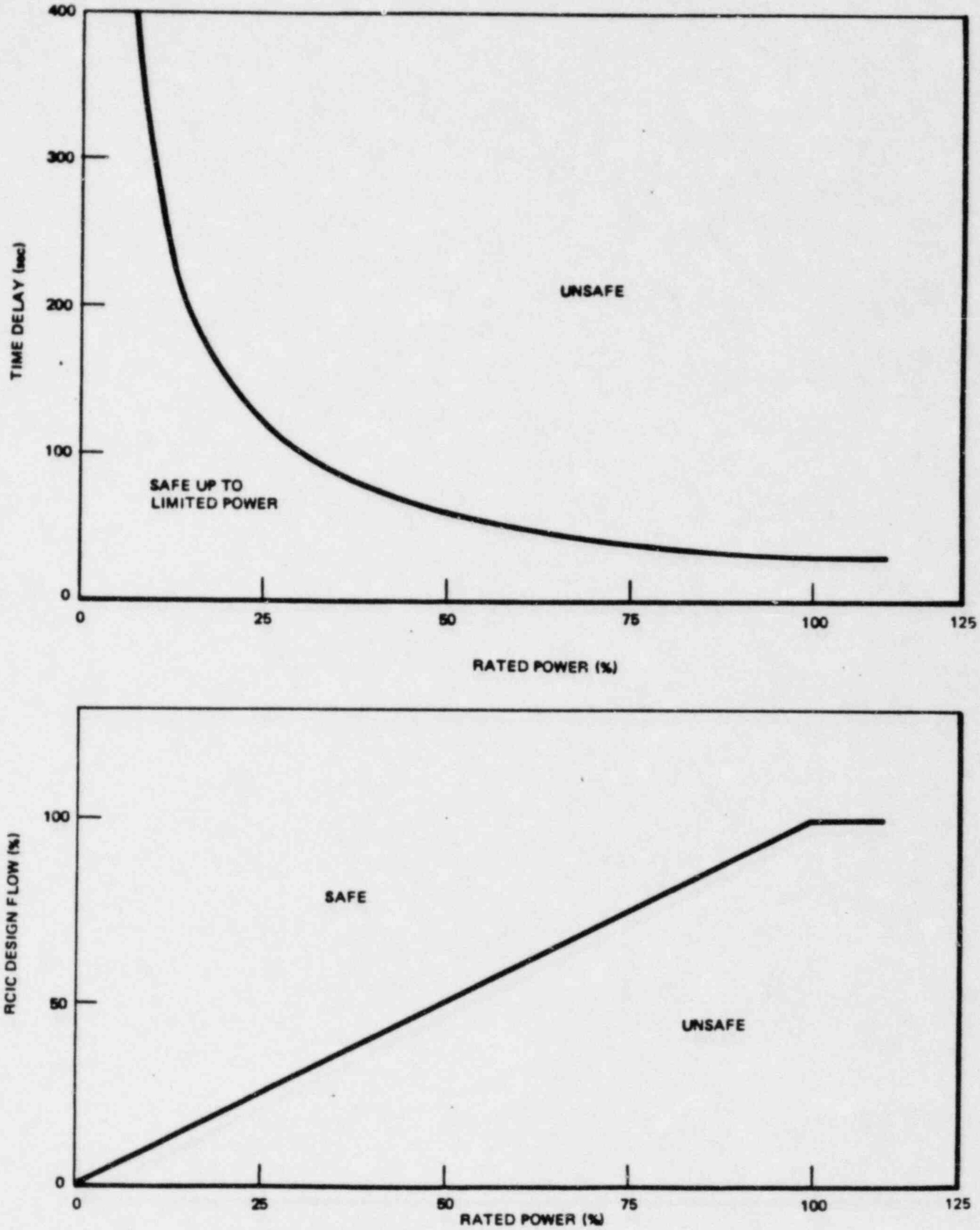


Figure 14.2-2. RCIC Acceptance Criteria Curves for Capacity and Actuation Time

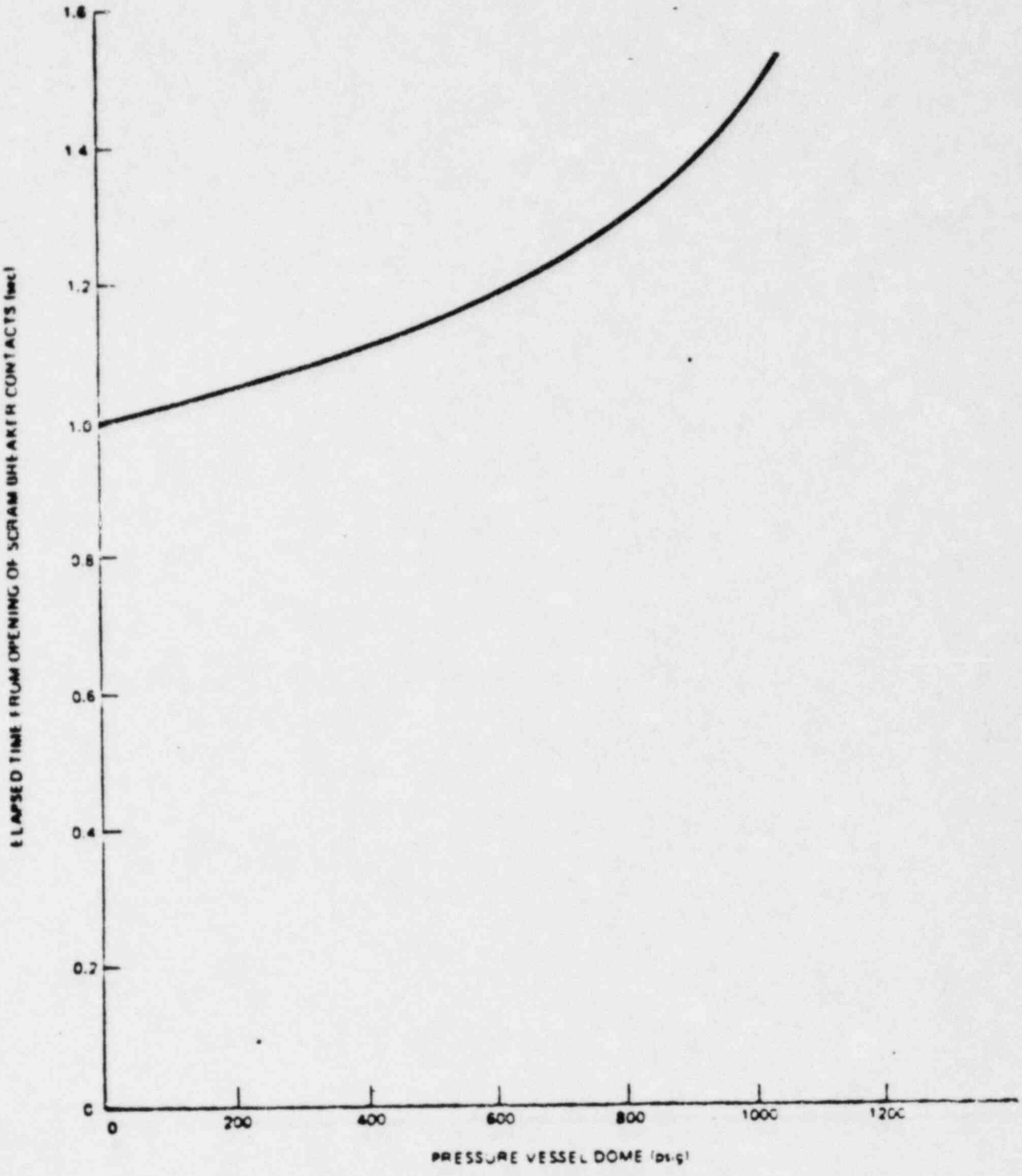
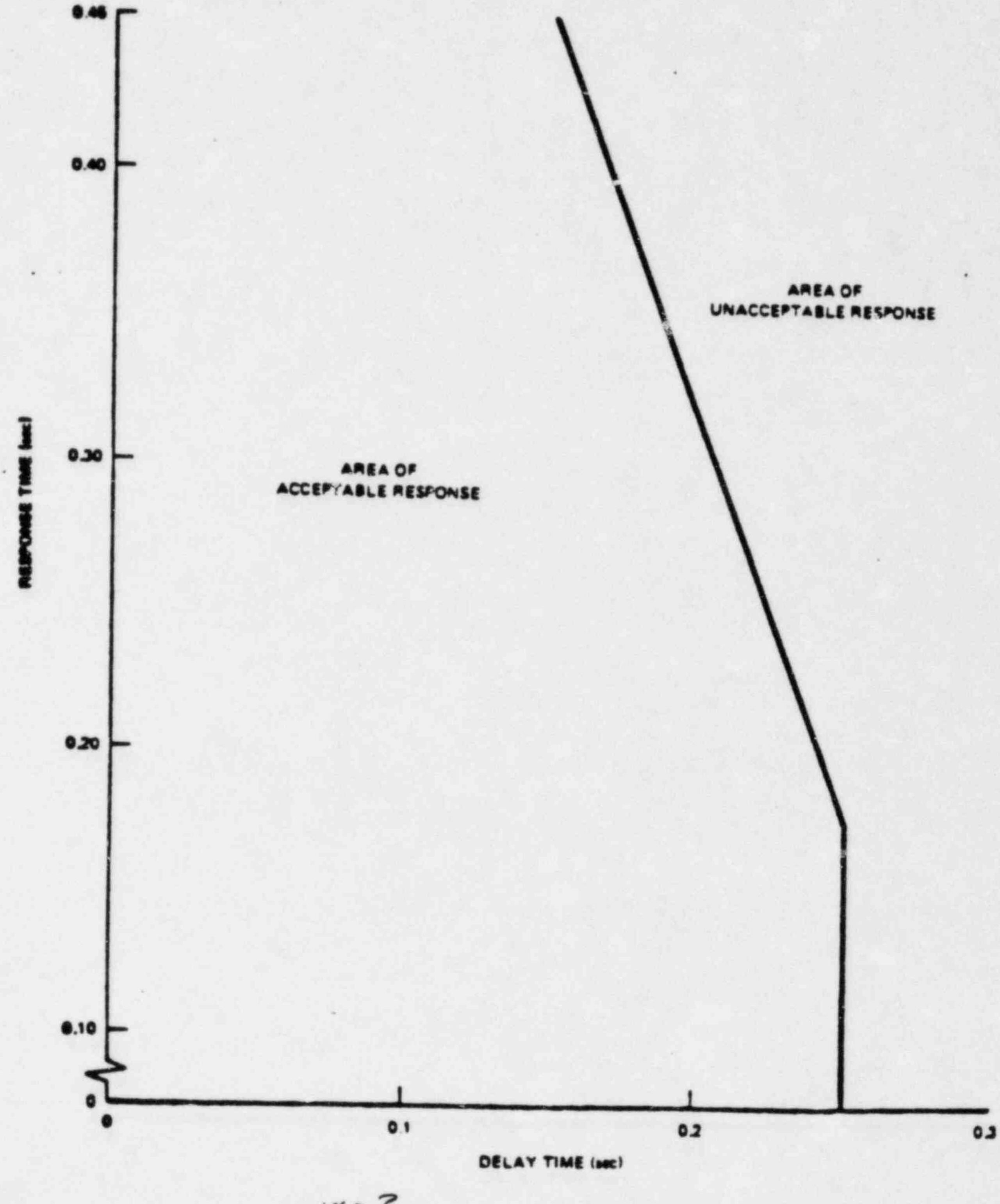


Figure ~~4A~~ 14.2-3 Range Of 75% Scram Insertion Times – As Measured By The Pickup Time Of Phase Position Switch

ADD THIS FIGURE



14.3-7

Figure ~~[illegible]~~. Trade-off Curve for Step Sizes 0.2% to 0.5%

↑

ADD THIS FIGURE

ATTACHMENT NO. 2

DRAFT RESPONSES TO

STRUCTURAL ENGINEERING BRANCH

QUESTIONS

220.04 (3.5.3) You state in Section 3.5.3.2 of your FSAR that you use an analysis procedure similar to that in Reference 6 (Williamson & Alvy) to determine an equivalent static load representing the tornado missile. Describe the actual procedure by which tornado generated missiles are transformed into effective loads. Verify that your proposed design procedure produces static loads comparable to those determined using the Williamson & Alvy formula.

220.05 (3.5.3) Submit details of the methods and assumptions which you use in the evaluation of the overall response of concrete and steel barriers subjected to impactive and impulsive loads. If you use the ductility ratio concept, indicate the ductility ratios you assume and verify that you meet the criteria delineated in Appendix A of Section 3.5.3, Revision 1, of the SRP.

220.04 and 220.05 responses

The structural response to this load is evaluated using equivalent static forces obtained by the procedure in Reference 6 for rigid missiles, and the procedure in Reference 7 for deformable missiles.

Ductility in flexure of slabs and shapes is used. Ductility ratios do not exceed 10. The above text will be added to Section 3.5.3.2 and will meet the SRP requirements. For steel, requirements of Appendix A of SRP Section 3.5.3 are met. Ductility concepts were not used in concrete shear analysis.

Reference 7 (J. D. Riera, On the Stress Analysis of Structures Subjected to Aircraft Impact Forces, Nuclear Engineering and Design, North Holland Publishing Co, Vol. 8, 1968) will be added.

220.08 (3.7.1)

In Section 3.7.1.3 of your FSAR, you correctly quote our position in Section C.3 of Regulatory Guide 1.61. However, it is not clear whether you have complied with our position on this matter. Accordingly, clearly state whether you comply with this portion of Regulatory Guide 1.61. If so, indicate the mechanism used to assure this compliance. If not, justify your position.

220.08 - Response

~~[illegible]~~

The damping factors indicated in Table 3.7-1 were used in the response analysis of various structures and systems and in preparation of floor response spectra used as forcing inputs for piping and equipment analysis or testing and presented in Section 3.10. ~~[illegible]~~ These values are consistent with those given in NRC Regulatory Guide 1.61.

When developing seismic design data for the SSE, the higher damping values of Regulatory Guide 1.61 were not used. The SSE data was obtained by doubling the OBE values which were based on the lower damping values. In the design process, the stress levels have been assessed and found sufficiently high to justify the use of the damping factors in Table 3.7-1.

Section 3.7.1.3 will be revised as indicated above.
Table 3.7-1 will be revised as indicated.

QN. 220.C6

1/24

Table 3.7-1

CRITICAL DAMPING RATIOS FOR DIFFERENT MATERIALS

Item	Percent Critical Damping	
	OBE Condition	~~SSE Condition~~
Reinforced concrete structures	4.0	~~7.0~~
Welded structural assemblies	2.0	~~4.0~~
Equipment	2.0	~~3.0~~
Bolted or riveted structural assemblies	4.0	~~7.0~~
Vital piping systems		
- diameter greater than 12 in.	2.0	~~3.0~~
- diameter less than or equal to 12 in.	1.0	~~2.0~~
Reactor pressure vessel, support skirt, shroud head, separator	2.0	~~4.0~~
Guide tubes and CRD housings	1.0	~~2.0~~
Fuel	6.0	~~6.0~~
Steel frame structures	2.0	~~4.0~~

delete

220.10 (3.7.2) In Section 3.7.2.1.5.1.1 of your FSAR, you state that a study has been conducted which shows that the interaction between the steel containment vessel and the polar crane can be ignored and that the crane mass can be lumped into the containment model at that level. Provide this study.

<u>220.10</u>

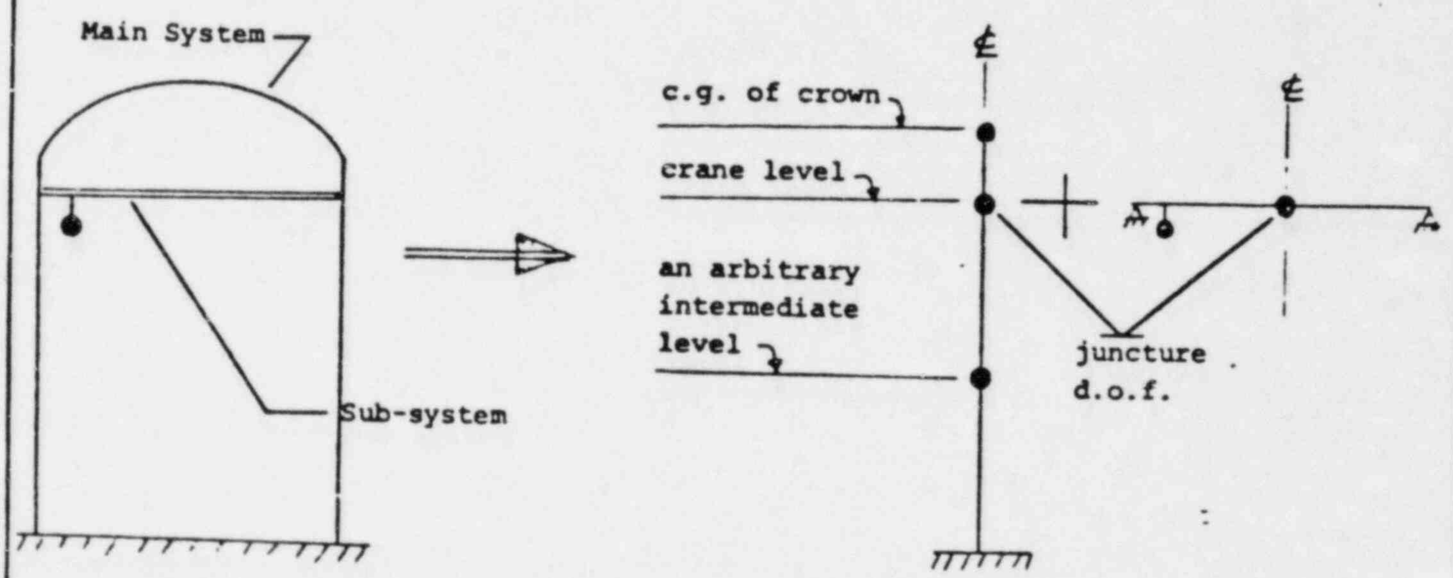
The report on the study of polar crane interaction with the containment is [redacted]. provided below.

DYNAMIC INTERACTION BETWEEN CONTAINMENT AND POLAR BRIDGE CRANE GIRDER

CONCEPT

Dynamic interaction between any two structural systems depends on their relative masses and stiffnesses.

The structural system in question, namely, the steel containment with the crane girder was divided into two systems. A main system consisting of the containment alone, and a sub-system consisting of the polar crane and the crane bridge. The main system was idealized as a 3-mass system with masses concentrated at the c.g. of the containment ellipsodial head, crane girder level and an intermediate level. The sub-system was idealized as a 2-mass system with masses concentrated at the center and at an extreme trolley position, the former representing the mass of the crane bridge and the later representing the trolley with L.L. To study dynamic interaction of the two systems in all possible modes of excitation, three different types of excitation were considered. They were vertical excitation, horizontal lateral excitation, and torsional excitation. For each of these excitations, the two systems were reduced to corresponding equivalent single d.o.f. systems by condensing out the non-juncture degrees of freedom. These effective masses and stiffnesses yielded the frequencies for the main system and for the sub-system for each of the three modes of excitation. Using the existing literature and the developed mass and frequency ratios, the percent error involved in decoupling the two systems and modifying the main system with the mass of the sub-system lumped into it was studied.



STRUCTURE MAIN SYSTEM SUB-SYSTEM

IDEALIZATION

CRANE GIRDER-CONTAINMENT INTERACTION
TVA STRIDE

November 5, 1974

SUMMARY OF RESULTS

	Main System			Sub-System			Mass Ratio M_S^*/M_M^*	Frequency Ratio $\frac{f_S}{f_M}$	% error in the eigenvalue for the modified main system compared with that of the complete system	Approximation Acceptable or not
	Effective Mass, M_M^*	Effective Stiffness, K_M^*	Frequency f_M	Effective Mass, M_S^*	Effective Stiffness, K_S^*	Frequency f_S				
Vertical Excitation	151.8 $\frac{K\text{-}SEC^2}{FT}$	1.20×10^6 K/FT	14.15 CPS	11.06 $\frac{K\text{-}SEC^2}{FT}$	2374 K/FT	2.33 CPS	0.07	0.16	< 10	Acceptable
Horizontal Lateral Excitation	151.8 $\frac{K\text{-}SEC^2}{FT}$	0.21×10^6 K/FT	5.88 CPS	11.06 $\frac{K\text{-}SEC^2}{FT}$	139 K/FT	0.56 CPS	0.07	0.10	< 10	Acceptable
Torsional Excitation	551,819 $\frac{K\text{-}SEC^2\text{-}FT}{RAD}$	15.84×10^8 K-FT/RAD	8.53 CPS	29,750 $\frac{K\text{-}SEC^2\text{-}FT}{RAD}$	0.5×10^6 $\frac{K\text{-}FT}{RAD}$	0.65 CPS	0.05	0.08	< 10	Acceptable

1/4

In conclusion, interaction between the steel containment and the crane can be ignored and the mass of the crane etc can be lumped into the containment model at that level for all types of excitation.

OVALING MODES OF CRANE GIRDER

Due to the non-axisymmetric point loads resulting from the polar bridge crane, the crane ring-girder and the steel containment shell can exhibit ovaling modes of vibration.

The frequencies of these modes have been computed using standard formulae. The exact shape of a given ovaling mode of vibration consists of a curve which is a sinusoid on the developed circumference of the ring. For these computations the ring-girder is assumed to act as a structural composite with a tributary shell section. The results are summarized below.

OVALING MODES

MODE OF VIBRATION	WITHOUT CRANE		WITH CRANE	
	RAD/SEC	CPS	RAD/SEC	CPS
n* = 2	25.4	4.04	18.8	3.00
n = 3	71.9	11.44	53.3	8.48
n = 4	138.0	21.96	102.0	16.23

*n = number of full sine waves along the circumference.

In conclusion, judging from the high frequencies and nature of the respective mode shapes, the ovaling modes have very little modal responses as well as very small participation factors and hence are not significant. In addition, the ovaling modes have been found to have hardly any coupling with the beam modes of vibration.

REFERENCES:

1 Pickel, T W, Jr, "Evaluation of Nuclear System Requirements for Accommodating Seismic Effects", Nuclear Engineering and Design, Vol 20, 1972.

2 Den Hartog, J P, "Mechanical Vibrations", 4th edition, McGraw-Hill, 1956.

3 Bechtel Power Corporation, "Topical Report - Seismic Analyses of Structures and Equipment for Nuclear Power Plants", BC-TOP-4, Rev 2, June 1974.

220.14 Question.

✓220.14 (3.7.2) In Section 3.7.2.11 of your FSAR, you indicate a method of analysis for torsional effects in your models. However, our position is that an additional eccentricity of five percent of the maximum building dimension at the level under consideration, be assumed in the design of seismic Category I structures to account for accidental torsion. This extra eccentricity is in addition to that which results from the actual geometry and mass distribution of the building. (Refer to Item II.11 in Section 3.7.2 of the SRP). State whether you comply with our position on this matter or whether you will pursue another method.

220.14 Response.

Section 3.7.2.11 will be revised as indicated this revision complies with the SRP.

3.7.2.11 Methods Used to Account for Torsional Effects

Torsional effects for two-dimensional analytical models are accounted for in the following manner. The locations of the center of mass are calculated for each floor. The centers of rigidity and rotational stiffness are determined for each story. Torsion effects are introduced in each story by applying a rotational moment about its center of rigidity. The rotational moment is calculated as the sum of the products of the inertial force applied at the center of mass of each floor above and a moment arm equal to the distance from the center of mass of the floor to the center of rigidity of the story. To be conservative, the absolute values of the moments are used in the sum. The torsional moment and story shear are distributed to the resisting walls and columns in proportion to each individual stiffness.

add! plus five percent of the maximum building dimension at the level under consideration.

In three-dimensional analytical models, the masses and stiffnesses are specified so that the torsional effects are automatically considered in the analysis.

The RPV model is axisymmetric with no built-in eccentricity. Hence the torsional effects on the RPV are only those associated with the Reactor Building model.

3.7.2.12 Comparison of Responses

Since only the time-history method is used for structural analysis, the responses obtained from response spectrum and time-history methods are not compared.

3.7.2.13 Methods for Seismic Analysis of Dams

Subsection 3.7.2.13 is not applicable because no dam is utilized directly or indirectly to provide water for the cooling system. (Applicant will verify.)

220.21 Question

220.21 (3.8.2) In Section 3.8.2.3.15 of your FSAR, you state that the structural design criteria for the steel containment vessel are consistent with our positions in Regulatory Guide 1.57. However, the stress intensity limits for various loading combinations presented in Table 3.8-2 of your FSAR do not clearly depict this. Accordingly, present these limits in a tabular form similar to that of Table 3.8.2-1 in Section 3.8.2 of the SRP. Verify that your stress intensity limits are consistent with our values in the SRP.

220.21 Response

Table 3.8.2 will be revised as indicated. This revision complies with the SRP.

[220.21]

Table 3.8-2

Stress Intensity Limits For Steel Containments

~~SECTION II.3.C.~~ ~~Load Categories~~ Loading Condition / Stress categories		Primary Stresses Gen. Mem. P_m	Primary Stresses Local Mem. P_L	Bending & Local Mem. $P_b + P_L$ (6)	Primary & Secondary Stresses $P_L + P_b + Q$	Peak Stresses $P_L + P_b + Q + F$	Buckling
Testing Condition (10)	Pneumatic	$0.75S_y$	$1.15S_y$	$1.15S_y$	N/A (2)	See Note ~~Consider for~~ (5) ~~fatigue evaluation~~	See Note (9)
Design Condition (1)		$1.0S_{mc}$	$1.5S_{mc}$	$1.5S_{mc}$	N/A	N/A	See Note (9)
Level A Service Limit (1)		$1.0S_{mc}$	$1.5S_{mc}$	$1.5S_{mc}$	$3.0S_{mi}$	S_a ~~Consider for fatigue evaluation~~	See Note (9)
Level B Service Limit (1)		$1.0S_{mc}$	$1.5S_{mc}$	$1.5S_{mc}$	$3.0S_{mi}$	S_a Consider ~~for~~ fatigue evaluation	See Note (9)
Level C Service Limit (1)	Not Integral and Continuous	$1.0S_{mc}$	$1.5S_{mc}$	$1.5S_{mc}$	$3.0S_{mi}$	N/A	See Note (9)
	Integral and Continuous (4),(7)	$1.2S_{mc}$ or * $1.0S_y$	$1.8S_{mc}$ or * $1.5S_y$	$1.8S_{mc}$ or * (8) $1.5S_y$	N/A	N/A	See Note (9)
Level D Service Limit (1)	Not Integral and Continuous (4)	$1.2S_{mc}$ or * $1.0S_y$	$1.8S_{mc}$ or * $1.5S_y$	$1.8S_{mc}$ or * (8) $1.5S_y$	N/A	N/A	See Note (9)
	Integ. & Con. Elas. Analysis (3)	S_f	$1.5S_f$	$1.5S_f$			
	Integ. & Con. Inelas. Analysis (3)	S_f	S_f	S_f	N/A	N/A	See Note (9)
Post-Flooding Condition (4) (9)	Flood: + OBE	$1.2S_{mc}$ or * $1.0S_y$	$1.8S_{mc}$ or * $1.5S_y$	$1.8S_{mc}$ or * $1.5S_y$	$3S_{mi}$	N/A (2)	See Note (9)
	Flooded only	$1.5S_{mc}$	$2.25S_{mc}$	$2.25S_{mc}$	$3S_{mi}$	N/A	See Note (9)

Notes:

NOTES:

1 Refer to NE-3221

2 N/A- No evaluation required.

3 S_f is 85 percent of the general primary membrane allowable permitted in Appendix F. In the application of the rules of Appendix F, S_{mi}, if applicable, shall be as specified in Table I-1.0.

4 Limit identified by (*) indicates a choice of the larger of two limits.

5 The number of testing sequences shall not exceed 10 unless a fatigue evaluation is considered.

6 Values shown are for a solid rectangular section. See NE-3221.3 (d) for other then a solid rectangular section.

7 These stress intensity limits also apply to the partial penetration welds.

8 Values shown are applicable when $P_L \leq 0.67\ S_y$. When $P_L > 0.67\ S_y$, use the larger of the two limits, $[2.5-1.5\ (P_L/S_y)]\,1.2S_{mc}$ or $[2.5-1.5(P_L/S_y)]\,S_y$.

9 See Section 3.8.2.3.16.

10 Refer to NE-6322.

220.22 Question

220.22 (3.8.2) In Table 3.8-1 of your FSAR, you present the proposed loading combination for the design of the steel containment vessel. However, the contents of this table are not clearly consistent with load combinations which are acceptable to us. Accordingly, provide the loading combinations in a tabular form which is consistent with the load combinations contained in Item II.3.b of Section 3.8.2 of the SRP. Verify that your proposed loading combinations are in agreement with those contained in the SRP.

220.22 Response

Subsections 3.8.2.3 and 3.8.2.3.1 through 3.8.2.3.14.

Will be revised as indicated. The loading combinations are consistent with those contained in Item II.3.b of Section 3.8.2 of the SRP. It has been verified that these loading combinations are in agreement with those in the SRP.

3.8.2.2.3 Code Compliance

The steel cylindrical shell and dome of the steel containment vessel, including all penetrations, transition sections, and attachments within the boundaries defined in Subsection 3.8.2.1.3, are designed, fabricated, erected, inspected, examined, and tested in accordance with Subsection NE, Class MC Components and Articles NA-4000 and NA-5000 of ASME Code Section III, Division 1.

The steel containment vessel is not ASME-Code stamped. However, all requirements of Subsections NE and CC of Division 1 and 2, respectively, are met. Hence, appropriate N-Type CC code symbols are applied to the containment vessel.

Structural steel attachments beyond the boundaries established for the steel containment vessel are designed, fabricated, and constructed according to the AISC Manual for Steel Construction, Seventh Edition.

The concrete mat foundation and flat bottom liner plate anchorage are described in Subsection 3.8.5.

3.8.2.3 Loads and Load Combinations

INSERT 1

3.8.2.3.1 Design Pressure and Temperature (Pa, Ta)

The design pressure and temperature conditions inside the steel containment vessel are as follows.

(1) Design, internal - 15 psig at 185°F and
(2) Design, external - 0.8 psig at 185°F.

The steel containment vessel is designed for the internal hydrodynamic head corresponding to the flooded condition given in Subsection 3.3.2.3.9.3. Fluid structure interaction is considered in the design.

The design life is 40 years.

3.8.2.3.2 Operating Pressure and Temperature (P_o, T_o)

The operating pressure and temperature conditions inside the steel containment vessel are as follows.

(1) The steady-state operating temperature conditions are:

(a) normal - 90°F;
(b) high, hot standby - 120°F; and
(c) low, cold shutdown - 60°F.

(2) The operating internal pressure in the air volume is 0 to 2 psig with a hydrostatic head of 20 ft, 5 in., in the internal suppression pool.

(3) The operating external pressure is 0 to 0.8 psig at 120°F with a hydrostatic head of 20 ft, 5 in., in the internal suppression pool.

3.8.2.3.3 Dead Loads (D)

The dead loads consist of the following typical loads:

(1) weight of the steel of the containment vessel and its appurtenances such as locks and hatch;

(2) polar crane weight;

(3) empty weights of attached piping; and

(4) weight of electrical connections, mechanisms, ladders, and platforms contributory to the containment vessel shell.

3.8.2.3.4 Live Loads (L)

The live loads consist of the following typical loads:

(1) crane lifting loads, 125-ton rated capacity plus a 25-ton auxiliary hook;

(2) crane dynamic loads (in addition to the lifting and dead loads, the girder is designed for a lateral load of 20% of the combined loads consisting of the lifted load and the weight of the crane trolley and a tangential load of 10% of the maximum wheel load. All are applied at the top of the crane rail. The crane design live load is increased 25% to account for impact);

(3) design floor loads of 100 psf for walkways, ladders, and platforms (the live load used for the design of the floor section of the personnel air locks is 250 psf along with a 1000-lb moving concentrated load); and

(4) operating fluid weight in attached piping and piping penetrations.

3.8.2.3.5 Mechanical Piping Loads (Ro.Ra)

Mechanical piping loads consist of the reactions produced by external and internal piping. These loads are summarized in Figure 3.8-4.

3.8.2.3.6 Thermal Loads

The thermal loads in the steel containment are produced by the presence of axial temperature gradients within the containment and its appurtenances. During the change from one steady-state

3.8.2.3.6 Thermal Loads (Continued)

condition to another, the rate of temperature change is negligible and therefore produces no transient thermal loads within the steel containment.

3.8.2.3.7 Construction Loads

In addition to normal construction loads, the following temporary loads are considered in the design of the steel containment vessel:

(1) wind loads (W) associated with the velocity of 130 mph during erection of the steel containment vessel before the completion of the Shield Building (Subsection 3.3.1);

(2) snow loads (L) of 50 psf on a projected flat surface of the vessel head before the completion of the Shield Building; and

(3) the initial load of the 6-inch-thick layer of concrete for the Shield Building dome supported on the torispherical head. (D)

3.8.2.3.8 Missile Loads

The containment vessel does not experience internal or external missile loads (Subsection 3.5.1).

3.8.2.3.9 Loss-of-Coolant Accident (LOCA) Loads

All piping of high or moderate energy and of a size sufficient to damage the containment is separated from the containment by concrete walls. Specific examples are the reactor water cleanup unit (RWCU) piping and the piping inside the steam tunnel.

3.8.2.3.9 Loss-of-Coolant Accident (LOCA) Loads (Continued)

The individual lines from the control rod drive (CRD) modules to the drive are too small to damage the containment. The CRD supply, high-pressure core spray (HPCS), low-pressure core spray (LPCS), and low-pressure coolant injection (LPCI) lines have check valves inside the drywell to prevent flow from the reactor; therefore, they do not represent a source of jet impingement. The influent flow through these lines does not have sufficient energy to damage the containment. LOCA loads considered in the design of the steel containment vessel consist of the following typical loads.

3.8.2.3.9.1 LOCA Loading Conditions (Pa, Ta)

This loading condition is determined by analysis of the transient pressure and temperature effects which occur during a LOCA and includes the effects of chugging and condensation oscillations. The governing design condition for the LOCA is discussed in Section 6.2.

3.8.2.3.9.2 Pool Swell Loads (Pa, Ta)

One type of pool swell load consists of several short-duration pressurizations of the two shell areas. The first shell area is located between the bottom of the vessel and the liquid surface of the suppression pool. The second shell area is located below the hydraulic conctrol unit (HCU) floor between elevation (+)11 ft, 0 in., and the surface of the suppression pool. The pressure distribution with elevation for both areas is discussed in Subsection 6.2.1.1.6. Both axi-symmetric and asymmetric loading conditions arising from partial incidence of pressure along the circumference are considered to determine the most severe loading condition.

3.8.2.3.9.2 Pool Swell Loads (Continued)

The pool swell also produces a dynamic impact load acting on support beams and shell protuberances at elevation (-)5 ft, 3 in. The only protuberances attached to the vessel shell at this elevation are the barrel of the equipment hatch and the beam supports for the equipment hatch bridge and the two stairwells. The dynamic impact loading and the drag forces on these protuberances are shown in Appendix 3B.

3.8.2.3.9.3 Accident Recovery Loads Flooded Condition (H_A)

Most of the accident recovery loads fall within the range of the design and operating loads. These loads are less severe because they exclude internal or external pressures and thermal transient loads. However, it is possible that some accidents within the drywell may require flooding of the drywell and the containment vessel. For the flooded condition, the elevation of the water level in the containment vessel is equal to (+)37 ft, 0 in., which produces a total water head of 68 ft, 7 in., above the bottom liner.

3.8.2.3.9.4 RPV Safety/Relief Valve Discharge Loads (P_S, T_S, R_S)

Safety/relief valve (SRV) discharge loads occur during the actuation of the reactor pressure vessel SRV's. These loads are expressed in terms of the pulsating pressure originating at the ends of the SRV discharge lines and impinging on the containment shell. There are 19 radial discharge lines spaced around the circumference. The quencher center is located 13 ft, 6 in., from the inside surface of vessel shell and the plane of the quencher arm centerline lies at 6 ft, 6 in., above the bottom plate liner.

Five discharge load cases are considered. Cases 1 and 2 represent the discharge of one and two adjacent valves, respectively.

3.8.2.3.9.4 RPV Safety/Relief Valve Discharge Loads (Continued)

A subsequent actuation of the lowest set valve is possible and is considered with the single valve discharge case only. Cases 3, 4, and 5 represent the simultaneous discharge of 10, 19, and 8 Automatic Depressurization System (ADS) valves distributed around the circumference of the vessel, respectively. The range of frequency of the pulsating pressure oscillations is equal to 5 to 12 Hz and the total duration of each load case is 0.75 second. Appendix 3B provides normalized dynamic peak pressures and the normalized radial and circumferential peak pressures for the five discharge load cases.

3.8.2.3.10 Seismic Loads (F_{eqo}, F_{eqs})

The method for calculating seismic loads is presented in Subsection 3.8.2.4.2. The effects of wedging of the polar crane on the vessel shell as a result of horizontal seismic forces on the polar crane is also considered. The SSE loads on beam seats, polar crane, and attachments to the vessel are taken as twice the OBE loads without increase in the damping factor. The OBE loads are shown in Figure 3.8-5.

3.8.2.3.11 Humidity

The normal relative humidity of the air volume inside the containment vessel is 50% with a maximum humidity of 60%. No control of minimum humidity inside the containment vessel or maximum and minimum humidity in the Shield Building annulus is required.

3.8.2.3.12 Test Loads (P_t, T_t)

The containment vessel and its appurtenances are tested at a pressure of 17.25 psig at 60°F in accordance with the requirements of Article NE-6000 of ASME Code Section III.

3.8.2.3.13 Radiation

The containment vessel is exposed to 100% gamma-type radiation resulting from the decay of fission products and/or from decay of N-16. The integrated doses, in rads (carbon), for operating and accident conditions are given in the following subsections at specified locations.

The operating integrated gamma doses within the containment are given in Section 3.11.

The fuel transfer chute integrated gamma dose is 4.3×10^5 rads (carbon) for one-year operation based on a one-day, spent-fuel source with 300 transfers per year and a 30-second exposure per transfer.

The maximum accident dosage results from a LOCA. The dose is integrated over a six-month period and is equal to 3.8×10^7 rads (carbon) for the area above suppression pool liquid level and 2.3×10^7 rads (carbon) for the area below the suppression pool liquid level.

3.8.2.3.14 Load Combinations

← INSERT 2

~~The load combinations required for the design of the steel containment vessel are in Table 3.8-1.~~

3.8.2.3.15 Accident Recovery Evaluation

Among the postulated LOCAs, there may be some accidents within the drywell that require flooding of the drywell and containment to remove the fuel from the reactor and to effect repairs.

[220.22]

INSERT 1

Load designations are as follows:

D	Dead loads.
L	Live loads.
P_t	Test pressure.
T_t	Test temperature.
T_o	Normal operating temperature.
R_o	Normal operating pipe reactions.
P_o	Normal operating pressure.
F_{ego}	Operating basis seismic loads.
F_{egs}	Safe shutdown seismic loads.
P_a	Design pressure.
R_a	Design pipe reactions.
T_a	Design temperature.
P_s	Pressure caused by the actuation of safety relief valve.
T_s	Temperature caused by the actuation of safety relief valve.
R_s	Pipe reactions caused by the actuation of safety relief valve.
H_a	Loads generated by the post-LOCA flooding of containment
W	Wind loads.
Y_r	Equivalent static load on the structure generated by the reaction on the broken pipe during the design basis accident.

The load magnitude and the design conditions are described in the following sections. The steel containment vessel does not experience missile loads and jet impingement. (See sections 3.8.2.3.9 and 3.8.2.3.10).

[220.22]
INSERT 2

5.P

3.8.2.3.14 Load conditions

The steel containment vessel shall be designed for the following loading combinations. The stress intensity limits for each loading combination are to refer to section 3.8.2.3.17.

1 Testing condition

$D + L + T_t + P_t$

2 Design condition

$D + L + P_a + T_a + R_a$

3 Service conditions

a Level A service limits

1 Normal operating plant condition.

$D + L + T_o + R_o + P_o$

2 Operating plant condition in conjunction with multiple safety relief valves actuation.

$D + L + T_s + R_s + P_s$

3 Multiple SRV actuations in combination with pipe break accident.

$D + L + T_a + R_a + P_a + T_s + R_s + P_s$

b Level B service limits

1 LOCA in combination with operating basis earthquake.

$D + L + T_a + R_a + P_a + F_{eqo}$

2 Operating plant condition in combination with operating basis earthquake.

$D + L + T_o + R_o + P_o + F_{eqo}$

3 Operating plant condition in combination with operating basis earthquake and multiple SRV actuations.

$D + L + T_s + R_s + P_s + F_{eqo}$

4 LOCA in combination with a single active component failure causing one SRV discharge.

$D + L + T_a + P_a + R_a + T_s + R_s + P_s$

c Level C Service limits

1 LOCA in combination with safe shutdown earthquake.

$D + L + T_a + R_a + P_a + F_{eqs}$

2 Operating plant condition in combination with safe shutdown earthquake.

$D + L + T_o + R_o + P_o + F_{eqs}$

3 Multiple SRV actuation in combination with pipe break accident and safe shutdown earthquake.

$D + L + T_a + R_a + P_a + T_s + R_s + P_s + E_{eqs}$

d Level D service limits

1 LOCA in combination with safe shutdown earthquake and local dynamic loadings.

$D + L + T_a + R_a + P_a + Y_r + E_{eqs}$

2 Multiple SRV actuations in combination with pipe break accident, Safe shutdown earthquake, and local dynamic loadings.

$D + L + T_a + R_a + P_a + Y_r + P_s + T_s + R_s + E_{eqs}$

e Post-flooding condition

$D + L + H_a + E_{eqo}$

DRR 11/6/83

~~(REVISED)~~

GE RESPONSE TO NRC QUESTIONS

SEISMIC AND IMPACT LOADS

(PORTION OF 220.40)

- Seismic loads are discussed in full detail in GE Document NEDE-24076-P.

- Impact loads are discussed in paragraph 4.3.2 of the above document where the significance of the global impact loads are judged to be small for the following rationale.

  a. The value of the gap between the fuel bundle and the rack tube is randomly distributed along the tube length and also varies randomly in different tubes. These gaps are due to manufacturing tolerances of the fuel bundles and tubes.

  b. The side gaps of the fuel depend on the fuel housing and deflection as well as the tube deflections caused by their manufacture and assembly. The side gap partitioning (on different sides of the fuel) is also random.

  c. For any initial ground motion the impact of fuel bundles is randomly distributed in time. Also, due to fuel rebounding (spring back), opposite impact forces cancel in a random fashion. The rebounding effect may also be characterized as random at different levels of a fuel, reducing the total impact of a single fuel bundle.

  d. A comparison of two systems, one with gaps and the other one without gaps, shows that, in the gapped fuel rack system there is a small increase in the loads on the fuel storage rack due to impact on a per bundle basis. However, the energy absorbed by local deformation during impact AND a reduction in the mass of the ungapped model ~~corre-sponding to the impact bundles~~ due to those bundles which are not in contact with the rack prior to impact as well as the friction effects between fuel and tube have the effect of offsetting the impact forces. Thus, these local effects reduce the amount of energy spent on global elastic deformation of the rack.

     Based upon evaluations of previous analysis, it has been calculated that if 5% of the fuel assemblies impact in phase, then there exists a small chance of a 4% increase in the overturning moment. This is not judged to be significant.

  e. The water filled small gaps reduce considerably the impact effect of fuel as compared to in vacuum vibration of the fuel in tubes.

  f. The effect of a single impact on one tube is analyzed previously leading to acceptable stresses.

- The bolted connection (56-1 3/4 INCH ø high strength cap screws) for a 13x13 rack has been evaluated and found to have considerable margin in strength. Margins ~~Safety Factors~~ are greater than 1.5 based upon interface drawing requirements over and above included Safety Factors.

ATTACHMENT NO. 3

DRAFT RESPONSES TO

RADIATION ASSESSMENT BRANCH

QUESTIONS

TEXT CHANGE FOR 471.04

12.1.1.1 Design and Construction Policies (Continued)

(Description on onsite inspections to determine that the design and operation keeps radiation exposures ALARA is, where required, the responsibility of the Applicant.)

12.1.1.2 Operation Policies

(Description of operational policies to maintain occupational doses ALARA is the responsibility of the Applicant.)

12.1.1.3 Compliance with 10CFR20 and Regulatory Guides 8.8, 8.10 and 1.8

Compliance of the Nuclear Island design with Title 10 of the Code of Federal Regulations, Part 20 (10CFR20), is ensured by the compliance of the design and operation of the facility within the guidelines of Regulatory Guides 8.8, 8.10 and 1.8.

12.1.1.3.1 Compliance with Regulatory Guide 8.8

The design of the Nuclear Island fully meets the intent of Revision ~~1~~ 3 of Regulatory Guide 8.8, and reflects the commitment of General Electric and its subcontractors. Examples of compliance with all items in Section ~~C.3~~ C.2 of the regulatory guide are delineated in Subsection 12.3.1 of this SAR. Design features of the Nuclear Island allow the Applicant to comply easily with the recommendations of Subsections C.2 and C.4 of the guide. For instance, provisions are made in systems such as the Reactor Water Cleanup System (RWCS) to allow flushing of the piping in shielded cubicles before entry, and to use remote reach rods. Breathing air headers are provided in areas where past experience indicates airborne radioactivity has been a problem. Design provisions allow for remote operation of fuel handling and radwaste cask filling.

Text revision to Question 471.08 response:

471.08 continued.

Carbon steel is used in a large portion of the system piping and equipment outside of the Nuclear Steam Supply System. Carbon steel is typically low in nickel content and contains a very small amount of cobalt impurity.

Stainless steel is used in portions of the system such as the reactor internal components, recirculation system piping, and heat exchanger tubes where high corrosion resistance is required. The nickel content of stainless steels is in the 8 to 10.5 percent range and is controlled in accordance with applicable ASME material specifications. ~~No cobalt content limits have been specified for stainless steels used within the reactor vessel with the exception that low cobalt (less than 0.05 percent) XM-19 alloy has been used in the control rod drives. Cobalt~~ Cobalt content is controlled to less than 0.05 % in the XM-19 alloy used in the control rod drives.

471.08 continued

~~content in stainless steels used outside the vessel has not been limited to 0.2 percent; however, a~~ A previous review of many materials certifications indicated an average cobalt content of only 0.15 percent in austenitic stainless steels.

Ni-Cr-Fe alloys such as Inconel 600 and Inconel X750 which have high nickel content are used in some reactor vessel internal components. These materials are used in applications for which there are special requirements to be satisfied (such as possessing specific thermal expansion characteristics along with adequate corrosion resistance) and for which no suitable alternate low-nickel material is available. Cobalt content in Inconel X750 used in the fuel assemblies is limited to 0.05 percent.

Stellite is used for hard facings of components

471.09 Provide a table of primary system components (e.g., the reactor pressure vessel internals, clad, fuel, the recirculation loop piping and the feedwater piping downstream of the CCS) which are in contact with the reactor coolant showing the corrosion producing areas in units of square feet, a description of the material (e.g., stainless steel, zirconium, Stellite, Inconel or carbon steel) the proposed cobalt content limits expressed as a weight percent of cobalt and the corrosion rate (in mg/dm^2-mo) for each material. Additionally, provide a table of the various materials used in the primary system and indicate their contribution to the cobalt in the primary system, expressed as a percentage; the total contributions should equal 100 percent.

Response

The most comprehensive study of cobalt inputs to the BWR system which is available was carried out under sponsorship of the Electric Power Research Institute. Results of the study were published in EPRI NP-2263 (Reference 11). This report contains tabulations by system component of the surface areas of materials exposed to the coolant, cobalt and nickel contents of these materials, and estimates of the material corrosion rates and corresponding cobalt input rates to the system.

Add to list of references. See attached page.

12.3.5 References

1. N. M. Schaeffer, "Reactor Shielding for Nuclear Engineers", TID-25951, U. S. Atomic Energy Commission (1973).

2. J. H. Hubbell, "Photon Cross Sections, Attenuation Coefficients, and Energy Absorption Coefficients from 10 KeV to 100 GeV", NSRDS-NBS29, U. S. Department of Commerce, August 1969.

3. "Radiological Health Handbook", U.S. Department of Health, Education, and Welfare, Revised edition, January 1970.

4. "Reactor Handbook", Volume III, Part B, E. P. Blizzard, U. S. Atomic Energy Commission (1962).

5. Lederer, Hollander and Perlman, "Table of Isotopes", Sixth Edition, (1968).

6. M. A. Capo, "Polynomial Approximation of Gamma Ray Buildup Factors for a Point Isotropic Source", APEX-510, November 1958.

7. "Reactor Physics Constants", Second Edition, ANL-5800, U.S. Atomic Energy Commission, July 1963.

8. ENDF/B-III and ENDF/B-IV Cross Section Libraries, Brookhaven National Laboratory.

9. PDS-31 Cross Section Library, Oak Ridge National Laboratory.

10. DLC-7, ENDF/B Photo Interaction Library.

11. "BWR Cobalt Source Identification", EPRI NP-2263, Electric Power Research Institute, February 1982

Response to 471.17 a

INSERT A

12.3.5 POST-ACCIDENT ACCESS REQUIREMENTS

The locations requiring access to mitigate the consequences of an accident during the 100 day post-accident period are the control room, the technical support center, the three manual valves in the Auxiliary and Fuel Building, and the ADS bottles in the Fuel Building.* The three manual valves are the ESW supply to the hydrogen mixing blowers of the Combustible Gas Control system and a Drywell Bleed-off Vent system valve. Access to the ADS bottles ~~are~~ may be required to replace them, in the event that the air supply in the bottles is depleted and in the event that the normal air supply from the air compressors is not available. Replacement of the bottles ~~are~~ is not required prior to 7 days following the accident.

The control room and the technical support center, which are continuously occupied, are designed to reflect the criteria in Section 3.1.2.2.10.

The doses received by personnel entering the Fuel and Auxiliary Building to operate the three manual valves and to replace the ADS air bottles are listed in the table below. For entry into the Fuel Building, it is assumed that self-contained full facepiece respirators operating in the pressure mode is used. The exposure time anticipated for operating each valve is 5 minutes, and for exchanging the ADS bottles is 30 minutes.

* However, as mentioned in Appendix 1A, access to the ADS bottles is not necessary because of the compressors.

Revision to Response 471.17a :

OPERATION	ESTIMATED DOSES (REM) GAMMA ~~DOSE~~	BETA (SKIN) ~~DOSE~~	THYROID ~~DOSE~~
OPERATING ESW VALVE (P41-FF171) IN FUEL BUILDING	0.3	0.2	0.1
OPERATING DRYWELL BLEED-OFF VENT VALVE (T41-FF061) IN FUEL BUILDING	0.3	0.2	0.1
OPERATING ESW VALVE (P41-FF118) IN AUXILIARY BUILDING	1.9	-	-
ADS BOTTLE REPLACEMENT - FUEL BUILDING	0.9	0.5	0.4

Revision to response 471.19

1AA.2 SUMMARY OF SHIELDING DESIGN REVIEW (Continued)

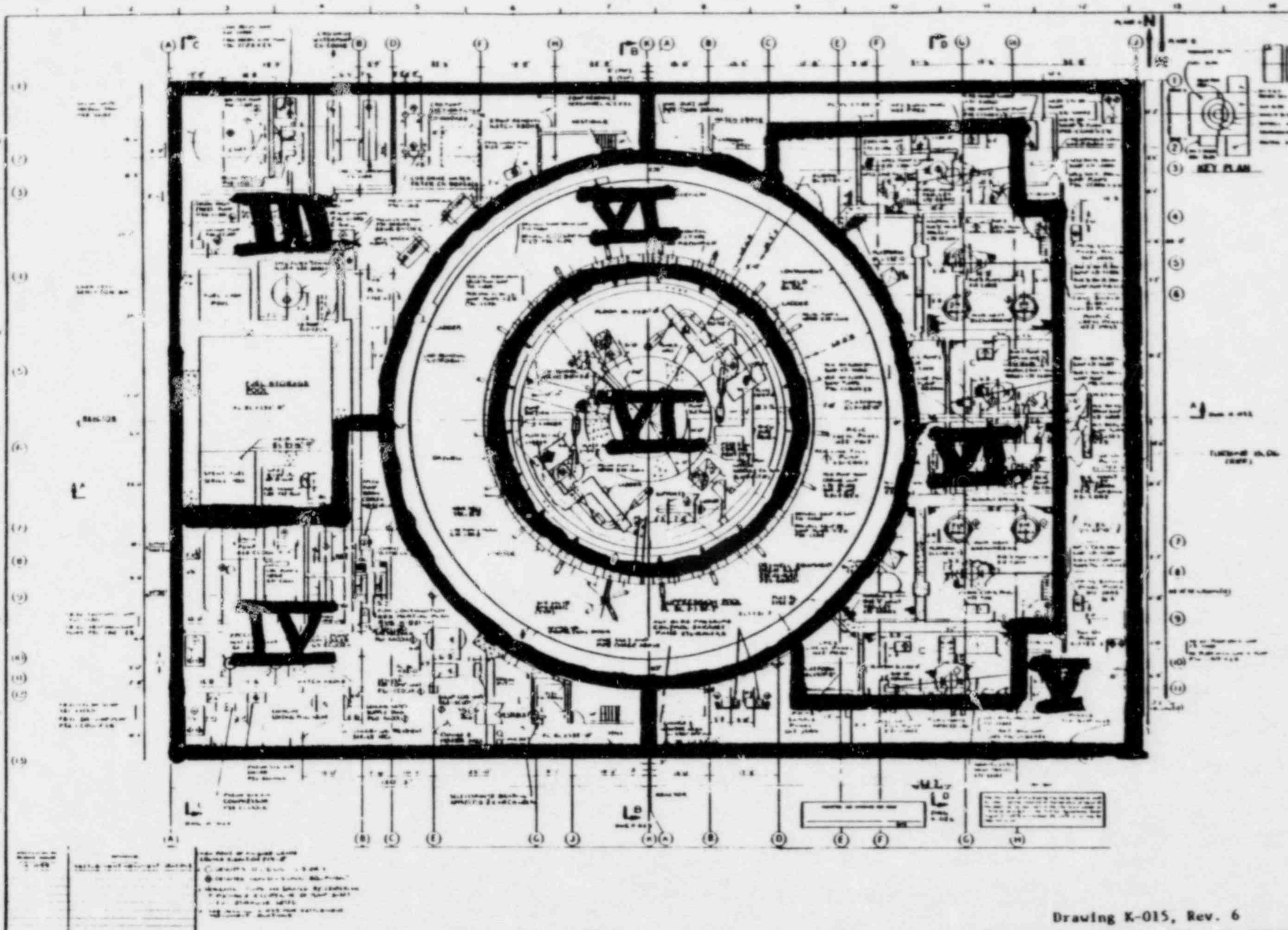
rooms and pumps and valves per Table 1AA-1. All vital equipment will be environmentally qualified. It is also shown that this exposure envelope is not time dependent after about 100 days.

c) It is not necessary for operating personnel to have access to any place other* than the Control Room, ~~and~~ the Technical Support Center, the post-accident sampling station, the sample analysis area, and three manual valves in the Auxiliary and Fuel Buildings to operate the equipment of interest during the 100 day period. The manual valves are for essential service water supply (one in each division) to the hydrogen mixing blowers of the Combustible Gas Control system and a Drywell Bleed-off Vent System valve. These valves are considered accessible on a controlled exposure basis. Direct shine from the containment is less than one R/hr within four hours post-accident.

d) The control room is designed to be accessible post-accident.

e) Access to radwaste is not required, but the Radwaste Building is accessible since primary containment sump discharges are isolated and secondary containment sump pump power is shed at the onset of the accident. Thus, fission products are not transported to radwaste. The hydrogen control system is operated from the Control Room; the 238 Nuclear Island does not have a containment isolation reset control area or a manual ECCS alignment area. These functions are provided in the Control Room.

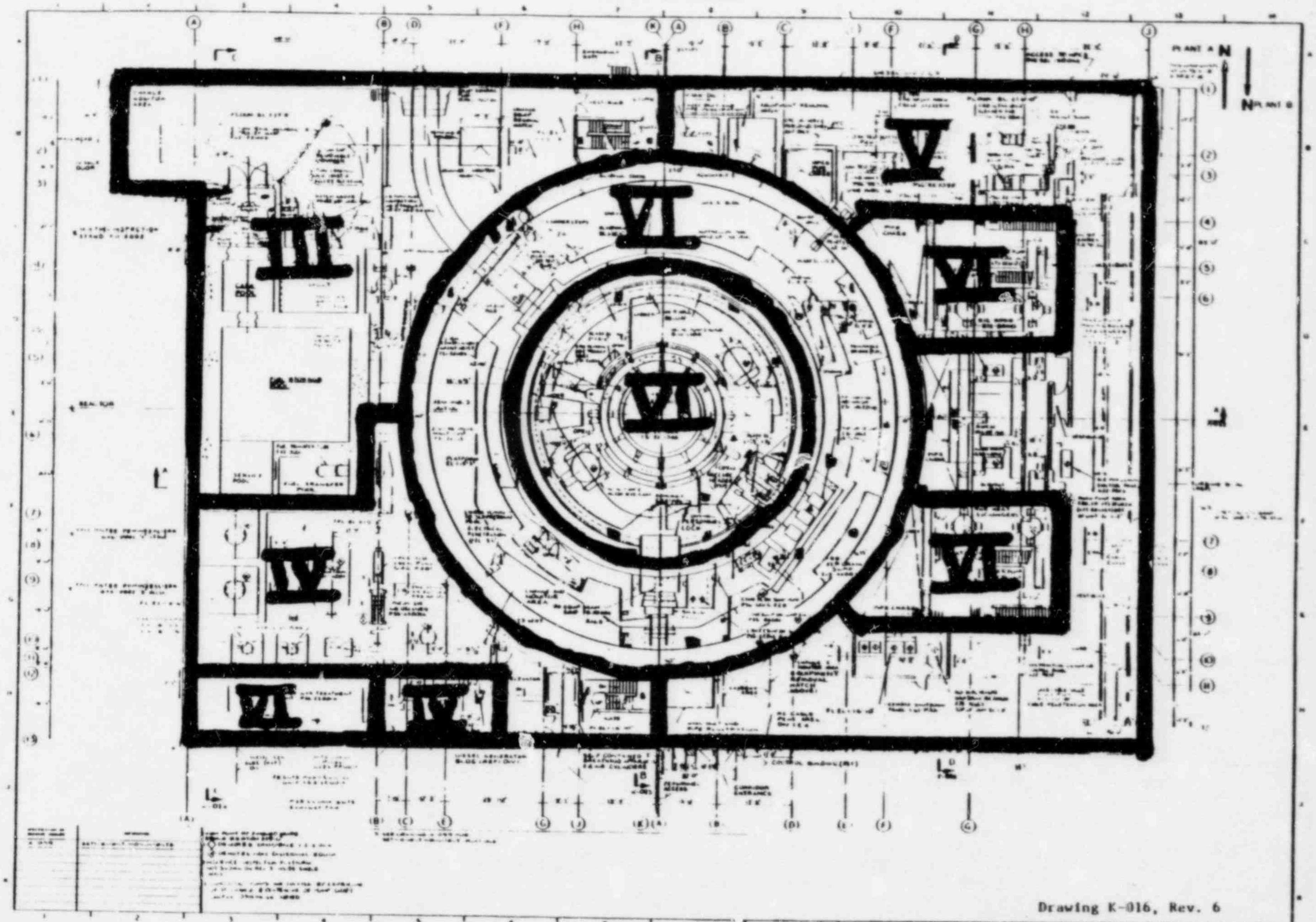
* Information related to the Technical Support Center, the post-accident sampling station and the sample analysis area will be provided by the applicant and is not included in the detailed discussion which follows.



Reactor, Auxiliary & Fuel Building Arrgt Plan at El(-)32'-0"

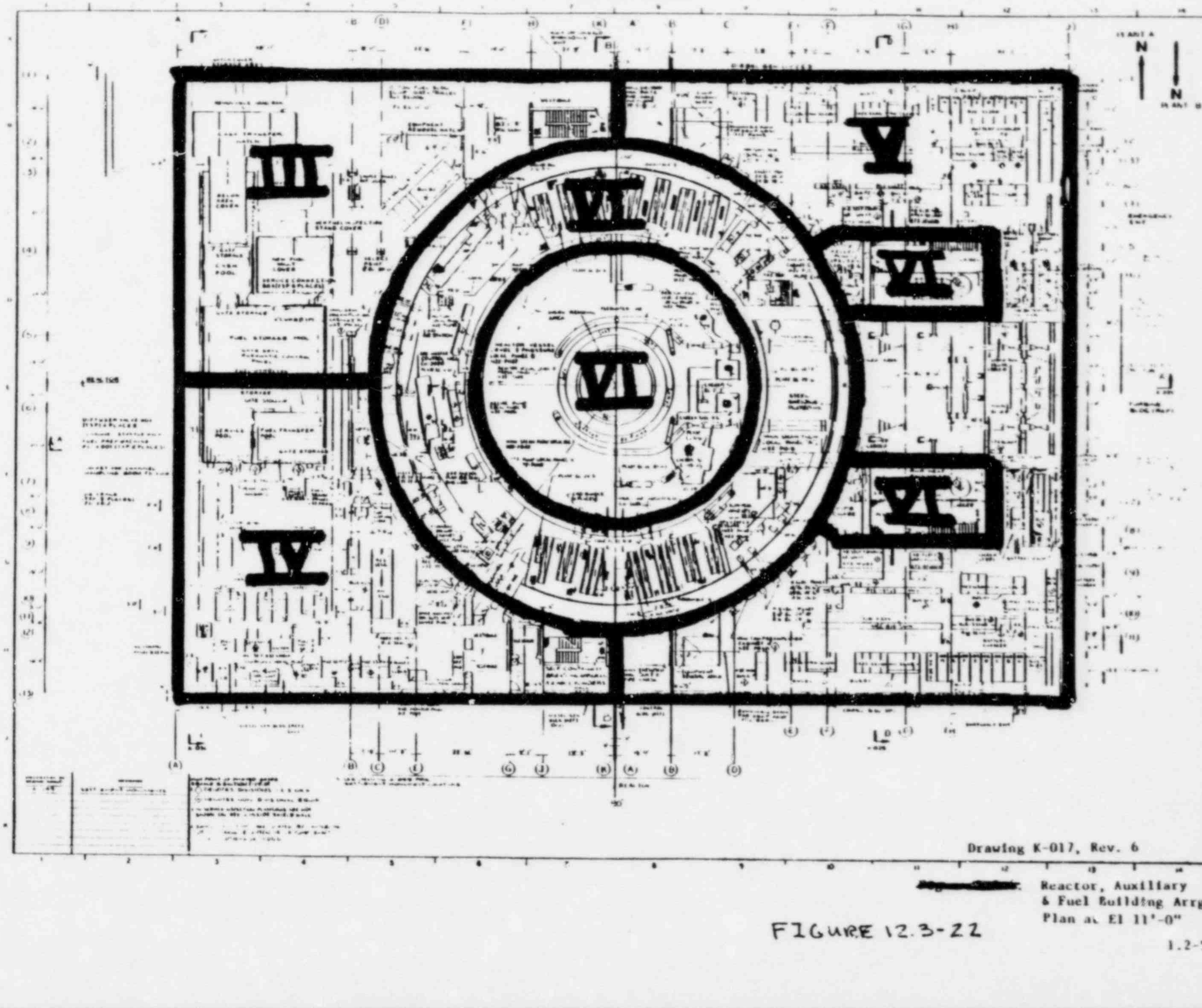
FIGURE 12.3-20

GESSAR II
238 NUCLEAR ISLAND



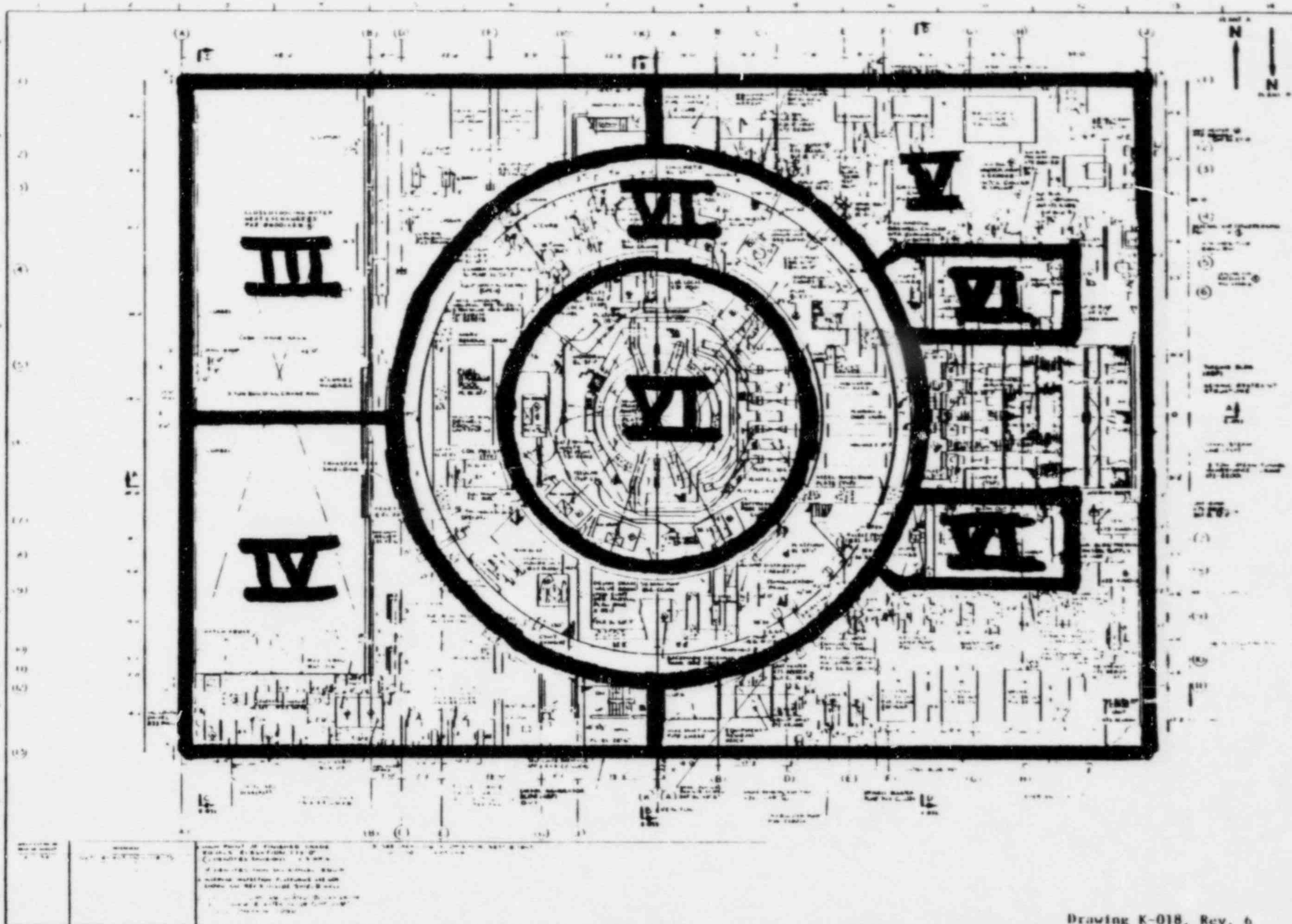
[redacted]: Reactor, Auxiliary & Fuel Building Arrgt Plan at El(-)6'-10" ⑥

FIGURE 12.3-21



[redacted] Reactor, Auxiliary
& Fuel Building Arrgt
Plan at El 11'-0"

FIGURE 12.3-22



Drawing K-018, Rev. 6
Reactor, Auxiliary
& Fuel Building
Plan at El 28'-6"

FIGURE 12.3-23

FIGURE 12.3-29

AUXILIARY BUILDING - ECCS ROOMS AND (-) 32'-0" CORRIDOR

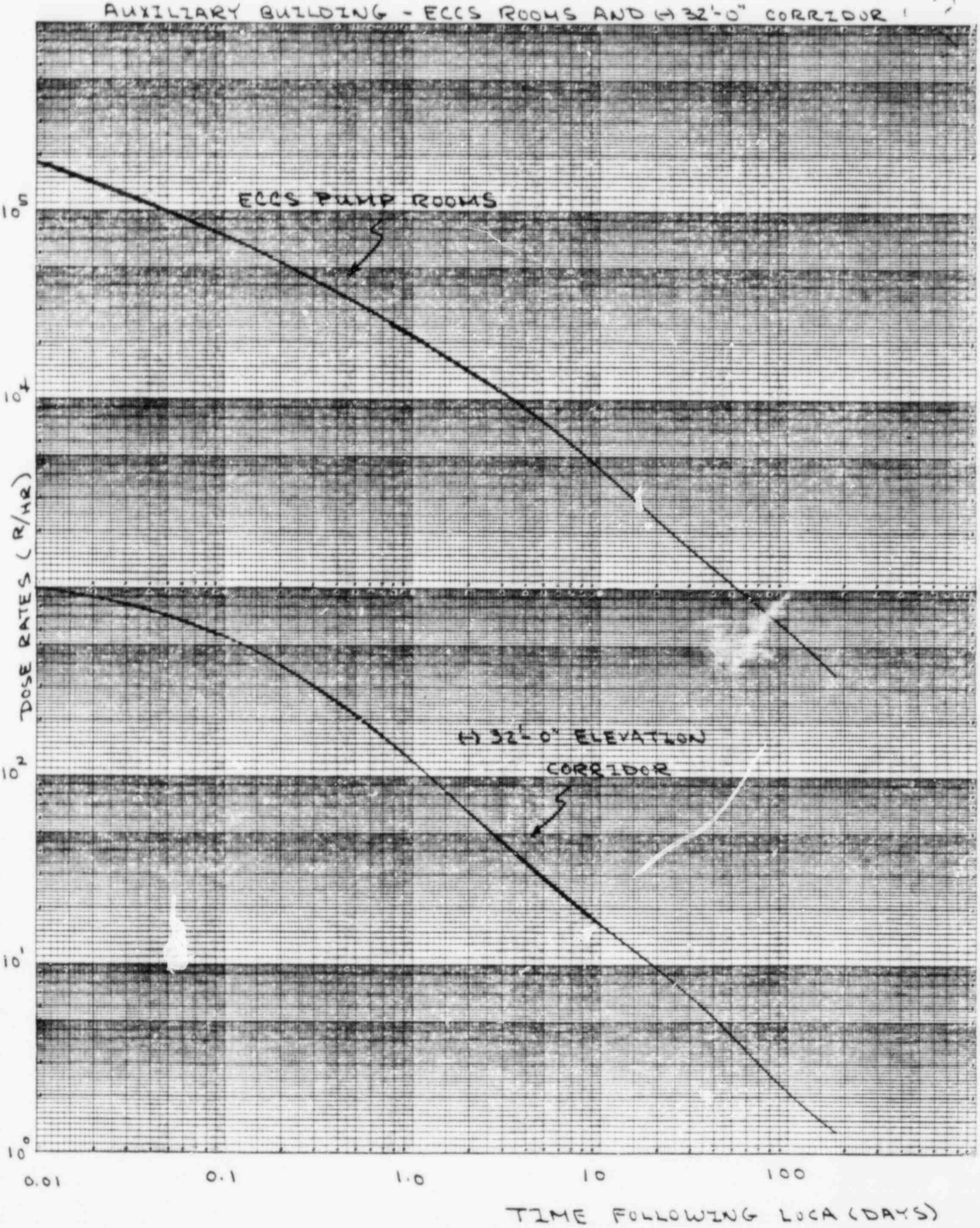
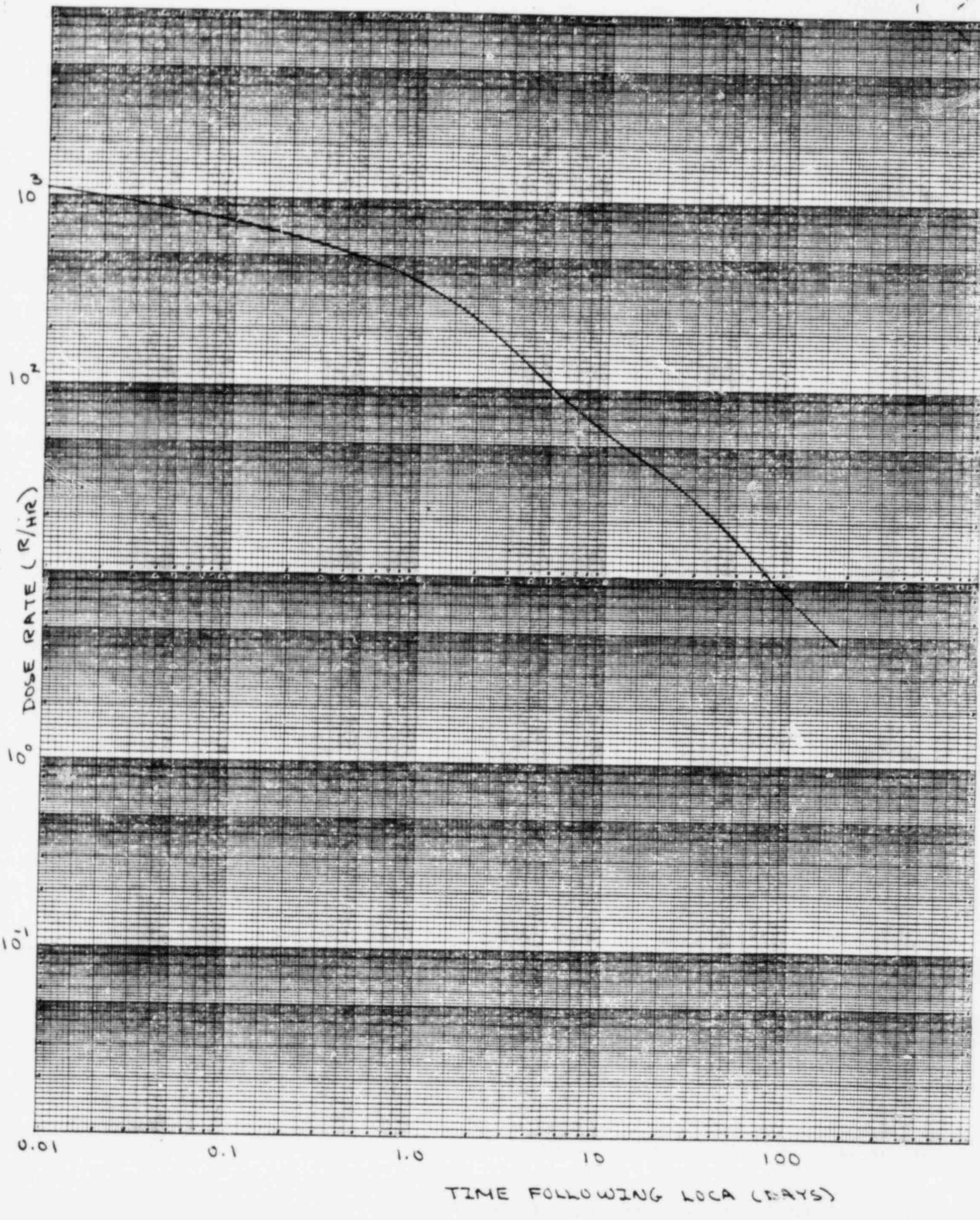


FIGURE 12.3-30

AUXILIARY BUILDING - ABOVE (-)6'-10" EL. OUTSIDE SECONDARY CONT.



ATTACHMENT NO. 4

DRAFT RESPONSES TO

POWER SYSTEMS BRANCH

QUESTIONS

... change for 430.01

8.3.1.1.2 480V Distribution System

Power for 480V auxiliaries is supplied from load centers consisting of 6.9-kV/480V transformers and associated metal clad switchgear.

Class 1E 480V load centers supplying Class 1E loads are arranged as independent radial systems, with each 480V bus fed by its own power transformer. Each 480V Class 1E bus in a division is physically and electrically independent of the other 480V buses in other divisions. A manual crosstie is provided between redundant buses of Division 1 and Division 2 and is equipped with a normally open circuit breaker in each substation. The ties are manually initiated and are guarded by key interlock to prevent paralleling of the two divisions.

Under normal operation, division 1 breaker "110A" is closed, (Bus E1 is fed from Bus E), division 2 breaker "210A" is closed, (Bus F1 is fed from Bus F) and the two tie breakers between divisions 1 and 2 are open (breaker 110F for Division 1 and breaker 210F for Division 2).

If during plant shutdown, the operator needs to close the tie breakers for maintenance flexibility, the following sequence has to take place.

- Trip breaker "110A"/bus E1, and lock it open.
- Remove the key from lock (A4) at breaker 110A/Bus E1. Key is removable only when breaker is locked open.
- Insert key in lock (A4) at breaker 210F (Bus F1)
- ~~With key (A3) in its respective lock, breaker 210F/Bus F1 may be closed~~, and a control Rm indicating light will indicate that BKR 210F is closed.
- Remove key from lock (A5) at breaker 110A/Bus E1.
- Insert key in lock (A5) at breaker 110F/Bus E1.
- With key (A2) in its repective lock, breaker 110F/Bus E1 may be closed, and a CR indicating light will indicate that Bkr 110F is closed

Main breaker 210A/Bus F1 is now feeding Buses E1 & F1 while main breaker 110A/Bus E1 is locked open. Similar steps could be taken in order to feed buses E1 & F1 from main breaker 110A while breaker 210A is locked open.

When Bkr 110A/BusE1 or Bkr 210A/Bus F1 are open, an indicating light will be initiated in the control Room.

The same applies for the tie breakers between non-divisional buses E2 & F2.

Interchanges A2 & A3 are provided to safeguard against personnel coming into contact with live bus in the rear of the cubicle.

The operator has to:

- Trip and lock out tie breakers 110F/Bus E1 & 210F/Bus F1. Then remove keys A2 & A3.
- Both keys must be inserted into their respective locks on rear door of the cubicle at breaker 110F/Bus E1 (or breaker 210F/Bus F1) in order to open the rear door to work in the Bus compartment.

The 480V unit substation breakers supply 460V motor loads up to and including 400 hp, and motor control centers. Switchgear for the 480V load centers is of indoor, metal-enclosed type with drawout circuit breakers. Control power is from the Class 1E 125VDC power system of the same division. The HPCS 480V auxiliaries are supplied from an independent Class 1E 6.9-kV bus and transformer in Division 3.

The 480V MCCs feed motors 100 hp and smaller, control power transformers, process heaters, motor-operated valves and other small electrically operated auxiliaries, including 480-120V and 480-240V transformers. Class 1E control centers are isolated in separate load groups corresponding to divisions established by the 480V unit substations. Current limiting reactors are used, when required, to limit short circuit currents to less than 25,000A. MCC branch circuit protection for all loads is provided by molded case circuit breakers.

Starters for the control of 460V motors 100 hp and less are the MCC-mounted, across-the-line magnetically operated, air break type. The starters are a combination type with circuit breakers of 25,000A, symmetrical interrupting capacity and a magnetic contactor to provide overload and undervoltage protection. Class 1E MOVs have molded case breakers with thermal magnetic protection, since the overload elements of the starter are in the circuit during testing although bypassed during normal plant operation. Circuits leading from the electrical penetration assemblies into the containment area have a fuse in series with the circuit breakers as a backup protection for a fault current in the penetration in the event of circuit breaker overcurrent or fault protection failure.

Figure Change for 430.01

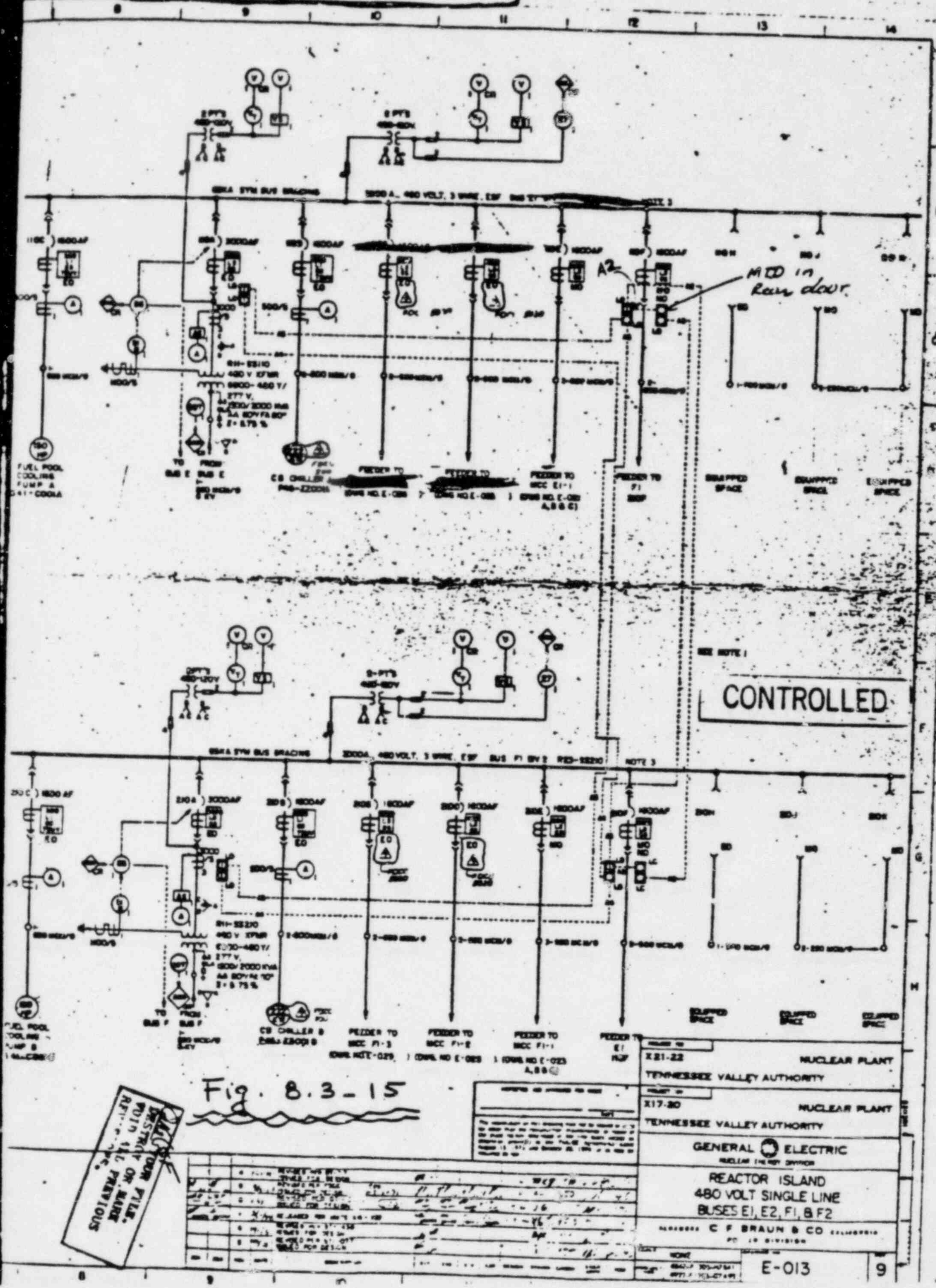


Fig. 8.3-15

Text addition for 430.04

 [redacted]

8.3.1.1.7 Load shedding and sequencing on class 1E buses (continued)

(8) Protection against degraded voltage

For protecting ~~rotating~~ ion of the division 1 and 2 electric equipment against the effects of a sustained degraded voltage, the normal and alternate BOP ~~feeder~~ bus voltages are monitored.
When the bus voltage degrades to 90%*or below of its rated value* and after a time delay (~~for not to be~~ to prevent triggering by transients), undervoltage will be annunciated in the control room.
Simultaneously a 5 minute timer is started, to allow the operator to take corrective action.
After 5 minutes the respective feeder breaker with the undervoltage is tripped.
Should a LOCA occur at the same time, the feeder breaker with the undervoltage will be tripped instantly.
Subsequent bus transfer will be as described above.

*Setpoint is subject to confirmation by applicant.

~~HPCS (div.3)~~

In addition to the undervoltage scheme provided to detect loss of offsite power at the 6900V HPCS bus, the second level of undervoltage protection will be provided to protect the Class 1E electric equipment connected on the bus, against the effects of a sustained degraded voltage condition. When the HPCS bus voltage degrades to 90%* of its rated value, a set of undervoltage relays operate to start a timer. Should the voltage restore to a value above 90%* before the preset time on the timer is exceeded, the relays reset and no further action takes place. However if the degraded voltage condition exceeds the preset time on the timer, a loss of offsite power operational sequence is started. This sequence includes automatic tripping of the offsite power feeder breaker, start up of the HPCS diesel generator and transfer of the division 3 bus from offsite to the diesel generator source.

* setpoint is subject to confirmation/verification by applicant.

Text revision for 430.05

8.3.1.1.6.4 Protection Requirements (Continued)

relay protection has voltage restraint so that disturbances in the plant auxiliary power system which result in excessive voltage drops will not damage the diesel generator.

In general, relay settings are coordinated so that loss of service is not communicated to a "higher" level involving equipment other than that immediately affected by the fault or overload. Trip levels and time-delay settings are selected so that faults are not passed through to circuit breakers upstream in a chain leading to the power supply. Backup relaying includes, within its protective zone, the next adjoining system interfacing element. Circuit protection functions are illustrated in Figures 8.3-2, 8.3-3 and 8.3-14 through 8.3-16.

8.3.1.1.7 Load Shedding and Sequencing on Class 1E Buses

This subsection addresses only Class 1E Divisions 1 and 2. Bus transfer, load shedding and sequencing on a 6.9-kV Class 1E bus is initiated on loss of bus voltage. Non-Class 1E loads (Buses E2 and F2) are tripped off and thereby automatically isolated from the Class 1E buses only by a LOCA signal.

Load shedding and sequencing is performed by the control system for the circuit breakers and by the control logic and LOPP signals (loss of preferred power undervoltage signals).

(1) <u>LOCA</u> - The existence of the LOCA condition is signalled by redundant one-out-of-two-twice sensor circuits originating from NSSS equipment. This is the same signal that initiates the ECCS described in Subsection 7.3.1.1.1.

The LOCA signal will trip the isolation breakers to the non-Class 1E buses (E2 and F2). The LOCA signal will also terminate diesel-generator testing (if this is in

430.05 cont

8.3.1.1.7 Load Shedding and Sequencing on Class 1E Buses (Continued)

progress), disable [redacted] protective diesel-generator protective relays except generator differential and diesel overspeed, start the diesel generator and start the ECCS motors in sequence as shown in Table 8.3-4 if not already running.

A load sequencer is not used. All load application, with or without time delay, is controlled separately for each large pump feeder breaker.

(2) Loss of Preferred Power (LOPP) - The 6.9-kV Class 1E buses are normally energized from the normal preferred power supply. Should the bus voltage decay to below 70% of its nominal rated value for a predetermined time (actuating one-out-of-two [redacted] undervoltage logic), a bus transfer is initiated and ~~a~~ signal will trip the supply breaker, & start the diesel generator [redacted] When the bus voltage decays to below 30% of its normal rated value, large pump motor breakers are tripped. [redacted] A closure signal to the alternate preferred power supply initiates transfer to the alternate preferred supply. If the alternate supply is not available, or subsequently lost (i.e., as sensed by the under-voltage relays as above), the transfer proceeds to the diesel generator. If the standby diesel generator is ready to accept load (i.e., voltage and frequency are within normal limits and no lockout exists, and the normal and alternate preferred supply breakers are open), then the diesel-generator breaker is signalled to close, accomplishing automatic transfer of the class 1E [redacted] bus to the diesel generator. Large motor loads will be sequence started as required and as shown on Table 8.3-4.

Load Shedding and Sequencing on Class 1E Buses (Continued)

(2a) When the alternate preferred power is lost, while it is powering the class 1E bus, with the diesel generator in standby, loss of preferred power (LOPP) exists. The same, as during LOCA, diesel generator trips are disabled, except for generator differential and engine overspeed. At 70% of the rated bus voltage, the alternate feeder breaker trips. Diesel start initiation occurs, but is ineffective, since the diesel generator is running.

At 30% of the rated bus voltage, large pump motor breakers are tripped. Providing, that the diesel generator is ready for loading, the diesel generator breaker will close and supply power to the class 1E bus.

(3) LOPP following LOCA - If the bus voltage (normal preferred power) is lost during post-accident operation, transfer to alternate preferred power occurs as

described in (2) above. Once voltage is restored, the loss-of-voltage sequencing procedure repeats itself with respect to starting motor loads. Since system reset is not a function of the presence or absence of bus voltage, no change to valve position occurs. Therefore, the restarting duty is less severe, because motor-operated valve power is not required.

(4) LOCA following LOPP - If a LOCA occurs after the automatic transfer of power to the diesel-generator as described in (2), following loss of both normal preferred power supplies, the LOCA signal starts ESF equipment as required. Automatic (LOCA + LOPP) time delayed load blocking assures that the diesel generator will not be overloaded.

Operating Class 1E loads will not be shed under LOCA conditions

QUESTION 430.08
(8.3.1)

In Section 8.3.1.1.6.4 of your FSAR, you state that the diesel-generator overcurrent relay protection has a voltage restraint so that disturbances in the plant auxiliary power system which result in excessive voltage drops, will not damage the diesel-generator. Indicate how far into the plant distribution system from the diesel-generator the relays will sense a disturbance. State whether these relays are sensitive to voltage transients created by normal power system evolutions such as motor starting.

RESPONSE

See revised Section 8.3.1.1.6.4

8.3.1.1.6.4 Protection Requirements

When the diesel-generators are called upon to operate during loss of preferred power (LOPP) or LOCA conditions, the only protective devices are the generator differential relays and engine overspeed trip device. The generator differential relays and overspeed trip device are retained under accident conditions to protect against possible, significant damage. Other protective relays, such as loss of excitation, antimotoring (reverse power) overcurrent voltage restraint, high jacket water temperature and low lube oil pressure, are used to protect the machine when operating in parallel with the normal power system, during periodic tests. The relays are automatically isolated from the tripping circuits during LOPP or LOCA conditions. In addition to these protective relays, a normal time-delay overcurrent relay senses generator overload, and alarms. Another time-delay overcurrent relay is provided with a voltage restraint which enables the relay to distinguish between normal operating over-load currents and short circuit currents of the same magnitude. This discrimination is accomplished by the fact that as opposed to short circuit conditions, the magnitude of generator voltage remains relatively high during operating load conditions, so that the relay's voltage - restraining element is able to keep the current element from operating the relay during overloads[9].

INSERT

INSERT A

For HPCS (Division 3) DG the overcurrent relays with voltage restraint will sense the voltage drops reflected on the HPCS bus only. This relay will operate during a DG overcurrent condition and voltage dropping to a preset value. However, this condition will not trip the DG when loss of coolant accident signal is present. The DG trip signal is bypassed inorder to make the HPCS DG available during LOCA condition. Any voltage transient created by normal power system evolution such as motor starting on Division 1 and/or Division 2 will have no effect on the Division 3 (HPCS) overcurrent relays with voltage restraint.

"A" All the bypassed trip devices listed in Subsection 8.3.1.1.8.1.5 alarm in the Main Control Room.

The means are provided for synchronizing and paralleling the diesel generators with the preferred power supply system, for load testing of the diesel generator.

In general, relay settings are coordinated so that loss of service is not communicated to a "higher" level involving equipment other than that immediately affected by the fault or overload. Trip levels and time-delay settings are selected so that faults are not passed through to circuit breakers upstream in a chain leading to the power supply. Backup relaying includes, within its protective zone, the next adjoining system interfacing element. Circuit protection functions are illustrated in Figures 8.3-2, 8.3-3 and 8.3-14 through 8.3-16.

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430.09 (8.3) A review of malfunction reports of diesel-generators at operating nuclear plants has disclosed that in some cases, the information available to the control room operator to indicate the operational status of the diesel-generator may be imprecise and could lead to misinterpretation. This can be caused by the sharing of a single annunciator station to: (1) alarm conditions that render a diesel-generator unable to respond to an automatic emergency start signal; and (2) alarm abnormal, but not disabling, conditions. Another cause can be the use of wording in an annunciator window which does not specifically indicate that a diesel-generator is inoperable (i.e., unable at the time to respond to an automatic emergency start signal) when in fact, it is inoperable for this purpose.

Accordingly, review and evaluate the alarm and control circuitry for the diesel-generators in your proposed nuclear island to determine how each condition which renders a diesel-generator unable to respond to an automatic emergency start signal, is alarmed in the control room. These conditions include not only the trips that lock out the diesel-generator start and require manual reset but also control switch or mode switch positions which block automatic start. Other conditions in this category are loss of control voltage, insufficient starting air pressure or low battery voltage. Your review should consider all aspects of possible diesel-generator operational conditions (e.g., test conditions and operation from a local control station). One area of particular concern is the unreset condition following a manual stop at the local station which terminates a diesel-generator test and prior to resetting of the diesel-generator controls to permit subsequent automatic operation.

Provide the details of your evaluation, the results and your conclusions, including the following information:

a. All conditions which render the diesel-generator incapable of responding to an automatic emergency start signal for each operating mode as discussed above.

b. The wording on the annunciator window in the control room which is alarmed for each of the conditions identified in your response to Item (a) above.

c. Any other alarm signals which are not included in Item (a) above and which also cause the same annunciator to alarm.

d. Any condition which renders the diesel-generator incapable of responding to an automatic emergency start singal and which is not alarmed in the control room.

e. Any modifications you propose following your evaluation of these matters.

RESPONSE 430.09

The details of the evaluation, the results and conclusions, are included in the following information table for parts a. and b. and the following text for parts

Div 1 & 2 (Division 1 is shown, Division 2 is identical except where noted otherwise)

a. (INOPERATIVE CONDITIONS)	b. (WORDING ON THE CONTROL ROOM STATUS LIGHT)	b. (WORDING ON THE CONTROL ROOM ANNUNCIATOR)
1-Engine Fuel Oil Shutoff Valve Closed	"ENG FUEL OIL SOV CLOSED"	"DIESEL GEN OUT OF SERVICE"
2-Out of Service Switch Actuated	"DG CONT SYSTEM OUT OF SERVICE"	
3-Local Control Only (Details by Applicant)	"DG SYST LOCAL CONTROL ONLY"	
4-BOP (Fuel Oil) Out of Service (Details by Applicant)	"BOP OUT OF SERVICE"	
5-Control Room Logic Fault	"DG LOGIC FAULT"	
6-Remote Shutdown Portion Actuated (Div 1 only)	"DG SYST LOCAL CONTROL ONLY"	
7-Unit Unavailable for Emergency (Details by Applicant - See Note)	"EMERG START INOP"	

NOTE - Typical unit unavailable conditions are: local control only, low starting air pressure, generator differential trip, emergency stop, engine overspeed trip, in maintenance mode, DC power failure, both fuel oil transfer pumps have motor overload/power loss or controls in OFF.

Normal, or test, start and stop do not make the unit unavailable.

c. Other alarm signals which are not included in Item (a) above do not cause the same annunciator to alarm. They go to separate alarms.

d. Open-circuited or short-circuited conditions could render the diesel-generator incapable of responding to an automatic emergency start signal and may not alarm automatically in the control room. Such conditions are detected through manual testing and alarmed manually in the control room by actuating the "Out of Service Switch".

e. However, No modifications are proposed.

Div 3 - By GE.

GESSAR II

QUESTION 430.09

a),b) Conditions which render the HPCS D-G incapable of responding to an automatic emergency start signal.

	Condition	Actuating device	Alarm in CR	Other Alarms
1.	Auto-Maint SW. in Maint. Pos	Switch MSI	HPCS sys not ready for Autostart	DE in Maint. posi -CR
2.	Loss of 125VDC control power at DGP	BF1,2,3,4,5 via common alarm (-70X11)	HPCS sys not ready for Autostart	- Diesel Engine trouble - CR and - count pwr fail - LCL
3.	Brk R1 in closed position	52/a contact from bkr #1 (SWGR Cub003)	No alarm but bkr position indication	None
4.	Gen lockout Not reset	K1 lockout relay (H22-P028)	HPCS sys Not ready for Autostart	Gen trip Lockout - CR (Via K3)
5.	Emerg. Shutdown Not reset	SDR	HPCS sys Not ready for Autostart	Gen trip Lockout (Via K3) - CR
6.	Voltage Regulator Mode sw not in Auto pos.	VR mode	HPCS sys Not ready for Autostart	none
7.	Cont pwr flr to SWGR (Cub002, 3&4)	74F1, F2 (Cub002) 74F1, (Cub003) 74F1, (Cub004)	HPCS sys Not ready for Autostart	none

c) No other signals annunciate the "HPCS system not ready for autostart" alarm.

d) Since "Low Starting air pressure" and "Fuel system fault" are annunciated in the control room as a "Diesel Engine Trouble" alarm, no other unalarmed conditions render the diesel generator incapable of responding to an automatic emergency start signal.

e) No modifications are proposed.

QUESTION 430.11
(8.3.1)

Provide the following additional information regarding the loading of the HPCS diesel-generator:

a. If the HPCS is operating on the preferred power source with the diesel-generator in standby, indicate the sequence of events following a loss of the preferred power sources. State whether the residual bus voltage is allowed to decay or whether a synchronizing scheme is utilized.

Reponse

The residual bus voltage is allowed to decay and there is no synchronization scheme for this mode. The following sequence occurs with no LOCA signal present:

1) Offsite power breaker to safety bus (6900 volt HPCS G Division 3) "trips", when the bus voltage drops below 70% of normal rated value. After 3 seconds ~~following~~ after the bus trip the DG receives a start signal.

2) Division 3 diesel generator accelerates to rated voltage and frequency while the residual voltage on the safety bus (6900 volt HPCS Bus G Division 3) decays.

3) The Division 3 diesel generator circuit breaker will close automatically when all of the following permissives are satisfied.

   a) the safety bus (6900 volt HPCS Bus G Division 3) voltage decays below 70% of the nominal bus voltage,
   b) the offsite source feeder breaker remains tripped in the open position,
   c) the diesel generator Division 3 has reached rated ~~shield~~ speed and voltage.

b. State whether diesel-generator will automatically separate from the test mode if an accident signal is received. Indicate the sequence of events.

Response

Diesel generator (HPCS, Div. 3) will separate from the test mode to return to standby condition upon receipt of the accident signal

1. Diesel generator breaker will open.

2. The accident signal will override the test signal.

3. Diesel generator will keep operating and will be ready to accept load if required

c. Indicate the sequence of events if the diesel-generator is on test in parallel with the offsite source and the offsite source is lost. Indicate whether the HPCS bus will require re-energization by local manual control in a manner similar to the Divisions 1 and 2 buses.

Response

Upon loss of offsite power during test mode the offsite feeder breaker will open by undervoltage relays on the offsite feeder. The diesel generator will keep operating. The diesel generator governor control be changed from droop to the isochronous mode and the voltage regulator to be set to automatic mode. Following these actions, the diesel generator will continue feeding power to the HPCS (Division 3) bus.

d. If the diesel-generator is powering the HPCS and offsite power is subsequently restored, state whether the safety buses automatically transfer back to the offsite source.

Response

If the diesel generator is powering the HPCS bus and the offsite power is subsequently restored, then the bus will not automatically transfer back to the offsite source.

430.17

IV.2.4 Regulatory Guide 1.75, Revision 1, Dated January 1975 (Continued)

Delete - GE to confirm.

(4) Position C.7 - Non-Class 1E instrumentation circuits can be exempted from the provisions of Section 4.6.2 provided they are not routed in the same raceway as power and control cables or are not routed with associated cables of a redundant division.

(5) Position C.8 - Section 5.1.1.2 should not be construed to imply that adequate separation of redundant circuits can always be achieved with a confined space such as a cable tunnel that is effectively unventilated.

(6) Position C.11 - Add "...and should preclude the need to frequently consult reference..."

Certain non-Class 1E loads important to orderly shutdown and surveillance such as emergency lighting are not disconnected upon a LOCA signal. Two separate trip devices are provided to isolate these non IE loads from the IE system under a fault condition

RESPONSE to 430.20

8.3.2.2.1.2.8 Compliance with Regulatory Guide 1.128 - Installation Design and Installation of Large Storage Batteries for Nuclear Power Plant

The Class IE batteries are specified and located in accordance with IEEE Standard 484-1975, as modified and augmented by Regulatory Guide 1.128, revision 1, with the exception that the DIV 4 battery (Battery H) are three-steps rather than two-tiered. The height of the 3-steps ~~should be~~ is equal or less than the height of the 2-tiered batteries. ~~This can be easily obtained~~ The lower height is possible due to the fact that the Division 4 battery (Battery H) is much smaller than the Division 1&2 batteries.

Space limitation for access necessitated this exception. No deleterious effects are anticipated and maintenance activities were evaluated to be acceptable.

Compliane with Safety, Installation Procedures and Records Section of IEEE 484-1975, as modified and augmented by Regulatory Guide 1.128 is the responsibility of the applicant.

430.23 (8.3.2.1) The specific requirements for monitoring the dc power system derive from the generic requirements embodied in Section 5.3.2(4), 5.3.4(5) and 5.3.3(5) of IEEE Std. 308-1974 and the guidance we provide in Regulatory Guide 1.47. In summary, these general requirements state that the dc system composed of batteries, distribution systems and chargers shall be monitored to the extent that it can be shown to be ready to perform its intended function. Accordingly, the guidelines used in our review of the dc power system designs are that the following indications and alarms of the Class 1E dc power system should be provided in the control room:

- Battery current (ammeter-charge/discharge)
- Battery charger output current (ammeter)
- DC bus voltage (voltmeter)
- Battery charger output voltage (voltmeter)
- Battery discharge
- DC bus undervoltage and overvoltage alarm
- DC bus ground alarm (for ungrounded systems)
- Battery breaker(s) or fuse(s) open alarm
- Battery charger output breaker(s) or fuse(s) open alarm
- Battery charger trouble alarm (one alarm for a number of abnormal conditions which are usually indicated locally)

We conclude that the monitoring cited above, augmented by the periodic test and surveillance requirements included in the Technical Specifications, provide reasonable assurance that the Class 1E dc power system is ready to perform its intended safety function. Indicate your compliance with these provisions for monitoring the Class 1E prower system. Alternatively, justify any deviation.

Response

We provide a local and/or remote indication for all of the items listed. For further information see the revised version of FSAR Section 8.3.2.2.1, paragraph 1 (see copies attached).

SEE SUPPLEMENT TO TABLE 8.3-12 FOR DIV-3 (HPCS)

8.3.2.2 Analysis

8.3.2.2.1 General DC Power Systems

The 480 VAC power supplies for the divisional battery chargers are from the individual Class 1E MCC to which the particular 125 VDC system belongs (Figure 8.3-1). In this way, separation between the independent systems is maintained and the AC power provided to the chargers can be from either preferred or standby AC power sources. The DC system is so arranged that the probability of an internal system failure resulting in loss of that DC power system is extremely low. Important system components are either self-alarming on failure or capable of clearing faults or being tested during service to detect faults. Each battery set is located on its own ventilated battery room as shown in Figures 8.3-8, 8.3-9, and 8.3-13. All abnormal conditions of important system parameters such as charger failure or low bus voltage are annunciated in the Main Control Room ~~.~~ and/or locally (See Table 8.3-12).

Cross connection between the independent 125 VDC systems is limited to manual breakers between Division 1 and Division 2 distribution panels. Key interlocks are used to enforce operating procedures. One breaker is furnished at each end of the cross tie to meet single-failure requirements. A control room indication is provided for each Tie-breaker in the "close" position.

AC and DC switchgear power circuit breakers in each division receive control power from the batteries in the respective load groups ensuring the following:

(1) The unlikely loss of one 125 VDC system does not jeopardize the supply of preferred and standby AC power to the Class 1E buses of the other load groups.

(2) The differential relays in one division and all the interlocks associated with these relays are from one

TABLE 8.[illegible]

DC SYSTEM INDICATION AND ALARMS

BUS	CONDITION	INDICATION	LOCATION
DC-E	UNDERVOLTAGE, OVERVOLTAGE, GROUND FAULT OPEN BATTERY MAIN BREAKER OPEN BATTERY DISCONNECT SWITCH LOW BATTERY CHARGER DC VOLT & AMPS LOW BATTERY CHARGER AC INPUT VOLTS	D1 125VDC BUS DC-E TROUBLE	CONTROL RM. ANNUNCIATOR PNL.
		D1 125VDC BUS DC-E & MCC DC-E1 & DC-E2 TROUBLE	CONTROL RM. STATUS LIGHT PNL.
	BUS VOLTAGE	VOLTMETER	LOCAL & CONTROL RM.
	BUS AMMETER BATTERY AMP & VOLTS	VOLT AND AMMETER	LOCAL
DC-F	UNDERVOLTAGE, OVERVOLTAGE, GROUND FAULT OPEN BATTERY MAIN BREAKER OPEN BATTERY DISCONNECT SWITCH LOW BATTERY CHARGER DC VOLT & AMPS LOW BATTERY CHARGER AC INPUT VOLTS	D2 125VDC BUS DC-F TROUBLE	CONTROL RM. ANNUNCIATOR PNL.
		D2 125VDC BUS DC-F & MCC DC-F1 TROUBLE	CONTROL RM. STATUS LIGHT PNL.
	BUS VOLTAGE	VOLTMETER	LOCAL & CONTROL RM.
	BUS AMMETER BATTERY AMP & VOLTS	VOLT AND AMMETER	LOCAL
DC-H	UNDERVOLTAGE, OVERVOLTAGE, GROUND FAULT OPEN BATTERY MAIN BREAKER OPEN BATTERY DISCONNECT SWITCH LOW BATTERY CHARGER DC VOLT & AMPS LOW BATTERY CHARGER AC INPUT VOLTS	D4 125VDC BUS DC-H TROUBLE	CONTROL RM. ANNUNCIATOR PNL.
			CONTROL RM. STATUS LIGHT PNL.
	BUS VOLTAGE	VOLTMETER	LOCAL & CONTROL RM.
	BUS AMMETER BATTERY AMP & VOLTS	VOLT AND AMMETER	LOCAL.
DC-J	UNDERVOLTAGE, OVERVOLTAGE, GROUND FAULT OPEN BATTERY MAIN BREAKER OPEN BATTERY DISCONNECT SWITCH LOW BATTERY CHARGER DC VOLT & AMPS LOW BATTERY CHARGER AC INPUT VOLTS	ND 125VDC BUS TROUBLE	CONTROL ROOM ANNUNCIATOR PANEL
	BUS VOLTAGE	VOLTMETER	LOCAL & CONTROL RM.
	BUS AMMETER BATTERY AMP & VOLTS	VOLT AND AMMETER	LOCAL
DC-E1	UNDERVOLTAGE GROUND FAULT	D1 125VDC MCC DC-E1 TROUBLE	CONTROL RM. ANNUNCIATOR
		D1 125VDC BUS DC-E & MCC DC-E1 & MCC DC-E2 TROUBLE	CONTROL RM. STATUS LIGHTS
	BUS VOLTAGE & CURRENT	VOLTMETER & AMMETER	LOCAL & CONTROL RM.
DC-F1	UNDERVOLTAGE GROUND FAULT	D2 125VDC MCC DC-F1 TROUBLE	CONTROL RM. ANNUNCIATOR
		D2 125VDC BUS DC-F & MCC DC-F1 TROUBLE	CONTROL RM. STATUS LIGHTS
	BUS VOLTAGE & CURRENT	VOLTMETER & AMMETER	LOCAL & CONTROL RM.
DC-E2	UNDERVOLTAGE GROUND FAULT	D1 125VDC MCC DC-E2 TROUBLE	CONTROL RM. ANNUNCIATOR
		D1 125VDC DC-E & MCC DC-E1 & MCC DC-E2 TROUBLE	CONTROL RM. STATUS LIGHTS
	BUS VOLTAGE & CURRENT	VOLTMETER & AMMETER	LOCAL & CONTROL RM.

SEE SUPPLEMENT FOR DIV. 3 (HPCS)

SUPPLEMENT TO TABLE 8.3-12

BUS	CONDITION	INDICATION	LOCATION
DIV. 3 (HPCS) 125VDC BUS "G"	① continuous bus voltage	Voltmer	Local and Control room
	② Battery output current	Ammeter	Local
	③ Bus "G" load (Amps)	Ammeter	Local
	④ Bus "G" ground fault ⑤ Bus "G" undervoltage	125VDC system trouble alarm	control room
	⑥ Control power failure to DG cont. pnl.	Control power failure alarm	control room as "DG Trouble" and Local
	⑦ Battery charger input breaker tripped/open ⑧ Battery charger failure (including high voltage and ground fault)	Battery charger trouble alarm	Control room
	⑨ Charger output voltage	Voltmeter	Local
	⑩ Charger output current	Ammeter	Local
	⑪ Charger ground fault	Ground indication Light	Local

430.27 (8.3.2) Provide the specified operating voltage range of the Class 1E dc loads. Provide the maximum equalizing charge voltages for the Class 1E batteries and the dc system minimum discharge voltage at the end of the two hour design discharge. Provide the rating of the Division 3 battery charger and indicate the number of cells in each Class 1E battery. State whether the Division 3 battery charger will be affected by the voltage sag which occurs when the HPCS pump is started on the diesel-generator.

Response

See GESSAR II section 8.3.2.1.1 & Fig. 8.3-1B

The number of cells in each battery bank (either Class 1E or non-Class 1E) is 60 cells for the divisions 1, 2 and 4 and the non-divisional batteries.

The operating voltage range for Division 3 (HPCS) Class 1E dc loads is 112.5V to 137.5V with 125V dc nominal voltage. The maximum equalizing charge voltage for Division 3 (HPCS) 125Vdc battery is 137.4 volts. Voltage at the end of two-hour design discharge will be provided by the applicant. Division 3 battery charger is rated for 240/480V AC input with 132 volts (nominal), 100 amps dc output. Division 3 dc battery has 60 cells.

INSERT "A"

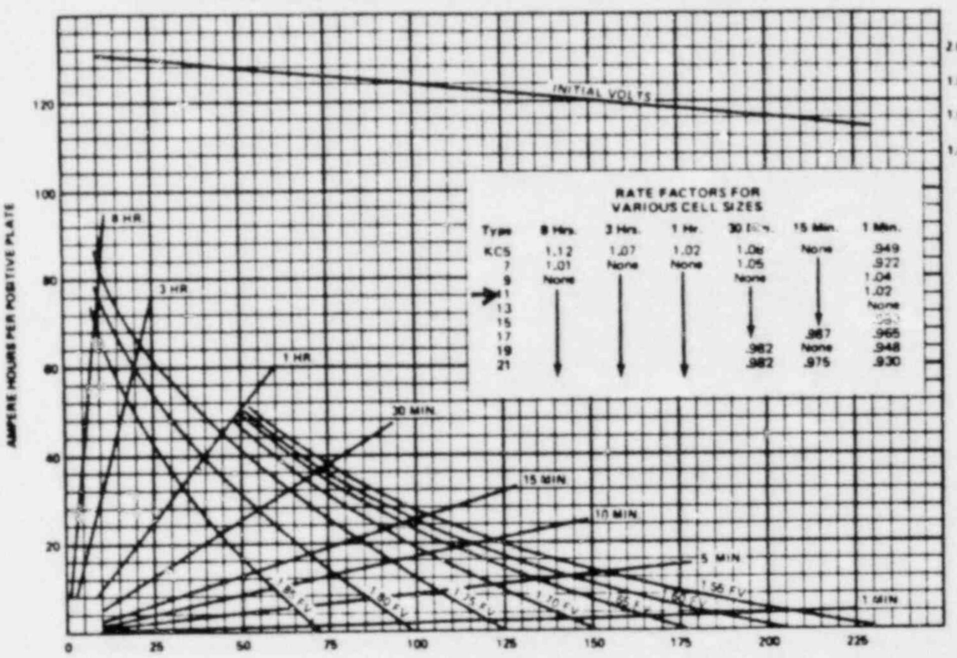
The charger is also capable of automatically regulating output voltage within ±1/2% of its rated value at any load between 0 and 100%, with the ac power feeding the charger deviating from the rated voltage by ±10%. Thus the Division 3 battery charger will not be affected by the voltage sag which occurs when the HPCS pump is started on the DG. The 125V DC battery will be able to maintain the bus voltage.

All dc loads connected on the division 3 dc bus are rated for operation in the voltage range of 112.5V to 137.5V.

INSER "A" TO RESPONSE 430.27

The division 3 (HPCS) 125V DC batteries are capable of supplying the connected loads for a period of 4 hours without recharging. Normal battery operating temperatures are between 60 and 90°F, averaging about 75°F. Following figure shows typical discharge characteristics of Type KC batteries furnished for the HPCS 125V DC distribution.

TYPICAL DISCHARGE CHARACTERISTICS OF KC, KA



Type	8 Hrs.	3 Hrs.	1 Hr.	30 Min.	15 Min.	1 Min.
KCS	1.12	1.07	1.02	1.08	None	.949
7	1.01	None	None	1.05		.922
9	None			None		1.04
11						1.02
13						None
15						[illegible]
17					.987	.965
19				.982	None	.948
21				.982	.975	.930

F.V = final voltage

Data based on discharge directly from a 72 hour float condition.

Five independent 125 VDC systems are provided ... Island normal and emergency DC power for each unit as appropriate. Four of the five 125 VDC systems are Class 1E power. The fifth system supplies non-Class 1E power.

The DC power systems provide adequate power for station emergency auxiliaries and for control and switching during all modes of operation.

The operating voltage range of Class 1E dc loads is 110V to 140V.

The maximum equalizing charge voltage for Class 1E batteries is 140Vdc. 430.7

The dc system minimum discharge voltage at the end of the two hour discharge period is 1.83Vdc per cell.

The 125 VDC systems provide a reliable control and switching power source for the Class 1E systems.

All batteries are sized so that required loads will not exceed 80% of nameplate rating, or warranted capacity at end-of-installed-life with 100% design demand. Each 125 VDC battery is provided with two chargers, each of which is capable of recharging its battery from a discharged state to a fully charged state while handling the normal, steady-state DC load.

Battery sizes are specified as:

(1) Battery E, Division 1 - 1950 A-hr at 8-hr rate; 2080A for 1 min

(2) Battery F, Division 2 - 1500 A-hr at 8-hr rate; 1620A for 1 min

(3) Battery G, Division 3 (HPCS) - 400 A-hr at 8-hr rate; 500A for 1 min

(4) Battery H, Division 4 - 425 A-hr at 8-hr rate; 550A for 1 min

Battery J, nondivisional - 2550 A-hr at 8-hr rate ...

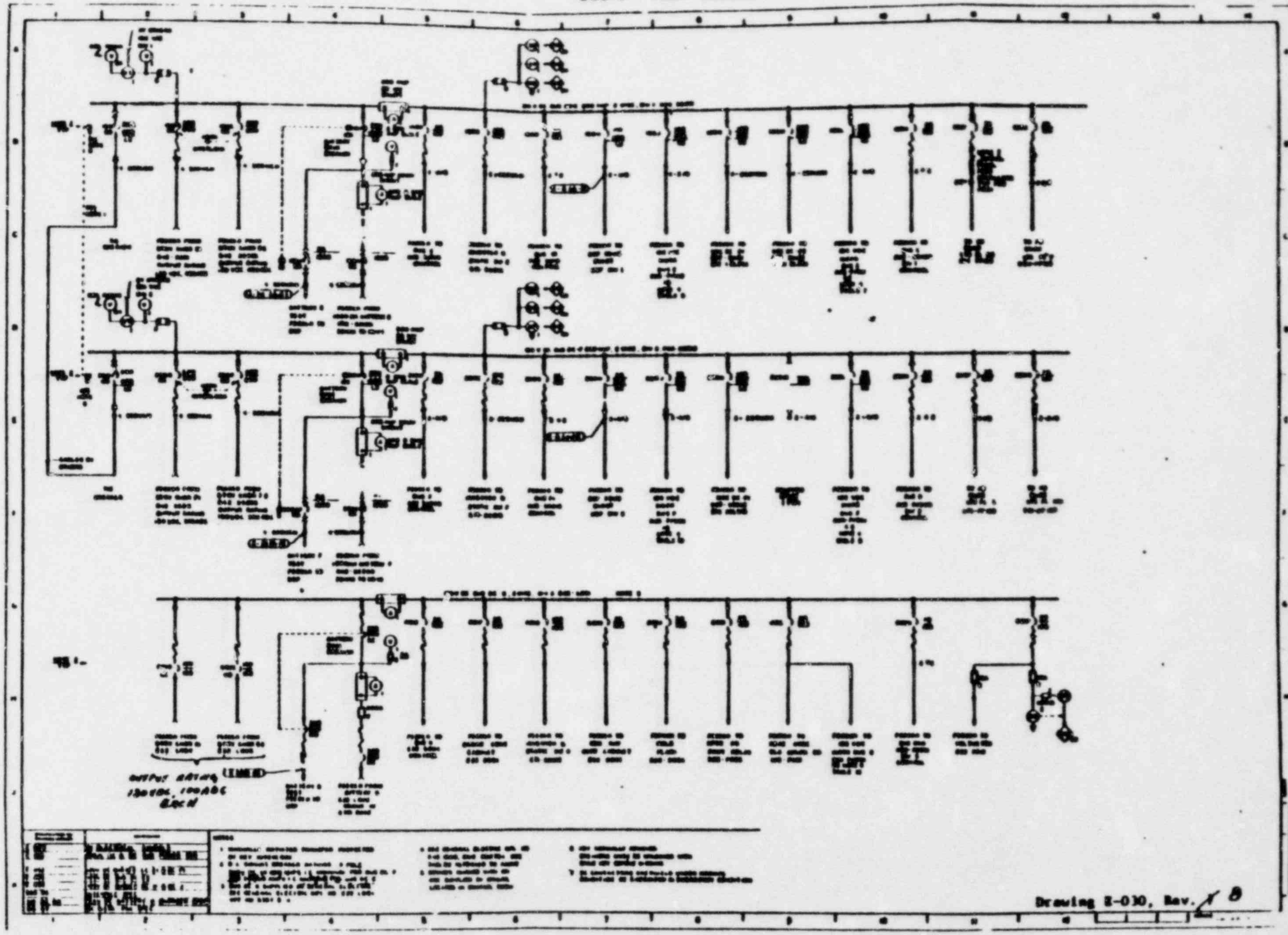


Figure 8.3-18. Nuclear Island 125 VDC Single-Line Buses DC-3, DC-F & DC-G