GE Nuclear Energy

General Electric Company
175 Curtner Avenue, San Jose, CA 95125

March 11, 1992

MFN No. 060-92
Docket No. STN 50-605
EEN-9235

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

Attention: Robert C. Pierson, Director
Standardization and Non-Power Reactor Project Directorate

Subject **GE Responses to the Resolution of Issues Related to ABWR DSER Chapters 1,2,3,5,6,9,10,12,13,14 & 15 (SECY-91-355)**

Reference: GE Responses to the Resolution of Issues Related to ABWR DSER Chapters 1,2,3,5,6.8,9,10,12,13,14 & 15 (SECY-91-355) (Proprietary Information), MFN No. 061-92 dated March 11, 1992

Enclosed are thirty-four (34) copies of the GE responses to the subject issues.

Responses to issues pertaining to Sections 9.3, 9.5 and 11.2 contain information that is designated as General Electric Company proprietary information. These responses are being submitted under separate cover (Reference).

It is intended that GE will amend the SSAR, where appropriate, with these responses in a future amendment.

Sincerely,

R.C. Mitchell

R.C. Mitchell, Acting Manager
Regulatory and Analysis Services
MC-444, (408)925-6948

cc: F. A. Ross (DOE)
N. D. Fletcher (DOE)
C. Poslusny, Jr. (NRC)
R. G. Ramirez (NRC)
R. C. Berglund (GE)
J. F. Quirk (GE)

D028

190012

1/34

ATTACHMENT A

RESPONSE TO OUTSTANDING ISSUES (2) THROUGH (13)

ISSUES (2) AND (3): Modeling of ABWR Containment Drywell Volumes and ABWR Containment Design Testing(6.2.1.2.1)

As noted in our August 9, 1991 telephone conversation with the staff, ABWR drywell-to-wetwell vent configuration is considered to be similar to the Mark III horizontal vent system. In ABWR, vertical vents total area is representative of vent annulus area in Mark III; horizontal vent length is consistent with that in Mark III; and horizontal vents and vertical vents total area ratio is comparable with that in Mark III. ABWR containment configuration, however, differ from Mark III design in some areas, which are:

a. significant pressurization of the wetwell (WW) airspace during LOCA blowdown,
b. the presence of a lower drywell (L/D),
c. the smaller number of horizontal vents (30 in ABWR vs 120 in Mark III),
d. extension of horizontal vents into the suppression pool,
e. larger suppression pool width (24.6 ft in APWR vs 20.5 in Mark III)

ABWR containment pressure and temperature transient following a loss-of-coolant accident (LOCA) wer calculated using approved analytical methods (described in NEDO-20533) which are adequate for modeling and analyzing ABWR containment response following a LOCA. Modeling scheme to account for the presence of L/D (ABWR unique feature) is described in detail on page 6.2-6 in Amendment 3. WW airspace response during pool swell phase of LOCA was determined using approved analytical methods (described in NEDE-21544-P), since the methods used in NEDO-20533 do not model and account for rapid pool acceleration during the pool swell phase.

With regard to LOCA condensation oscillation (CO) and chugging (CH) loads during the steam blowdown phase of LOCA, it was anticipated that, because of ABWR unique features (as noted above), it was anticipated that these loads for ABWR plant might differ from prior (Mark III) testing in horizontal-vent facilities. Consequently, a test program was conducted to confirm the CO and CH loading conditions which could occur in the event of a LOCA in an ABWR plant. This test program is described in detail in Appendix 3B.

In all, a total of 24 tests which bounded ABWR LOCA blowdown conditions were conducted in test facility representing 1 one-cell (36°) sector of the horizontal vent in ABWR design, which included a single vertical/horizontal vent module. ABWR CO and CH pressure loading conditions were developed based on data from these tests, and these loading conditions were conservatively specified for application over the full (360°) configuration of the ABWR facility. The ABWR CO loading specification implied all vents having CO in phase. The ABWR CH loading specification defined two load cases: i) all vents chugging in phase, and ii) vents in one half 180° out of phase with the other half vents (this loading condition conservatively bounds the condition of vents chugging out of phase).

ISSUE (4): Drywell Depressurization (6.2.1.5.1)

WW/DW vacuum breaker (VB) system in ABWR containment design utilizes, in all, eight 20 in vacuum breaker valves, which includes one valve for single failure (valve fail to open) criterion. These valves are intended to be swing check type valves which open passively due to negative differential pressure (WW airspace greater than the DW pressure) across the valve disk, and require no external power to actuate them. VB valves are installed horizontally locating in WW airspace, one valve per penetration (through pedestal wall) opening into L/D. Position locations of these valves, both axially and azimuthally, are shown in Figures 1.2-3C and 1.2-13K in SSAR, Amendment 6. Attached Figure 6.2.1.5.1-a shows a typical swing check type valve.

Response to "performance demonstration results" will be provided by March 31, 1992.

ISSUE (5): Suppression Pool SRV Loading Tests (6.2.1.6)

As noted in Appendix 3B, SRV quencher discharge loads for the ABWR containment will be developed based on the same calculation methodology as that used for prior Mark II/III containments. Prior BWR tests have shown that SRV discharge loads are strongly dependent upon the SRV discharge line discharge device, and the X-quencher discharge device used in the ABWR containment design is same as that used in Mark II/III designs. In developing and defining SRV actuation loads, both first and subsequent SRV actuation (valves re-opening a second time) will be considered.

Further, as noted in Appendix 3B, recent studies (performed by GE for BWR Owners Group) have concluded that suppression pool temperature limits (specified in NUREG-0783) associated with steady state SRV steam flow conditions are not needed. Steam condensation loads with quencher discharge devices over the full range of pool temperature up to saturation are low compared to loads due to SRV discharge line air clearing and LOCAs which will be considered and defined for the ABWR containment design evaluations. Results and conclusions from these recent studies are described and discussed in NEDO-30832, Class 1, December 1984 ("Elimination of Limit on BWR Suppression Pool Temperature for SRV Discharge With Quenchers), which is being reviewed by the staff. In view of the conclusions from these recent studies, it is now believed that suppression pool temperature limits (NUREG-[illegible]3) in analyzing steady state SRV steam flow conditions no longer apply.

ISSUE (6): Data for Suppression Pool Test Conditions (6.2.1.6)

Attached Figures 6.2.1.6-a and 6.2.1.6-b show a comparison of vent steam mass flux vs pool temperature rise conditions between ABWR plant and ABWR horizontal vent tests.

ISSUE (7): Clarification of Assumptions (6.2.1.6)

Only one assumption (i.e., effective pool surface area equal to 0.8 times actual pool surface area), is unique to the ABWR design. Other assumptions are consistent with those used in prior BWR analyses.

ISSUE (8): Clarification of Methods Used to Calculate Loads (6.2.1.6)

As described in Appendix 3B, ABWR SRV actuation loads will be defined based on approved Mark II/III methodology using ABWR unique SRV discharge line parameters. This methodology is in the form of empirical correlations involving physical parameters significant from phenomena point of view. With regard to LOCA loads, CO and CH loads will be defined based on ABWR horizontal vent tests, and loading conditions during pool swell phase will be determined using analytical models which model and simulate pool swell process with pressurizing WW airspace.

ISSUE (9): Justification for Scaling Laws

Necessary scaling laws procedures to transform subscale test data into the loads expected for the representative ABWR containment design were developed. Based on a review of then available test data and analytical work on different scaling procedures, it was decided to ase the testing on a Mach scaling approach. With Mach scaling, the implicit assumption has been made that the thermodynamic properties associated with the steam condensation process are more important than gravitational effects. Pressure, specific enthalpy, vent steam velocity, temperature and all other thermodynamic properties are maintained at full-scale values.

Accordingly, the SS testing was performed in a facility which was geometrically (all linear dimensions scaled by a factor of 2.5) similar to the prototypical ABWR design, maintaining full scale thermodynamic conditions. This approach is based on the belief that condensation phenomena at the vent exit are mainly governed by the thermodynamic properties of the liquid and vapor phases. In accordance with this scaling procedure, measured pressure amplitudes are equal to full-scale values at geometrically similar locations whereas measured frequencies are 2.5 times higher than the corresponding full-scale frequencies. Comparison of test data from the ABWR scaled and full-scale horizontal vent tests exhibited a satisfactory confirmation of the scaling procedure used in designing and conducting SS tests for developing CO loads for the ABWR plant design. Thus, this scaling procedure will make it possible to use the measured SS data directly for load definition purpose after the time scale is compressed by a factor of 2.5.

ISSUE (10): Additional Modeling Assumptions (6.2.1.6)

Response will be provided by March 31, 1992.

ISSUES (11) : Subcompartment Pressure Analysis (6.2.1.7)

Following is the additional information requested by the staff.

1. The time dependent mass and energy release rates were determined using critical flow homogeneous equilibrium models, and were ramped to zero over the valve closure time. Typical values used in analyzing a MSL break in steam tunnel are shown in Figure 6.2.1.7-a.

2. The subcompartment pressure analyses were performed using GE engineering computer program SCAM (Subcompartment Analysis Method).

3. No specific nodalization sensitivity studies were performed.

4. Subcompartment initial thermodynamic conditions were those corresponding to plant normal operating conditions, as defined in SSAR, Appendix I.

ISSUE (12): <u>Subcompartment Pressure Analysis (6.2.1.7</u>

Response will be provided by March 31, 1992.

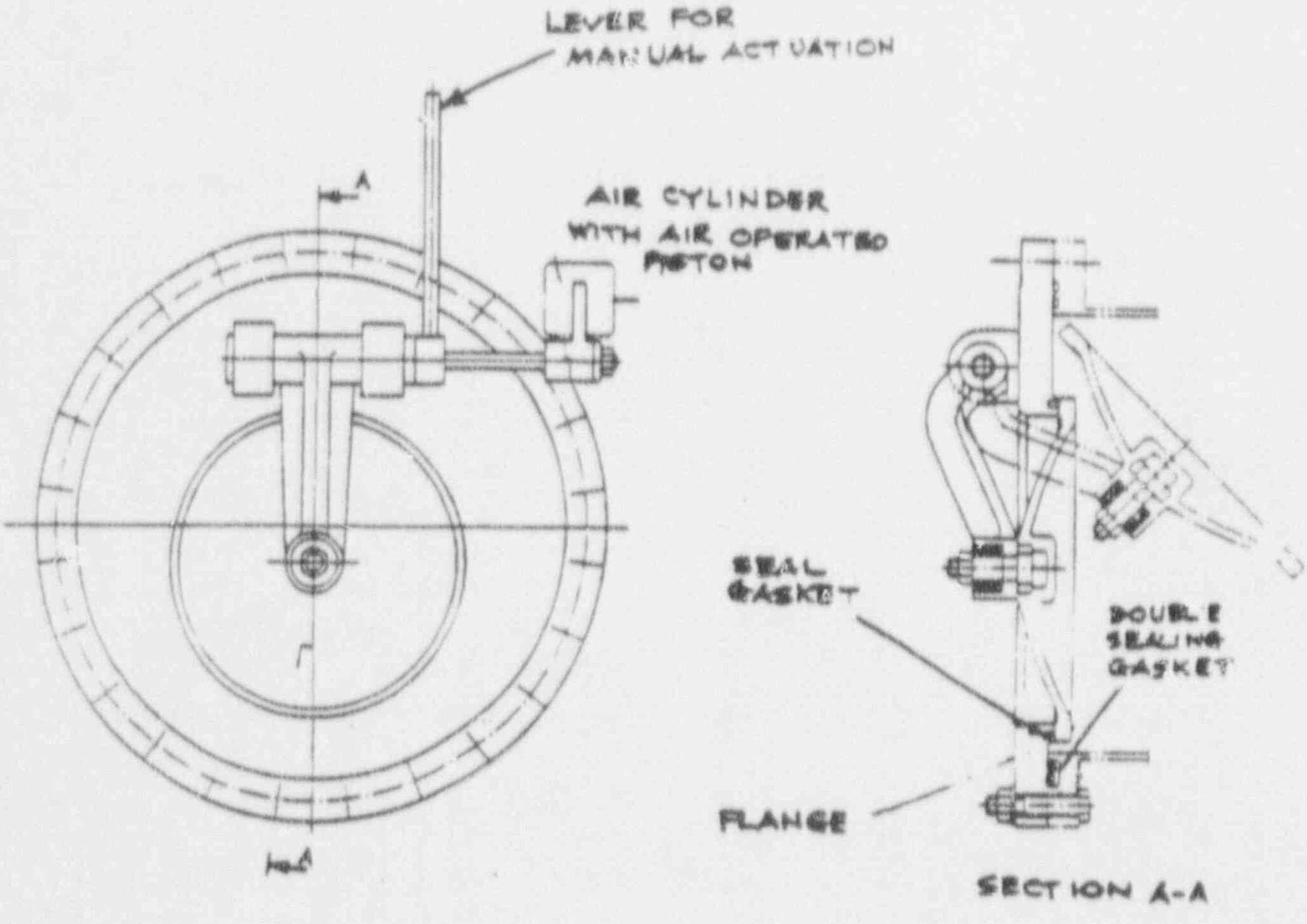
ISSUE (13): <u>Steam Bypass of the Suppression Pool</u>

RESPONSE:

From steam bypass leakage point of view, ABWR containment configuration is, apparently, quite similar to the Mark II, compared to the Mark III design. In the ABWR design, the drywell and wetwell airspace are physically separated by a lined diaphragm floor similar to that in Mark II, and the WW airspace volume to DW volume ratio in ABWR is comparable to that in Mark II.

During the October '91 and December '91 meetings with the staff in San Jose, GE described and explained the basis for specifying a steam bypass leakage capability ($A/K^{(1/2)}$) of 0.05 ft^2 for the ABWR design. It was also noted that the ABWR Technical Specifications will define and require that maximum leakage during periodic leakage rate tests shall be less than 10% of the design bypass capability, consistent with the SRP requirements. It should be noted here that allowable steam bypass leakage capability ($A/K^{(1/2)}$) for the Mark II design is about 0.03 ft^2, compared to 0.05 ft^2 for the ABWR design.

At staff's request in the above meetings, GE has undertaken a task for performing sensitivity studies to evaluate ABWR bypass leakage capability over a full spectrum of breaks (from small to large). Primary objectives of these sensitivity studies will be to confirm that 0.05 ft^2 is not at the high point of cliff, and evaluate feasibility of achieving leakage capability greater than 0.05 ft^2. These sensitivity studies are currently in progress at GE.



SWING CHECK VALVE - TYPICAL

FIGURE 6.2.1.5-R

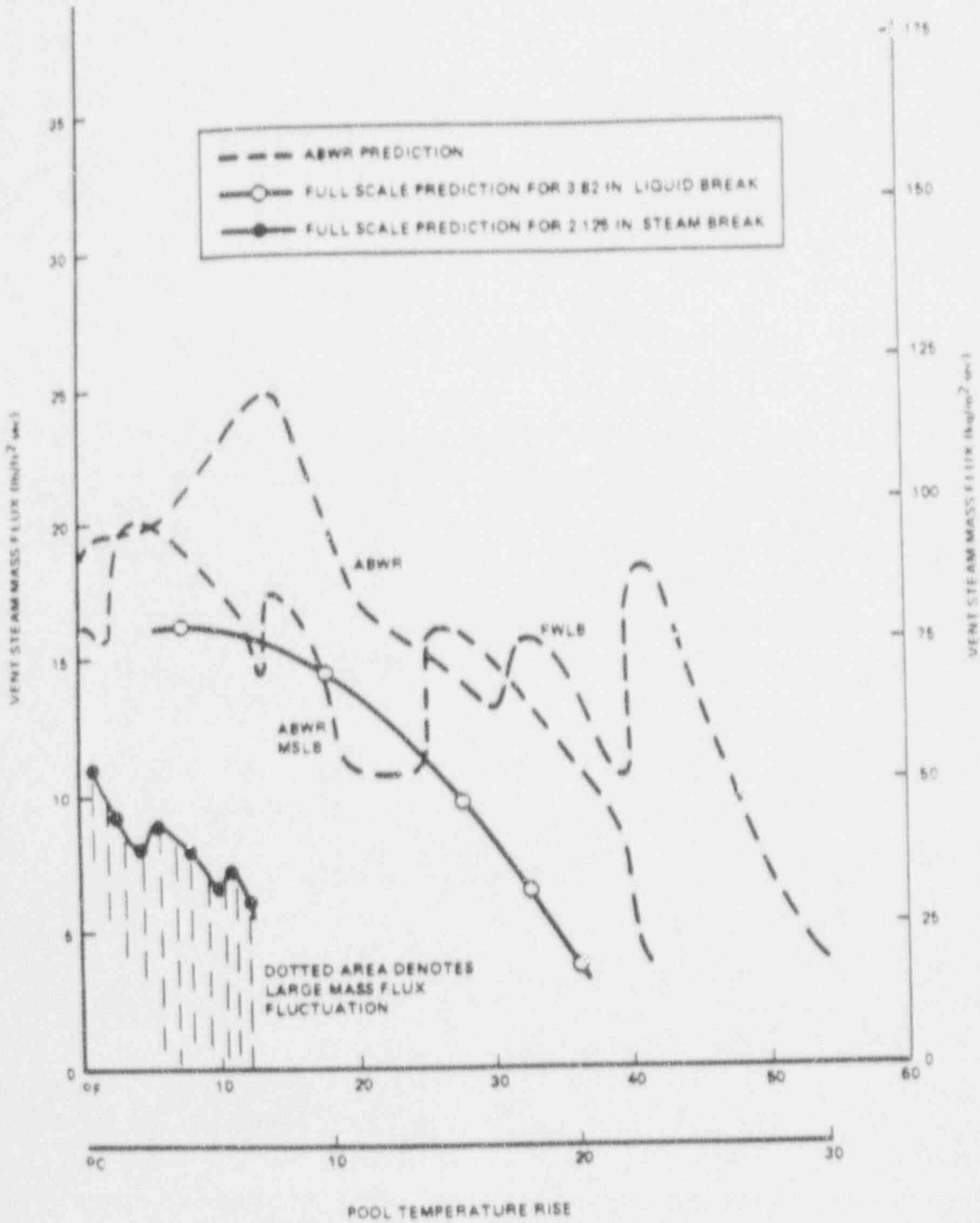


FIGURE 6.2.1.6-a: Comparison of Predicted Vent Steam Mass Fluxes Between ABWR and Full-Scale Tests

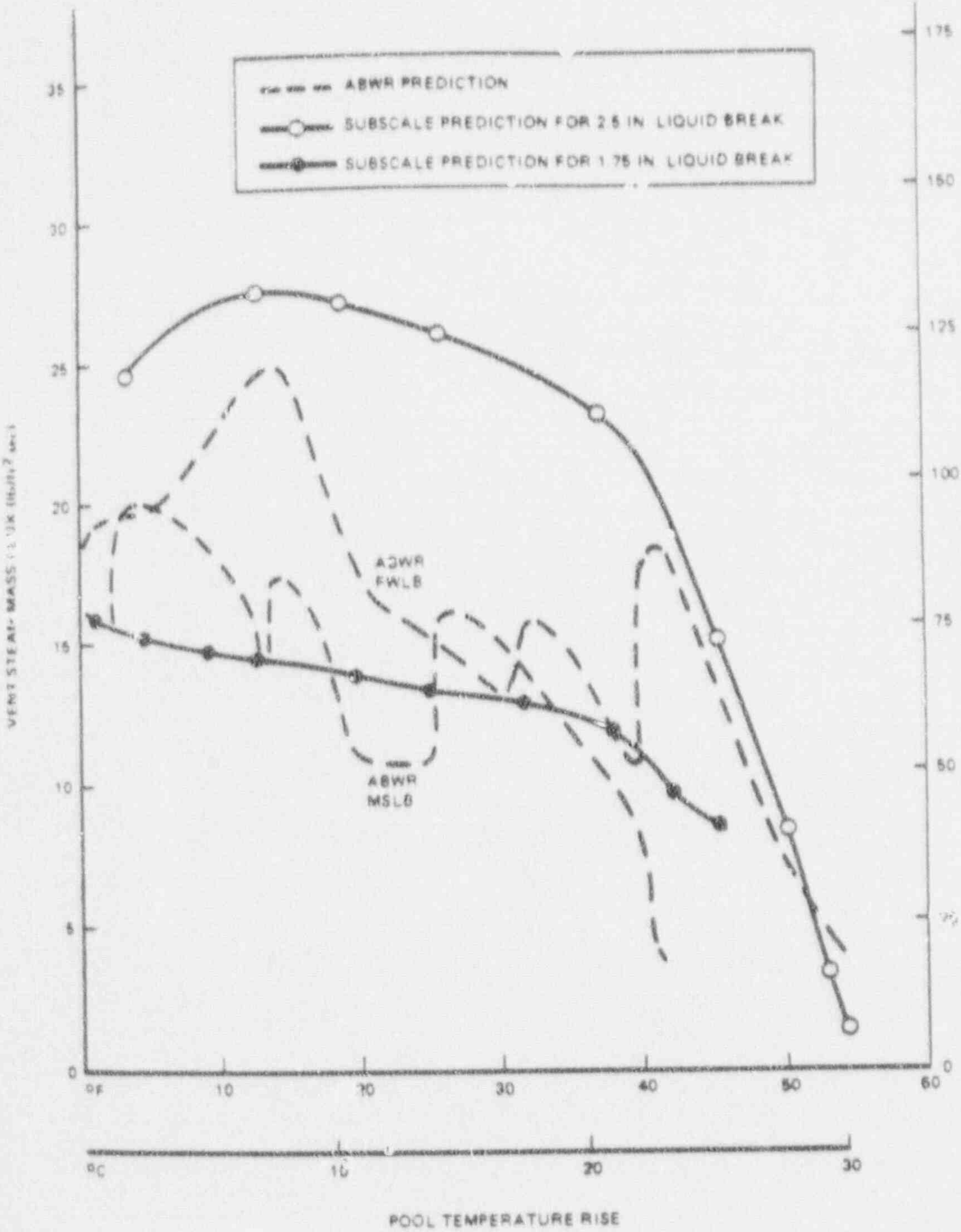
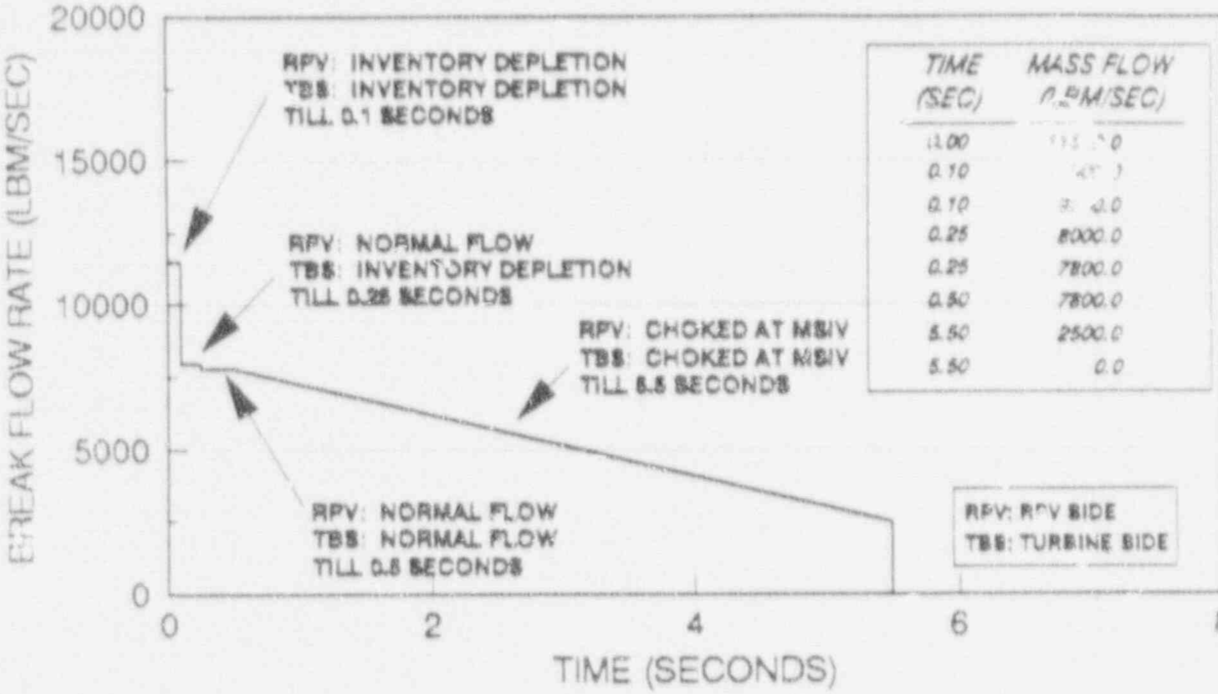


FIGURE 6.2.1.6-6: Comparison of Predicted Vent Steam Mass Fluxes between ABWR and Subscale Tests

FIGURE 6.2.1.7-a

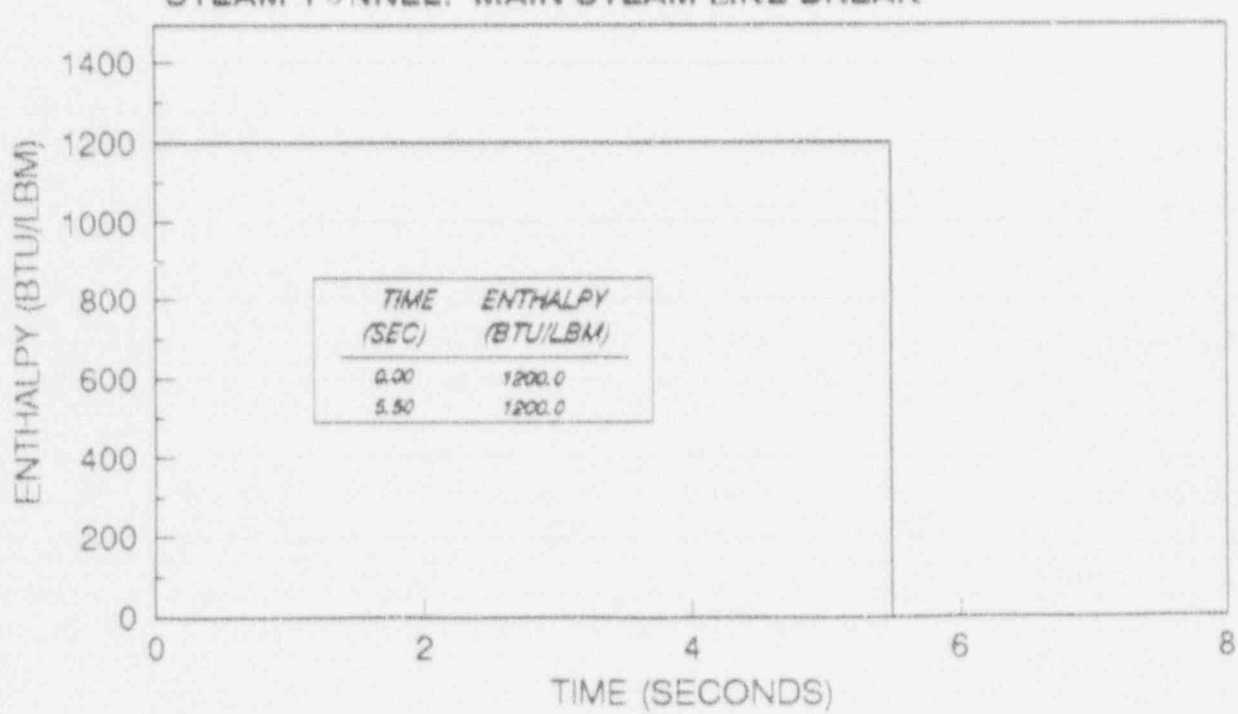
BREAK FLOW RATE VS. TIME

STEAM TUNNEL: MAIN STEAM LINE BREAK



ENTHALPY VS. TIME

STEAM TUNNEL: MAIN STEAM LINE BREAK



ATTACHMENT B

RESPONSE TO OUTSTANDING ISSUE 17 - VALVE CLOSURE TIMES PORTION

Atmospheric control system isolation valves T31-(F001, F002, F004, F006 and F009) are 22-inch diameter butterfly type with instrument air operated actuators which need only 90 degrees of travel to close.
These isolation valves are normally closed because their main function supports containment purging and nitrogen inerting when the reactor is less than 15% power. Smaller air operated valves may be opened for short periods during reactor operation to lower primary containment pressure or add nitrogen to keep primary containment pressurized to prevent any air inleakage. These include T31- (F005, F039, F040 and F041) all are 2-inch diameter globe type air operated isolation valves which close within 5-seconds. T31-F0[illegible] is a 10-inch diameter normally closed outboard air operated butterfly type Isolation valve connected to the SGTS and is opened in series with T31-F005. T31-F025 is a 16-inch diameter normally closed butterfly type outboard isolation valve opened only during initial inerting of the primary containment when the reactor is below 15% power. Opening/closing times of <30 seconds is planned for all except the 2-inch diameter isolation valves.

Flammability control system isolation valves T49- (F001, F002, F006, and F007) are all normally closed 6-inch gate valves. These valves may be individually actuated for tests during reactor operation. Two of the valves are air or nitrogen operated and two valves are motor operated. This system is not activated for days following a LOCA and < 30 seconds opening /closing times are planned.

ATTACHMENT C

RESPONSE TO OUTSTANDING ISSUE 18

Purge and vent valves are currently licensed with both inboard and outboard isolation valves located outside primary containment so they are not exposed to the harsh environments of the wetwell and drywell and are accessible for inspection and testing during reactor operation.

Criteria of BTP CSB 6-4 are addressed in Figure 6.2-39 and Subsection 6.2.5 as follows:

1. Radiological consequence analysis for LOCA with the purge system initially open relates to Chapter 16 Section 3.6.3.2 Primary Containment Oxygen Concentration. Purging through the ACS 22-inch purge isolation valves is permitted only after reactor power is less than 15% and within 24-hours of reactor shutdown or startup. The potential for LOCA at such low power levels is negligible and site radiological limits do not exceed 10CFR100 limits.

2. Penetrations, piping, isolation valves and rupture discs maintain their structural integrity for all accident thermal hydraulic conditions, containment peak pressure and temperature limits with required design margins. Periodic Type C leak rate tests of the above components will be conducted at the containment peak pressure. The design meets safety class 2 requirements and Seismic Category I limits. Isolation valves are signaled to close for LOCA isolation signals and fail close on loss of instrument air. Purge system isolation valves AO-F001, AO-F002, AO-F003, AO-F004, AO-F006, and AO-F025 are locked close whenever reactor is above 15% power. Purge exhaust isolation valve AO-F005 is normally closed and is open only for 90 hours per year with SGTS operation for containment pressure control. Additions of nitrogen to the primary containment during reactor operation are accomplished by opening isolation valves AO-F0039, AO-F0040 for the drywell and AO-F0039 and AO-F041 for the wetwell.

3. Drywell and wetwell purge penetrations have seismic category 1 debris screens.

4. ECCS systems with suction from the suppression pool are designed with primary containment at atmospheric pressure and without credit to NPSH for containment backpressure.

5. Case-by-case isolation valve maximum allowable leak rates are based on valve size, type, containment peak pressure for Type C periodic tests as required by the technical specifications. Test branch connections are provided.

6. Purge system isolation valves AO-F005, AO-F040 and AO-F041 are opened for short periods during reactor operation for containment pressure control. These valves are all 2-inch diameter and are capable of full closure in 5-seconds.

ATTACHMENT D

RESPONSE TO OUTSTANDING ISSUE 98

Capability is provided to obtain samples from the main condenser evacuation off gas, standby liquid control system tank, sumps inside containment, liquid radwaste system process lines, and liquid radwaste system collection and sampling tanks.

The guidelines in RG 1.21, RG 1.56, and ANSI N13.1969 shall be used except as noted.

Passive flow restrictors are not provided in reactor water sampling lines to control the release of radioactive materials from a rupture of the sample line. These devices become crud traps during normal operation and overly restrict sampling flow rate during shutdowns when the reactor is at low pressure. Each reactor water sampling line is provided with two remotely operable isolation valves to limit reactor water loss from a sample line rupture.

The seismic design and quality group classification of the sampling lines is in Subsection 9.3.2.1.1(1) and the last paragraph of Subsection 9.3.2.6.

ATTACHMENT E

RESPONSE TO OUTSTANDING ISSUE 103

The staff is asking that GE supply a system operational description as well as design information for components used in the smoke removal mode of operation. The instructions to the operator are, "When a fire is reported by the alarm system or a roving operator, place the HVAC mode switch for the affected fire zone in the smoke removal mode switch for the affected fire zone in the smoke removal mode and dispatch the fire brigade." The fire alarm system will identify the affected fire zone and probably even the room in which the fire is located. The operator should have the information as to the rooms served by each HVAC system. A table listing the fire zones, room numbers and HVAC systems for each room in the reactor building is attached to this response as an example of the information that should be available to the operator. Similar table will be prepared for the other buildings as part of the final design of the plant.

The requested design information is in the HVAC section of the SSAR (Section 9.4, see especially Table 9.4-4 for flow rates).

REACTOR BUILDING FIRE ZONES AND HVAC SYSTEMS

ROOM NO.	FIRE AREA	NORMAL AIR SUPPLY/ EXHAUST COOLING SYSTEM	MEANS OF SMOKE REMOVAL
110	F1100	NHVAC-1	NHVAC
112	F1100	NHVAC-1	NHVAC
116	F1100	NHVAC-1	NHVAC
117	F1100	NHVAC-1	NHVAC
118	F1100	NHVAC-1	NHVAC
119	F1100	NHVAC-1	NHVAC
210	F1100	NHVAC-1	NHVAC
211	F1100	NHVAC-1	NHVAC
212	F1100	NHVAC-1	NHVAC
213	F1100	NHVAC-1	NHVAC
214	F1100	NHVAC-1	NHVAC
215	F1100	NHVAC-1	NHVAC
216	F1100	NHVAC-1	NHVAC
217	F1100	NHVAC-1	NHVAC
218	F1100	NHVAC-1	NHVAC
219	F1100	NHVAC-1	NHVAC
251	F1100	NHVAC-1	NHVAC
311	F1100	NHVAC-1	NHVAC
312	F1100	NHVAC-1	NHVAC
313	F1100	NHVAC-1	NHVAC
314	F1100	NHVAC-1	NHVAC
318	F1100	NHVAC-1	NHVAC
342	F1100	NHVAC-1	NHVAC
343	F1100	NHVAC-1	NHVAC
414	F1100	NHVAC-1	NHVAC
518	F1100	NHVAC-1	NHVAC
121	F1200	NHVAC-2	NHVAC
122	F1200	NHVAC-2	NHVAC
123	F1200	NHVAC-2	NHVAC
124	F1200	NHVAC-2	NHVAC
125	F1200	NHVAC-2	NHVAC
126	F1200	NHVAC-2	NHVAC
129	F1200	NHVAC-2	NHVAC
133	F1200	NHVAC-2	NHVAC
134	F1200	NHVAC-2	NHVAC
140	F1200	NHVAC-2	NHVAC
141	F1200	NHVAC-2	NHVAC
142	F1200	NHVAC-2	NHVAC
143	F1200	NHVAC-2	NHVAC
144	F1200	NHVAC-2	NHVAC
146	F1200	NHVAC-2	NHVAC
147	F1200	NHVAC-2	NHVAC
148	F1200	NHVAC-2	NHVAC
149	F1200	NHVAC-2	NHVAC
220	F1200	NHVAC-2	NHVAC
221	F1200	NHVAC-2	NHVAC

REACTOR BUILDING FIRE ZONES AND HVAC SYSTEMS

ROOM NO.	FIRE AREA	NORMAL AIR SUPPLY/ EXHAUST COOLING SYSTEM	MEANS OF SMOKE REMOVAL
222	F1200	NHVAC-2	NHVAC
223	F1200	NHVAC-2	NHVAC
224	F1200	NHVAC-2	NHVAC
225	F1200	NHVAC-2	NHVAC
233	F1200	NHVAC-2	NHVAC
234	F1200	NHVAC-2	NHVAC
241	F1200	NHVAC-2	NHVAC
243	F1200	NHVAC-2	NHVAC
244	F1200	NHVAC-2	NHVAC
248	F1200	NHVAC-2	NHVAC
321	F1200	NHVAC-2	NHVAC
323	F1200	NHVAC-2	NHVAC
324	F1200	NHVAC-2	NHVAC
325	F1200	NHVAC-2	NHVAC
327	F1200	NHVAC-2	NHVAC
344	F1200	NHVAC-2	NHVAC
346	F1200	NHVAC-2	NHVAC
347	F1200	NHVAC-2	NHVAC
348	F1200	NHVAC-2	NHVAC
349	F1200	NHVAC-2	NHVAC
421	F1200	NHVAC-2	NHVAC
528	F1200	NHVAC-2	NHVAC
115	F1300	NHVAC-3	NHVAC
130	F1300	NHVAC-3	NHVAC
131	F1300	NHVAC-3	NHVAC
132	F1300	NHVAC-3	NHVAC
230	F1300	NHVAC-3	NHVAC
231	F1300	NHVAC-3	NHVAC
330	F1300	NHVAC-3	NHVAC
332	F1300	NHVAC-3	NHVAC
333	F1300	NHVAC-3	NHVAC
335	F1300	NHVAC-3	NHVAC
431	F1300	NHVAC-3	NHVAC
532	F1300	NHVAC-3	NHVAC
111	F1400	NHVAC-2	NHVAC
195	F1510	NHVAC-1	NHVAC
192	F1520	NHVAC-[illegible]	NHVAC
811	F1520	NHVAC-1	NHVAC
193	F1530	NHVAC-2	NHVAC
194	F1540	NHVAC-2	NHVAC
821	F1540	NHVAC-2	NHVAC
190	F1900	NONE	PCVE
290	F1900	NHVAC+T31(SHDWN)	PCVE
390	F1900	NHVAC+T31(SHDWN)	PCVE
191	F1901	NHVAC+T31(SHDWN)	PCVE
291	F1901	NHVAC+T31(SHDWN)	PCVE

REACTOR BUILDING FIRE ZONES AND HVAC SYSTEMS

ROOM NO.	FIRE AREA	NORMAL AIR SUPPLY/ EXHAUST COOLING SYSTEM	MEANS OF SMOKE REMOVAL
391	F1901	NHVAC+T31(SHDWN)	PCVE
310	F3100	EHVAC(A)-1	EHVAC(A)
341	F3101	EHVAC(A)-1	EHVAC(A)
320	F3200	EHVAC(B)-2	EHVAC(B)
322	F3200	EHVAC(B)-2	EHVAC(B)
340	F3200	EHVAC(B)-2	EHVAC(B)
383	F3200	EHVAC(B)-2	EHVAC(B)
426	F3200	EHVAC(B)-2	EHVAC(B)
527	F3200	EHVAC(B)-2	EHVAC(B)
541	F3200	EHVAC(B)-2	EHVAC(B)
326	F3201	EHVAC(B)-2	EHVAC(B)
329	F3210	NHVAC-2	NHVAC
328	F3211	NHVAC-2	NHVAC
315	F3300	EHVAC(C)-3	EHVAC(C)
331	F3300	EHVAC(C)-3	EHVAC(C)
336	F3300	EHVAC(C)-3	EHVAC(C)
413	F3300	EHVAC(C)-3	EHVAC(C)
517	F3300	EHVAC(C)-3	EHVAC(C)
638	F3300	EHVAC(C)-3	EHVAC(C)
654	F3300	EHVAC(C)-3	EHVAC(C)
715	F3300	EHVAC(C)-3	EHVAC(C)
337	F3301	EHVAC(C)-3	EHVAC(C)
316	F3310	NHVAC-3	NHVAC
317	F3311	NHVAC-3	NHVAC
345	F3400	NHVAC-2	NHVAC
380	F3400	NHVAC-2	NHVAC
444	F3400	NHVAC-2	NHVAC
543	F3400	NHVAC-2	NHVAC
381	F3401	EHVAC(A)-2	EHVAC(A)
412	F4100	EHVAC(A)-1	ESA(A)
514	F4100	EHVAC(A)-1	ESA(A)
515	F4100	EHVAC(A)-1	ESA(A)
612	F4100	EHVAC(A)-1	ESA(A)
410	F4101	NHVAC-1	NHVAC
411	F4101	NHVAC-1	NHVAC
510	F4101	NHVAC-1	NHVAC
511	F4101	NHVAC-1	NHVAC
512	F4101	NHVAC-1	NHVAC
516	F4102	EHVAC(A)-1	EHVAC(A)
613	F4102	EHVAC(A)-1	EHVAC(A)
614	F4102	EHVAC(A)-1	EHVAC(A)
653	F4102	EHVAC(A)-1	EHVAC(A)
423	F4200	EHVAC(B)-2	ESA(B)
522	F4200	EHVAC(B)-2	ESA(B)
523	F4200	EHVAC(B)-2	ESA(B)
624	F4200	EHVAC(B)-2	ESA(B)

REACTOR BUILDING FIRE ZONES AND HVAC SYSTEMS

ROOM NO.	FIRE AREA	NORMAL AIR SUPPLY/ EXHAUST COOLING SYSTEM	MEANS OF SMOKE REMOVAL
420	F4201	NHVAC-2	NHVAC
424	F4201	NHVAC-2	NHVAC
441	F4201	NHVAC-2	NHVAC
442	F4201	NHVAC-2	NHVAC
443	F4201	NHVAC-2	NHVAC
445	F4201	NHVAC-2	NHVAC
446	F4201	NHVAC-2	NHVAC
447	F4201	NHVAC-2	NHVAC
520	F4201	NHVAC-2	NHVAC
521	F4201	NHVAC-2	NHVAC
542	F4201	NHVAC-2	NHVAC
544	F4201	NHVAC-2	NHVAC
545	F4201	NHVAC-2	NHVAC
546	F4201	NHVAC-2	NHVAC
547	F4201	NHVAC-2	NHVAC
622	F4201	NHVAC-2	NHVAC
623	F4201	NHVAC-2	NHVAC
626	F4201	NHVAC-2	NHVAC
641	F4201	NHVAC-2	NHVAC
643	F4201	NHVAC-2	NHVAC
682	F4201	NHVAC-2	NHVAC
683	F4201	NHVAC-2	NHVAC
684	F4201	NHVAC-2	NHVAC
685	F4201	NHVAC-2	NHVAC
524	F4202	EHVAC(B)-2	EHVAC(B)
625	F4202	EHVAC(B)-2	EHVAC(B)
663	F4202	EHVAC(B)-2	EHVAC(B)
425	F4230	EHVAC(B)-2	EHVAC(B)
432	F4300	EHVAC(C)-3	ESA(C)
533	F4300	EHVAC(C)-3	ESA(C)
534	F4300	EHVAC(C)-3	ESA(C)
632	F4300	EHVAC(C)-3	ESA(C)
430	F4301	NHVAC-3	NHVAC
433	F4301	NHVAC-3	NHVAC
435	F4301	NHVAC-3	NHVAC
438	F4301	NHVAC-3	NHVAC
530	F4301	NHVAC-3	NHVAC
531	F4301	NHVAC-3	NHVAC
538	F4301	NHVAC-3	NHVAC
539	F4301	NHVAC-3	NHVAC
615	F4301	NHVAC-3	NHVAC
616	F4301	NHVAC-3	NHVAC
617	F4301	NHVAC-3	NHVAC
634	F4301	NHVAC-3	NHVAC
639	F4301	NHVAC-3	NHVAC
657	F4301	NHVAC-3	NHVAC

REACTOR BUILDING FIRE ZONES AND HVAC SYSTEMS

ROOM NO.	FIRE AREA	NORMAL AIR SUPPLY/ EXHAUST COOLING SYSTEM	MEANS OF SMOKE REMOVAL
658	F4301	NHVAC-3	NHVAC
664	F4301	NHVAC-3	NHVAC
665	F4301	NHVAC-3	NHVAC
674	F4301	NHVAC-3	NHVAC
690	F4301	NHVAC-3	NHVAC
692	F4301	NHVAC-3	NHVAC
693	F4301	NHVAC-3	NHVAC
711	F4301	NHVAC-3	NHVAC
716	F4301	NHVAC-3	NHVAC
720	F4301	NHVAC-3	NHVAC
721	F4301	NHVAC-3	NHVAC
722	F4301	NHVAC-3	NHVAC
723	F4301	NHVAC-3	NHVAC
733	F4301	NHVAC-3	NHVAC
734	F4301	NHVAC-3	NHVAC
741	F4301	NHVAC-3	NHVAC
742	F4301	NHVAC-3	NHVAC
743	F4301	NHVAC-3	NHVAC
760	F4301	NHVAC-3	NHVAC
761	F4301	NHVAC-3	NHVAC
762	F4301	NHVAC-3	NHVAC
763	F4301	NHVAC-3	NHVAC
536	F4302	EHVAC(C)-3	EHVAC(C)
633	F4302	EHVAC(C)-3	EHVAC(C)
635	F4302	EHVAC(C)-3	EHVAC(C)
673	F4302	EHVAC(C)-3	EHVAC(C)
730	F4302	EHVAC(C)-3	EHVAC(C)
436	F4320	EHVAC(C)-3	EHVAC(C)
440	F4900	NHVAC	NHVAC
491	F4901	NHVAC+T31(SHDWN)	PCVE
591	F4901	NHVAC+T31(SHDWN)	PCVE
691	F4901	NHVAC+T31(SHDWN)	PCVE
659	F6100	NHVAC-1	NHVAC
610	F6101	EHVAC(A)-1	EVHAC(A)
640	F6200	EHVAC(B)-2	EHVAC(B)
680	F6200	EHVAC(B)-2	EHVAC(B)
620	F6201	EHVAC(B)-2	EHVAC(B)
642	F6201	NHVAC-2	NHVAC
630	F6301	EHVAC(C)-3	EHVAC(C)
710	F7100	NHVAC-1	NHVAC
681	F7200	EHVAC(B)-2	EHVAC(B)
740	F7200	EHVAC(B)-2	EHVAC(B)
764	F7200	EHVAC(C)-2	EHVAC(C)
820	F9200	NO	AREA IS OUTSIDE
840	F9200	NO	AREA IS OUTSIDE
810	F9300	NO	AREA IS OUTSIDE

REACTOR BUILDING FIRE ZONES AND HVAC SYSTEMS

ROOM NO.	FIRE AREA	NORMAL AIR SUPPLY/ EXHAUST COOLING SYSTEM	MEANS OF SMOKE REMOVAL
830	F9300	NO	AREA IS OUTSIDE

NHVH INPUT FRNON-ESSENTIAL NORMAL SUPPLEMENTAL COOLIN
SHVH(FCU)INPUT FRFAN COIL UNIT - NORMAL SUPPLEMENTAL COOL
EHVAC INPUT FRESSENTIAL COOLING SYSTEM
NHVAC INPUT FRNORMAL AIR SUPPLY/EXHAUST COOLING SYSTEM
SHVAC INPUT FRNORMAL SUPPLEMENTAL COOLING SYSTEM
EHVH INPUT FRESSENTIAL COOLING SYSTEM
DWC INPUT FRDRY WELL COOLING
ESA OUTSIDE EMERGENCY SUPPLY AIR

ATTACHMENT F

RESPONSE TO OUTSTANDING ISSUE 123

Resolution Status of Specific Staff Comments on Line Item Testing Requirements from Reg Guide 1.68, Rev. 2, Appendix A

Reg Guide 1.68 Appendix A Item	Resolution/Comment
1.a.(2)(d)	see Amendment 18, also revised Subsection 5.4.1.14 to cross-reference 3.9.2.1.1
1.a.(4)	see Amendment 18
1.c	see Amendment 18
1.h.(4)	see Amendment 18
1.h (9)	see Amendment 18
1.i.(1)	see Amendment 18
1.j.(12)	see Amendment 18
1.j.(15)	see Amendment 18
1.k.(2)	see Amendment 18
1.n.(14)(f)	see Amendment 18
2.c	see Amendment 18
2.d	see Amendment 18
4.k	see new Section 14.2.12.2.39
4.l	see Amendment 18
5.j	see Amendment 18
5.n	see new Section 14.2.12.2.36
5.o	see Amendment 18
5.q	see Amendment 18
5.u	see Amendment 18
5.w	see new Section 14.2.12.2.37
5.x	see Amendment 18
5.z	see Amendment 18
5.c.c	see new Section 14.2.12.2.38
5.g.g	see Amendment 18
5.h.h	see Amendment 18

ATTACHMENT G

RESPONSE TO OUTSTANDING ISSUE (99)

Discharges From Plant and Containment

During the development of an accident, samples of liquid and gaseous discharges from both the plant and containment will be obtained. Chemical and radiochemical analyses will be performed for protection of the health and safety of the public and the plant operators. These samples will be obtained from the Process Sampling System. The Post Accident Sampling Systems will not be required to obtain these samples.

Core Damage Assessment

During this initial period, instrumentation will provide sufficient information for the operators to perform their duties. For example, the containment high range radiation meters will give instant information concerning the radiation level in containment. (To obtain data from the PASS several hours may be required for sampling and analyses.) Calculations can be performed to relate containment radiation level with the probable extent of core damage.

Core damage assessment instrumentation is described in Section 18.4.6 of the ABWR SSAR. This section describes the safety parameter display system (SPDS). The principle purpose of the SPDS is to aid the control room personnel during abnormal and emergency conditions in determining the safety status of the plant and in assessing whether abnormal conditions warrant corrective action by operators to avoid a degraded core. Displays of critical plant variables sufficient to provide information to plant operators about the following critical safety functions are to be provided at the wide screen display panel in the main control room:

(1) Reactivity control,
(2) Reactor core cooling and heat removal from the primary system,
(3) Reactor coolant system integrity,
(4) Radioactivity control, and
(5) Contamination conditions.

This instrumentation and the PASS work together to obtain complementary information.

After this initial period during the development of an accident, the ABWR PASS will be used to obtain samples of reactor water and containment atmosphere to assess the extent of core damage. The ABWR PASS has been designed to safely obtain samples with radioactivity levels up to 1 Ci/g. It is expected that sample radioactivity levels will be no more than this value approximately one day after a serious core damage accident. Early in such an accident, the plant instrumentation in the main control room would be indicating that abnormal conditions exist. If a reactor coolant sample were obtained which had excessive radioactivity, as measured by the area radiation monitor in the PASS area, the plant operators would use this high radiation signal as confirmatory evidence that severe core damage has occurred and continue following the emergency operating procedures. It would not be necessary to perform any radiochemical analyses to reach this conclusion.

During less severe accidents, in which only some cladding damage has occurred, samples may be obtained from either the Process Sampling System or PASS.

NUREG-0737 Requirements

The ABWR PASS has been designed to meet the eleven requirements listed in NUREG-0737 except as noted in the following table.

REQUIREMENT IN NUREG-0737 (ABBREVIATED)	FEATURES OF ABWR PASS
1- THE COMBINED TIME ALLOTTED FOR SAMPLING AND ANALYSIS SHOULD BE 3 HOURS OR LESS FROM THE TIME A DECISION IS MADE TO TAKE A SAMPLE	MEETS THE REQUIREMENTS OF NUREG-0737.
2- THERE SHALL BE ONSITE CAPABILITY TO PERFORM THE FOLLOWING WITHIN THE 3 HOUR TIME PERIOD:	
(A) DETERMINE THE PRESENCE AND AMOUNT OF CERTAIN RADIONUCLIDES IN THE REACTOR COOLANT AND CONTAINMENT ATMOSPHERE THAT MAY BE INDICATORS OF THE DEGREE OF CORE DAMAGE;	MEETS THE REQUIREMENTS OF NUREG-0737.
(B) HYDROGEN IN CONTAINMENT ATMOSPHERE;	HYDROGEN IN CONTAINMENT ATMOSPHERE IS MEASURED BY THE CONTAINMENT ATMOSPHERE MONITORING SYSTEM.
(C) DISSOLVED GASES, CHLORIDE AND BORON IN LIQUIDS;	DISSOLVED GASES ARE DISCUSSED IN ITEM 4 BELOW . MEETS THE REQUIREMENTS CONCERNING CHLORIDE AND BORON OF NUREG-0737.
(D) INLINE MONITORING CAPABILITY IS ACCEPTABLE.	NO INLINE MONITORS ARE PROVIDED IN PASS.

REQUIREMENT IN NUREG-0737 (ABBREVIATED)	FEATURES OF ABWR PASS
3- SAMPLING NEED NOT DEPEND UPON AN ISOLATED AUXILIARY SYSTEM BEING PUT INTO OPERATION.	MEETS THE REQUIREMENTS OF NUREG-0737.
4- REACTOR COOLANT SAMPLES AND ANALYSES FOR TOTAL DISSOLVED GASES AND HYDROGEN ARE REQUIRED.	DURING A SEVERE CORE DAMAGE ACCIDENT FOR THE ABWR, THE REACTOR WATER WILL BECOME MIXED WITH THE SUPPRESSION POOL WATER. THE PRESSURE IN THE REACTOR VESSEL WILL DECREASE TO APPROXIMATELY THE PRESSURE WITHIN THE WETWELL AND THE DRYWELL. AS A RESULT OF THIS DECREASE IN PRESSURE, DISSOLVED GASES WILL PARTIALLY PASS OUT OF THE WATER PHASE INTO THE GAS PHASE. DATA ON GASES DISSOLVED IN THE REACTOR WATER UNDER THESE CONDITIONS WILL HAVE LITTLE MEANING IN RESPONDING TO THE ACCIDENT. DURING ACCIDENTS IN WHICH ONLY SMALL AMOUNTS OF CLADDING DAMAGE HAS OCCURRED OR IN ACCIDENTS IN WHICH THE REACTOR VESSEL HAS NOT BEEN DEPRESSURIZED, PRESSURIZED REACTOR WATER SAMPLES MAY BE OBTAINED FROM THE PROCESS SAMPLING SYSTEM. THEREFORE, THE ABILITY TO OBTAIN PRESSURIZED OR UNPRESSURIZED REACTOR WATER SAMPLES FOR DISSOLVED GAS ANALYSES HAS NOT BEEN PROVIDED.

REQUIREMENT IN NUREG-0737 (ABBREVIATED)	FEATURES OF ABWR PASS
5- IF BOTH OF THE FOLLOWING ARE PRESENT, (A) THERE IS ONLY A SINGLE BARRIER BETWEEN PRIMARY CONTAINMENT AND THE COOLING WATER AND (B) IF THE COOLING WATER IS SEAWATER OR BRACKISH WATER, CHLORIDE ANALYSIS WITHIN 24 HOURS AFTER SAMPLING SHALL BE PROVIDED. IF BOTH ARE NOT PRESENT, THE TIME TO COMPLETE THE ANALYSES IS INCREASED TO 4 DAYS. ANALYSIS DOES NOT HAVE TO BE DONE ONSITE.	MEETS THE REQUIREMENTS OF NUREG-0737. (NOTE THAT THERE ARE SEVERAL BARRIERS TO PREVENT CHLORIDE INTRUSION FROM THE POWER CYCLE COOLING WATER INTO THE REACTOR VESSEL. THESE BARRIERS ARE: THE MAIN CONDENSER TUBING, THE CONDENSATE POLISHING DEMINERALIZERS AND THE PUMPS AND VALVES IN THE CONDENSATE/FEEDWATER SYSTEMS. THESE PUMPS ARE STOPPED AND THESE VALVES CLOSED DURING UPSET CONDITIONS. THUS, BECAUSE BOTH FACTORS ARE NOT PRESENT, THE TIME TO COMPLETE THE ANALYSIS IS INCREASED TO 4 DAYS.)
6- IT MUST BE POSSIBLE TO OBTAIN AND ANALYZE A SAMPLE WITHOUT RADIATION EXPOSURES TO ANY INDIVIDUAL EXCEEDING 5 REM FOR WHOLE BODY AND 75 REM FOR EXTREMITIES.	MEETS THE REQUIREMENTS OF NUREG-0737.
7- ABILITY TO SAMPLE AND ANALYZE FOR REACTOR COOLANT BORON MUST BE PROVIDED.	MEETS THE REQUIREMENTS OF NUREG-0737.
8- IF INLINE MONITORING IS USED, BACKUP SAMPLING AND ANALYSIS CAPABILITY MUST BE PROVIDED.	INLINE MONITORING IS NOT USED.

REQUIREMENT IN NUREG-0737 (ABBREVIATED)		FEATURES OF ABWR PASS
9-	(A) CAPABILITY TO IDENTIFY AND QUANTIFY A SPECIFIED NUMBER OF ISOTOPES OVER A RANGE OF NUCLIDE CONCENTRATIONS FROM APPROXIMATELY 1 MICROCI/G TO 10 CI/G.	CAPABILITY IS PROVIDED TO IDENTIFY AND QUANTIFY THE DESIRED ISOTOPES IN SAMPLES OVER A RANGE FROM APPROXIMATELY 1 MICROCI/G TO 1 CI/G. SAMPLES OBTAINED DURING THE ACCIDENT RECOVERY PHASE WOULD BE WITHIN THIS RANGE FOR MOST CORE DAMAGE ACCIDENTS. IF THE GROSS RADIOACTIVITY LEVELS ARE HIGHER THAN 1 CI/G, THIS WOULD CONFIRM THAT SEVERE CORE DAMAGE HAS OCCURRED.
	(B) RESTRICT BACKGROUND LEVELS OF RADIATION IN THE LABORATORY AND PROVIDE PROPER VENTILATION.	MEETS THE REQUIREMENTS OF NUREG-0737
10-	PROVIDE ADEQUATE ACCURACY, RANGE AND SENSITIVITY TO PROVIDE PERTINENT INFORMATION.	MEETS THE REQUIREMENTS OF NUREG-0737.
11-	(A) PROVIDE SAMPLE LINES WITH PROPER FEATURES FOR SAMPLING DURING ACCIDENT CONDITIONS.	MEETS THE REQUIREMENTS OF NUREG-0737.
	(B) PASS VENTILATION EXHAUST SHOULD BE FILTERED WITH CHARCOAL ADSORBERS AND HEPA FILTERS.	MEETS THE REQUIREMENTS OF NUREG-0737.

SUMMARY RESPONSE TO OUTSTANDING AND CONFIRMATORY ISSUES OF ABWR DSER CHAPTERS 1,2,3,5,6,8,10,12,13,14 and 15
SECY-91-355

Outstanding Issue	Description	Resolution/Comment
1	Accessibility to ASME Class 1, 2, and 3 components (5.4.2, 6.6)	Response provided on attached pages 4.5-4.1, 5.2vi, 5.2-15.1, 5.2-16, 5.2-17, 5.2-17.1, 5.2-17.2 and 5.2-36.1.
2	Modeling of ABWR containment testing (6.2.1.2.1)	See Attachment A
3	ABWR containment design testing (6.2.1.6)	See Attachment A
4	Drywell depressurization (6.2.1.5.1)	See Attachment A
5	Suppression pool SRV loading tests (6.2.1.6)	See Attachment A
6	Data for suppression pool test conditions (6.2.1.6)	See Attachment A
7	Clarification of assumptions (6.2.1.6)	See Attachment A
8	Clarification of methods used to calculate loads (6.2.1.6)	See Attachment A
9	Justification for scaling laws (6.2.1.6)	See Attachment A
10	Additional modeling assumptions (6.2.1.6)	See Attachment A
11	Subcompartment pressure analysis (6.2.1.7)	See Attachment A
12	Subcompartment pressure analysis inconsistencies (6.2.1.7)	See Attachment A
13	Steam bypass of the suppression pool (6.2.1.8)	See Attachment A
14	Administrative control of openings, doors and hatches (6.2.3)	Response provided on attached pages 6.2-50.55 and 6.2-50.56

15	Response to questions regarding containment isolation system (6.2.4)	<u>Question 430.32</u> The deferred response to this question is provided on attached pages 20.3-48, 6.5-2 and 6.5-6. <u>Question 430.34</u> Instrumentation requirements for the secondary containment openings are contained in Subsection 6.2.3.5 and discussed on a system by system basis in each system description <u>Question 430.36</u> The information on isolation valves is given on a system by system basis in Table 3.2-1 Classification Summary
16	Commitment to GDCs 1,2,4,16 and 56 (6.2.4)	<u>Commitment to GDCs 1,2,4 and 16</u> The ABWR commitments to GDCs 1, 2,4 and 16 are contained in Subsections 3.1.2.1.1, 3.1.2.1.2, 3.1.2.1.4 and 3.1.2.2.7, respectively <u>Commitment to GDC 56</u> Previous NRC reviews on operating BWRs and GESSAR II have agreed that suppression pool lines connected to closed loops are sealed against direct connection to the containment atmosphere
17	Containment isolation valve information (6.2.4)	<u>Valve Condition</u> Valve condition is detailed on the system piping and instrumentation diagram P&ID as locked open closed, normally open closed and normally energized deenergized <u>Valve Closure Times</u> See Attachment B
18	Containment purge system design information (6.2.4.1)	See Attachment C

19	Atmospheric control system design (6.2.5)	The flammability control system consists of redundant safety grade hydrogen recombiners for post LOCA combustible gas control. The atmospheric control system is not required for perform a LOCA function and therefore only the isolation valves and piping are safety grade. This includes the wetwell rupture discs for emergency containment overpressure venting with normally open stop valve AO-F010 to interrupt the [illegible] System design is covered in Subsection 6.2.5.2.
20	Capability of post-LOCA purging of the containment (6.2.5)	Following a LOCA the primary containment pressure will exceed 0.719 psig specified for normal operating conditions. The normal operating purge system for maintaining the pressure and oxygen concentration is not required post LOCA. The ECCS containment spray systems will control the post LOCA containment pressure and the hydrogen recombiners will control the post LOCA oxygen concentration. All purge line valves will be closed and any minor leakage drawn to the operating SGTS. This minor leakage is incorporated in the overall 0.5% per day primary containment leakage specification and the radiological consequences of this leakage shown in Subsection 15.6.5. Design bases are covered in Subsection 6.2.5.1(8) through 6.2.5.1(13).
21	Availability of hydrogen recombiners following a LOCA (6.2.5)	Redundant dedicated primary containment penetrations are provided for each recombiner as shown in Figure 6.2-20 and Subsection 6.2.5.2.7.
22 thru 68	Chapter 8 issues	Response to these issues will be provided in a separate document at the conclusion of the GE/NRC Chapter 8 DSER meetings and telephone calls.

69	Compressed air system (CAS) valve number and valve operator inconsistencies (9.3.1)	Revised P&IDs have been transmitted in letter from R.C. Mitchell to R.C Pierson dated 2/3/92. Numbering inconsistencies, including valve numbers and valve operators have been resolved.
70	Identification of CAS component safety classification (9.3.1)	Revised P&IDs have been transmitted in letter from R.C. Mitchell to R.C Pierson dated 2/3/92 The inconsistency in Figure 20.3-55 (page 20.3-354.30 attached) has been corrected.
71	Identification of CAS failure modes (9.3.1)	In the HPIN, IA and SA systems, all motor operated valves fail as is, unless otherwise noted and air operated valves fail open, unless otherwise noted. In the AC system, all air operated valves fail closed.
72	Failure position of CAS valves AO F019A & B (9.3.1)	These valves have been changed to motor operated valves and are normally locked closed. They are opened by a low pressure in the line supplying nitrogen to the ADS accumulators.
73	ANSI compliance of high pressure nitrogen gas supply system (9.3.1)	The nitrogen supply subsystem, which is part of the AC system, provides oil-free nitrogen with a moisture content of less than 2.5 ppm. This nitrogen is provided to the HPIN system through carbon steel piping which may not maintain an acceptable amount of particulates. Filters, which remove particles larger than 5 microns, are provided in the HPIN system piping. Downstream of the filters the HPIN piping is stainless steel. Requirements added to Subsection 6.7.2 (page 6.7-1 attached) and Subsection 6.2.5 (page 6.2-32 attached).

74	Discrepancy in identification of instrument air (IA) system (9.3.1)	The first sentence of the response to Question 430.218 on page 20.3-354.12 has been changed to state that the instrument air system does serve as a backup to the HPIN system to operate pneumatically operated equipment inside containment. (The page changed is proprietary and is provided under separate cover).
75	Justification for particulate size for IA system (9.3.1)	The instrument air system provides compressed air that has been filtered to remove particles larger than 5 microns. All components using specifications which state the 5 micron criteria. There have been no problems with air quality at those plants at which the 5 micron criteria has been used.
76	Discrepancy in identification of radioactive drain transfer system containment isolation valves (9.3.8)	Figure 11.2-2 has been revised and have been transmitted in letter from R.C. Mitchell to R.C. Pierson dated 2/3/92.
77	Classification of radioactive drain transfer system check valves (9.3.8)	The ECCS equipment room sump backflow protection check valves have been classified as safety class 3 and designed to seismic Category I and Quality Group C criteria as shown on revised Figure 11.2-2 and Table 3.2-1. (Figure 11.2-2 is proprietary and is provided under separate cover).
78	Discrepancy resolution and component qualification requirements (9.3.8)	Figure 11.2-1a has been modified to show the shower facility discharging into the HSD receiver tank. (The changed page is proprietary and is provided under separate cover). The component qualification requirements have been added to the P&IDs submitted in letter R.C. Mitchell to R.C. Pierson dated 2/3/92. An interface requirement has been added to attached page 9.3-13.2 which require monitoring of the non-radioactive effluents. (Page 9.3-13.2 is proprietary and provided under separate cover).

79	Safety related designation of drain system (9.3.8)	Item (1) of Subsection 9.3.12.1 states that only a portion of the drain transfer system is considered safety-related.
80	Provisions for tornado missile auxiliary support systems (9.5.4.1)	The DSER has already indicated that damage to the vent pipe assembly would have no adverse safety consequences. In addition, each diesel generator has its own day tank, which is located inside the reactor building. This provides another level of protected fuel supply for each diesel generator. Also, there are three independent diesel generator systems, any one of which can safely shut down the plant. For these reasons, no specific missile protection is provided for each vent pipe, nor is considered necessary.
80a	Test and calibration frequencies (9.5.4.1)	The diesel generator units are tested per Regulatory Guide 1.108, as delineated in Subsections 14.2.12.1.45.3 (preop) and 16.11.1 (surveillance - see pages 16.11-10 through 16.11-19). Reg Guide 1.108 unambiguously defines "diesel generator units" as both the diesel generator and its auxiliaries. Generally, the successful operation of the auxiliaries is confirmed by the successful testing of the complete units. Testing of the auxiliaries is therefore coincident with that of the diesel generators, and is done at the same frequency. Separate surveillance testing is required for fuel transfer equipment and the storage and day tanks. The surveillance frequency for this equipment is given in Subsection 16.11.3 (pages 16.11-24 and 16.11-25).
81	Interface requirement for DG fuel oil transfer pump motive power (9.5.4.2)	There are two transfer pumps provided with each diesel generator unit. These have been added to the attached Figure 9.5-6 (page 9.5-18) in response to Issue 83. The pumps are motor-driven.

		Item (1) of Subsection 9.5.13.5 has been deleted on attached page 9.5-10.6, and item (a) of Response to Question 430.274 (page 20.3-359) has been appropriately modified. Page 20.3-259 is proprietary and is provided under separate cover.
82	Verification of interfaces and instrumentation discrepancies (9.5.4.2)	A new Table 8.3-11 "Diesel Generator Alarms" is being added in conjunction with the Chapter 8 DSER review. A "LOW LEVEL - FUEL STORAGE TANK" alarm is included in this table. Also, the first sentence of Subsection 9.5.4.5 (page 9.5-4.2) and interface item 9.5.13.5(2) (page 9.5-10.6 attached) have been modified to show the storage tanks. Also, a stick guage symbol has been added, along with the storage tank itself, to Figure 9.5-6 (page 9.5-18 attached). (Page 9.5-4.2 is proprietary and provided under separate cover).
83	Figure 9.5-6 discrepancies (9.5.4.2)	Figure 9.5-6 (page 9.5-18 attached) has been modified to show the 7 day storage tank, and associated instrumentation, pumps, valves and piping. The sentence "Connection for an optional motor-driven fuel oil booster pump are also provided" was added first paragraph of page 9.5-4.1. (This page is proprietary and is provided under separate cover). A temperature indicator has been added to discharge line of the fuel oil tank in Figure 9.5-6 (page 9.5-18 attached).
84	Interface requirement for verifying day tank full (9.5.4.2)	New interface Subsection 9.5.13.13 (page 9.5-10.7 attached) has been added for diesel fuel refueling procedures.

85	Discrepancies in SSAR regarding jacket circulating water pump (9.5.5)	Subsection 9.5.5.2 (page 9.5-5) has been modified and the words "motor driven" have been deleted from both jacket water pumps on Figure 9.5-7 (page 9.5-19 attached). The interface requirement is correct in that the type of jacket water pump is dependent on the specific diesel manufacturer. (Page 9.5-5 is proprietary and is provided under separate cover).
86	Interface requirement for temperature sensor (9.5.5)	See revised Item (2) of Subsection 9.5.13.6 (page 9.5-10.6 attached).
87	DG cooling water heat removal capacity (9.5.5)	Subsection 9.5.13.6 requires a table to be provided which identifies the design flow and heat removal requirements for the diesel generator cooling water system. With regard to the keep warm system, Subsection 9.5.5.2 (page 9.5-5) has been modified accordingly. (Page 9.5-5 is proprietary and is provided under separate cover). Also, the words "MOTOR-DRIVEN" were added the keep-warm pump symbol on Figure 9.5-7 (page 9.5-16 attached) Also, the cold start time (consistent with Chapter 8 DSER resolution) has been changed from 13 to 20 seconds (page 9.5-5.1) This page is proprietary and is provided under separate cover).
88	Documentation of DG starting air system filter arrangement (9.5.6)	See new Note 4 on Figure 9.5-8 (page 9.5-20 attached).
89	DG starting air system interface requirements (9.5.6)	See new items (7) and (8) added to Subsection 9.5.13.5 (page 9.5-10.6 attached). Also, the "ready to load" status (consistent with the Chapter 8 DSER resolution) has been changed on page 9.5-6 from 13 to 20 seconds (This page is proprietary and is provided under separate cover).

90	Omission of reference to air compressor discharge coolers (9.5.7)	See modified second sentence of Subsection 9.5.6.2 (page 9.5-6) (This page is proprietary and is provided under separate cover).
91	Omission of DG lubrication system level indication (9.5.7)	The flow transmitter (FT) shown on the lube oil sump tank on Figure 9.5-9 (page 9.5-1 attached) is an error and corrected to "LT. Also, a locally mounted level indicator (LI) has been added to this figure.
92	Identification of design criteria as interface requirements (9.5.7)	Item 5 of Subsection 9.5.13.5 (page 9.5-10.6 attached) has been clarified. Subsection 9.5.8.2.1 (page 9.5-8) has been expanded to include protection against crank explosions. (This page is proprietary and is provided under separate cover). The response to Question 430.294 on page 20.3-369 was modified accordingly. (This page is proprietary and is provided under separate cover).
93	Classification of components in the DG lubrication system (9.5.7)	Note 2 of Figure 9.5-9 (page 9.5-21 attached) has been expanded to identify the requirements of ANSI B31.1. Also, Item 4 of the Response to Question 430.271 (page 20.3-357 has been appropriately modified. (Page 20.3-357 is proprietary and is provided under separate cover).
94	Identification of ASME and ANSI components (9.5.7)	See response to outstanding issue 93.
95	Selection of a combustion air flow capacity (9.5.8)	Response is provided in new Item (6) of Subsection 9.5.13.5 (page 9.5-10.6 attached).
96	DG combustion air intake and exhaust system provisions for tornado missiles (9.5.8)	Response provided in revised Subsection 9.5.8.1 (page 9.5-8) (This page is proprietary and is provided under separate cover).

97	Design information on areas not included in SSAR (9.5.8)	See response to outstanding issue 92.
98	Adequacy of process sampling system (9.3.2.1)	See Attachment D
99	Adequacy of post-accident sampling system (9.3.2.2)	See Attachment G and revised Subsection 9.3.2 (pages 9.3-1b, 9.3-1c and 9.3-1d) and Table 9.3-2 (page 9.3-15d). All of these pages are proprietary and are provided under separate cover.
100	Adequacy of hydrogen water chemistry system (9.3.9)	The response is provided on revised page 9.3-12 attached
101	Adequacy of zinc injection system	The response is provided on revised page 9.3-13 attached
102	Fire hazards analysis (9.5.1.1)	Under staff review
103	HVAC smoke removal-system description (9.5.1.2) (9.5.1.4.4)	See Attachment E
104	Water distribution and fire extinguishing systems (9.5.1.3.2)	Under staff review
105	Adequa of condensate cleanu ystem (10.4.6)	<u>Item 1</u> There are no safety-related systems in the turbine building <u>Item 2</u> Reference to the evaluation of the shielding design for the condensate cleanup system is located in Table 12.2-5 <u>Item 3</u> The response is provided on attached page 10.4-12 <u>Item 4</u> The response is provided on attached page 10.4-12
106	Upper drywell shielding concerns (12.1.2)	Response will be provided by March 31, 1992

107	Identification and description of contained and airborne radioactive sources in SSAR (operation and accident conditions) (12.2.1)	Response will be provided by March 31, 1992
108	Plant layout drawing deficiencies regarding identification of radiation sources, legibility, and consistency (12.3.1)	Response will be provided by March 31, 1992
109	Identification of post-LOCA vital areas (12.3.1)	Subsection 12.3.1 has been expanded in Amendments 10 and 17 to better define the plant vital areas, access and egress pathways to the vital areas has been added to the zone drawings and the vital components shown on the zone drawings.
110	Justification of high radiation zone above spent fuel pool during operation (12.3.1)	The pool areas have been rezoned in Amendment 17 consistent with the level of shielding provided and the zone drawings updated.
111	Identification of "highly radioactive systems" (12.3.1)	Decontaminations information will included in Amendment 20. All heat exchangers except the fuel pool cleanup heat exchangers are provided with either chemical or water flushing decontamination connections. The fuel pool cleanup heat exchanger is located downstream of the filter demineralizer pack and does not require separate decontamination.
112	Drywell and reactor vessel shielding design information (12.2.3)	Drywell and reactor drawings are given in Section 1.2. Some drywell details will be added to the radiation zone drawings in Section 12.3 by March 31, 1992. In addition, Table 12.2-5 will be expanded in Amendment 20 to provide shielding dimension and data for components and major pipe chases.
113	Airborne contamination information (12.3.2)	This issue is being covered by a DAC on radiation protection and monitoring.

114	Airborne radiation monitoring (12.3.4)	This issue of being covered by a DAC on radiation protection and monitoring.
115	Dose assessment background, bases, consistency, justification (12.4)	Section 12.4 has been expanded and rewritten and submitted as Amendment 18 and will be expanded in Amendment 20.
116	Power-to-flow operating map (14.2.11)	See new Figure 14.2-1 (page 14.2-67) attached
117	Table listing startup tests and test conditions (14.2.11)	See new Table 14.2-1 (pages 14.2-66.2 through 14/2-66.5) attached
118	Generic interfacing support system availability individual test abstracts (14.2.12)	Under NRC review
119	DI commitment to perform tests (14.2.12)	See revised Subsection 14.2.12.1 (page 14.2-7) attached
120	Modifications to individual test abstracts (14.2.12)	Under NRC review
121	Clarify acceptance criteria and modify startup test abstracts (14.2.12)	Under NRC review
122	Screening to identify tests not essential to demonstrate conformance (14.2.12)	COL Action Item; see revised Subsection 14.2.13 (pages 14.2-65 and 14.2-65.1) attached
123	Conformance of the ABWR with RG 1.68 Revision 2 (14.2.12.3)	See Attachment F
124	TMI Items (14.2.12.3)	See Section 1A2.4 for general assessment; Chapter 14 complies with testing related items
125	Functioning of conductivity meters (14.2.12.4)	Provided in Amendment 18
126	Modification to feedwater control test description (14.2.12.4)	See current Subsection 14.2.12.2.14(3) (page 14.2-53) and new Table 14.2-1 (pages 14.2-66.2 through 14.2-66.5) attached
127	Clarification of feedwater control test acceptancen criteria (14.2.12.4)	Provided in Amendment 18

128	Total air demand for instrument air and station air (14.2.12.4)	Provided in Amendment 18
129	Functional testing of instrument and control air systems (14.2.12.4)	Provided in Amendment 18
130	HVAC preoperat[illegible] testing requirements (1[illegible]2.4)	Provided in Amendment 18
131	Design, maintenance, and testing criteria for ventilation systems (14.2.12.4)	Provided in Amendment 18
132	RHR system isolation (14.2.12.4)	See revised Subsection 14.2.12.1.8()(i) (page 14.2-3) attached
133	Verification of relief valve settings by vendor bench tests (14.2.12.4)	Provided in Amendment 18
---	Selected issues from GE/NRC March 5, 1992 conference call	In addition to the DSER issues, several of the issues identified in the subject conference call have been addressed
134	Approval of REDYA and ODYNA (15.1)	The NRC staff and its consultant, Brookhaven National Laboratory, performed an on-site audit at GE offices in San Jose, California January 28-30, 1992. GE is waiting for the audit report.
135	Loss of feedwater heater transient (15.1 Item (1))	GE submitted additional information to the NRC in letter P.W. Marriott to R.C. Pierson dated 1/10/92.
136	Software reliability in determining limiting faults (15.1 Item (3))	GE is waiting for NRC response stemming from the February 28, 1992 GE/NRC meeting in Rockville.
137	Rod block algorithm and setpoint (15.1 Item (4)(b))	GE submitted additional information to the NRC in letter P.W. Marriott to R.C. Pierson dated 1/10/92.
138	Credit for non-safety grade equipment in safety analysis (15.1 Item (6))	GE provided additional information as requested by the NRC on February 28, 1992.
139	Slow turbine control valve closure event (15.1 Item (6))	GE will submit additional information by March 6, 1992.

140	Compliance of ATWS Rule 10CFR50.62 (15.4)	GE will revise Appendix 15E by March 31, 1992.
141	Pressure suppression pool as a fission product cleanup system (15.3 (1))	A resubmittal of the radiological portions of Subsection 15.6.5 has been made (FAX, Careway to Lee, dated 2/1/92 and FAX, Fox to Poslusny, dated 2/13/92) with further details and justification for using suppression pool scrubbing. The staff has stated that there is insufficient time to review this area and therefore a revised submittal is under preparation in which credit for suppression pool scrubbing is deleted.
142	Radioactive iodine deposition in the main steam lines and condensers (15.3 (3))	The resubmittal under issue (141) also utilized the BWROG MSIV methodology. Additionally discussions between the NRC and GE have resolved the question of the applicability of using the steam lines and the main condenser mitigation pathway.
143	Containment leak rate (15.3.1)	Response to be provided by March 31, 1992.
144	Compliance of ATWS Rule 10CFR50.62 (15.4)	GE will revise Appendix 15E by March 31, 1992.
145	Compliance with 10CFR 50.55a(g) (5.2, 6.6)	Response provided on attached pages 6.6-iii and 6.6-1 through 6.6-5.
146	Design basis tornado analyses (2.3.2)	GE is waiting for formal staff guidance on the tornado characteristics

SUMMARY RESPONSE TO OUTSTANDING AND CONFIRMATORY ISSUES OF
ABWR DSER CHAPTERS 1,2,3,5,6,8,10,12,13,14 and 15
SECY-91-353

Confirmatory Issue	Description	Resolution/Comment
1	GE commitment to add additional references to RGs (14.2.7)	Provided in Amendment 10 and revised Table 1.8-20 (page 1.8-42) attached.
2	Completion of pre-operational testing (14.2.10)	Provided in Amendment 16

TABLE 1.8-20

RGs Applicable to ABWR (Continued)

RG No.	Regulatory Guide Title	Appl. Rev.	Issued Date	ABWR Appli-cable?	Comments
1.60	Design Response Spectra for Seismic Design of Nuclear Power Plants.	1	12/73	Yes	
1.61	Damping Values for Seismic Design of Nuclear Power Plants.	0	10/73	Yes	
1.62	Manual Initiation of Protective Actions.	0	10/73	Yes	
1.63	Electric Penetration Assemblies in Containment Structures of Nuclear Power Plants.	3	2/87	Yes	
1.64	Quality Assurance Requirements for the Design of Nuclear Power Plants.		Superceded		See Table 17.0-1
1.65	Materials and Inspections for Reactor Vessel Closure Studs.	0	10/73	Yes	
1.68	Initial Test Programs for Water-Cooled Reactor Power Plants.	2	8/78	Yes	
1.68.1	Preoperational and Initial Startup Testing of Feedwater and Condensate Systems for Boiling Water Reactor Power Plants.	1	1/77	Yes	
1.68.2	Initial Startup Test Program to Demonstrate Remote Shutdown Capability for Water-Cooled Nuclear Power Plants.	1	7/78	Yes	
1.68.3	Preoperational Testing of Instrument and Control Air Systems.	~~1~~ 0	~~[illegible]~~ 4/82	Yes	
1.69	Concrete Radiation Shields for Nuclear Power Plants.	0	12/73	Yes	
1.70	Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants.	3	11/78	Yes	
1.71	Welder Qualifications for Areas of Limited Accessibility.	0	12/73	---	Interface
1.72	Spray Pond Piping Made From Fiberglass-Reinforced Thermosetting Resin.	2	11/78	Yes	

TABLE 3.2-1

CLASSIFICATION SUMMARY (Continued)

Principal Component[a]	Safety Class[b]	Location[c]	Quality Group Classification[d]	Quality Assurance Requirement[e]	Seismic Category[f]	Notes
H1 Main Control Room Panel						
1. Panels	3/N	X	---	B/E	I/---	(aa)
2. Electrical Modules with safety-related function	3	X	---	B	I	
3. Cable with safety-related function	3	X	---	B	I	
4. Other mechanical and electrical modules	N	X	---	E	---	
H2 Local Control Panels						
1. Panels or Racks	3/N	C,SC,X	---	B/E	I/---	(aa)
2. Electrical modules with safety-related function	3	C,SC,X	---	B	I	
3. Cable with safety-related function	3	C,SC,X,	--	B	I	
4. Other mechanical and electrical modules	N	C,SC,X	---	E	---	
K1 Radioactive Drain Transfer System						
1. Drain piping including supports and valves - radioactive	N	ALL (except) RZ,X)	D	E	---	(p)
2. Drain piping including supports and valves - nonradioactive	N	ALL	D	E	---	(p)
3. Piping and valves - containment isolation	2	C,SC	B	B	I	
4. Other mechanical and electrical modules	N	ALL	---	E	---	(p)
5. ECCS equipment room sump backflow protection check valves	3	SC	C	B	I	

260.4

210.20

(77)

years in BWR applications. Extensive laboratory tests have demonstrated that XM-19 is a suitable material and that it is resistant to stress corrosion in a BWR environment.

4.5.3 Interfaces

4.5.3.1 CRD Inspection Program

The CRD inspection program shall include provisions to detect incipient defects before they could become serious enough to cause operating problems. [See Subsection 4.5.1.2(2)] The CRD nozzle and CRD bolting are included in the inservice inspection program. [See Table 5.2-8, System Number B11/B12] CRD bolting is available for inservice examinations during normally scheduled CRD maintenance.

SECTION 5.2

CONTENTS (Continued)

radiography or UT, the length of the weld to be examined shall include the location least favorable for the welder.

Records of the results obtained in welder accessibility qualification shall be as certified by the manufacturer or installer, shall be maintained and shall be made accessible to authorized personnel.

Socket weld with a 50A nominal pipe size and under are excluded from the above requirements.

(2) (a) For accessibility, when more restricted access conditions than qualified will obscure the welder's line of sight to the extent that production welding will require the use of visual aids such as mirrors. The qualification test assembly shall be welded under the more restricted access conditions using the visual aid required for production welding.

(b) GE complies with ASME Section IX.

(3) Surveillance of accessibility qualification requirements will be performed along with normal surveillance of ASME Section IX performance qualification requirements.

5.2.3.4.3 Regulatory Guide 1.66: Nondestructive Examination of Tubular Products

For discussion of compliance with Regulatory Guide 1.66, see Subsection 5.2.3.3.3.

5.2.4 Preservice and Inservice Inspection and Testing of Reactor Coolant Pressure Boundary

This subsection describes the preservice and inservice inspection and system pressure test programs for NRC Quality Group A, ASME Boiler Class 1, items.* It describes those programs implementing the requirements of Subsection IWB Pressure Vessel (B&PV) Code, Section III and XI ~~of the ASME B&PV Code Section XI.~~ (1A)

5.2.4.1 Class 1 System Boundary

5.2.4.1.1 Definition

The class 1 system boundary for both preservice and inservice inspection programs and the system pressure test program includes all those items within the Class 1 and Quality Group A boundary on the piping and instrumentation drawings (P&IDs). That boundary includes the following: (1B)

(1) Reactor pressure vessel
(2) Portions of the main steam system
(3) Portions of the feedwater system
(4) Portions of the standby liquid control system
(5) Portions of reactor water cleanup system
(6) Portions of the residual heat removal system
(7) Portions of the reactor core isolation cooling system
(8) Portions of the high pressure core flooder system

Those portions of the above systems within the Class 1 boundary are those items which are part of the reactor coolant system up to and including any and all of the following:

(1) the outermost containment isolation valve in the system piping which penetrates primary reactor containment.

(2) the second of two valves normally closed during normal reactor operation in system piping which does not penetrate primary reactor containment.

(3) the reactor coolant system safety and relief valves,

(4) the main steam and feedwater system up to and including the outermost containment isolation valve.

5.2.4.1.2 Exclusions

Portions of systems within the reactor coolant pressure boundary, as defined in 5.2.4.1.1, that are excluded from the Class 1 boundary are as follows: (1C)

* *Items as used in this subsection are products constructed under a Certificate of Authorization (NCA-3120) and material (NCA-1220). See Section III, NCA-1000, footnote 2.*

INSERTS FOR PAGE 5.2-15.1

(1A) The ASME Code requirements provided in this section for information are based on the 1989 Edition of ASME Section XI. The preservice and inservice inspection requirements and accepted Code Editions and Addenda are specified by 10 CFR, Section 50.55a.

(1B) Based on 10 CFR (1-1-90 Edition) and Regulatory Guide 1.26, Revision 3,

(1C) based on 10 CFR (1-1-90 Edition),

(1) those components where, in the event of postulated failure of the component during normal reactor operation, the reactor can be shut down and cooled down in an orderly manner, assuming makeup is provided by the reactor coolant makeup system only; and

(2) components which are or can be isolated from the reactor coolant system by two valves (both closed, both open, or one closed and one open). Each such open valve is capable of automatic actuation and if the other valve is open its closure time is such that, in the event of postulated failure of the component during normal reactor operation, each valve remains operable and the reactor can be shut down and cooled down in an orderly manner assuming makeup is provided by the reactor coolant makeup system only.

5.2.4.2 Accessibility

All items within the Class 1 boundary are designed ~~to the extent practicable~~ to provide access for the examinations required by ASME Section XI, IWB-2500. ~~Items for which the design is known to have inherent access restrictions are described in Subsection 5.2.4.8.~~

5.2.4.2.1 Reactor Pressure Vessel Access

Access for examinations of the reactor pressure vessel (RPV) is incorporated into the design of the vessel, biological shield wall and vessel insulation as follows:

(1) RPV Welds Below the Top Biological Shield Wall

The shield wall and vessel insulation behind the shield wall are spaced away from the RPV outside surface to provide access for remotely operated ultrasonic examination devices as described in Subsection 5.2.4.3.2.1 Access for the insertion of automated devices is provided through removable insulation panels at the top of the shield wall and at access ports at reactor vessel nozzles. Platforms are attached to the bioshield wall to provide access for installation of remotely operated nozzle examination devices.

(2) RPV Welds Above Top of the Biological Shield Wall

Access to the reactor pressure vessel welds above the top of the biological shield wall is provided by removable insulation panels. This design provides reasonable access for both automated as well as manual ultrasonic examination.

(3) Closure Head, RPV Studs, Nuts and Washers

The closure head is dry stored during refueling. Removable insulation is designed to provide access for manual ultrasonic examinations of closure head welds. RPV nuts and washers are dry stored and are accessible for surface and visual (VT-1) examination. RPV studs may be volumetrically examined in place or when removed.

(4) Bottom Head Welds

Access to the bottom head to shell weld and bottom head seam welds is provided through openings in the RPV support pedestal and removable insulation panels around the cylindrical lower portion of the vessel. This design provides access for manual or automated ultrasonic examination equipment. Sufficient access is provided to partial penetration nozzle welds, i.e., CRD penetrations, instrumentation nozzles and recirculation internal pump penetration welds, for performance of the visual, VT-2, examination during the system leakage and system hydrostatic examinations.

(5) Reactor Vessel Support Skirt

The integral attachment weld from the number four shell course forging to the RPV skirt will be examined ultrasonically. Sufficient access is provided for either manual or automated ultrasonic examination. Access is provided to the balance of the support skirt for performance of visual, VT-3, examination.

5.2.4.2.2 Piping, Pumps Valves and Supports

Physical arrangement of piping pumps and valves provide personnel access to each weld location for performance of ultrasonic and surface (magnetic particle or liquid penetrant) examinations and sufficient access to supports for performance of visual, VT-3, examination. Working platforms are provided in some

INSERTS FOR PAGE 5.2-16

(1D) Items (1) and (2) above describe the Class 1 boundary only and are not exemptions as defined by Section XI of the ASME Boiler and Pressure Vessel Code (ASME Section XI)

(1E) Items such as nozzle-to-vessel welds often have inherent access restrictions when vessel internals are installed therefore the preservice examination shall be performed on these items prior to installation of internals which would interfere with examination.

areas to facilitate servicing of pumps and valves. Platforms and ladders are provided for access to piping welds including the pipe-to-reactor vessel nozzle welds. Removable thermal insulation is provided on welds and components which require frequent access for examination or are located in high radiation areas. Welds are located to permit ultrasonic examination from at least one side, but where component geometries permit, access from both sides is provided.

Restrictions: For piping systems and portions of piping systems subject to volumetric and surface examination, the following piping designs are not used:

(1) Valve to Valve
(2) Valve to Reducer
(3) Valve to Tee
(4) Elbow to Elbow
(5) Elbow to Tee
(6) Nozzle to elbow
(7) Reducer to elbow
(8) Tee to tee
(9) Pump to valve

Straight sections of pipe and spool pieces shall be added between fittings. The minimum length of the spool piece has been determined by using the formulate L = 2T + 152mm, where L equals the length of the spool piece (not including weld preparation) and T equals the pipe wall thickness.

5.2.4.3 Examination Categories and Methods

5.2.4.3.1 Examination Categories

The examination category of each item is listed in Table 5.2-8 (provided as an example). The items are listed by system and line number where applicable. Table 5.2-8 also states the method of examination for each item. The preservice and inservice examination plans will be supplemented with detailed drawings showing the examination areas, such as Figures 5.2-7a and 5.2-7b.

1F →

5.2.4.3.2 Examination Methods

5.2.4.3.2.1 Ultrasonic Examination of the Reactor Vessel

~~Ultrasonic examination of the RPV will be conducted in accordance with ASME Section XI, IWA-2232 (a), and Section V, Article 4.~~ In addition the ultrasonic examination system shall meet the requirements of Regulatory Guide 1.150 as described in Table 5.2-9. RPV welds and nozzles subject to examination are shown in Figure 5.2-7a. (1G)

The GE reactor vessel inspection system (GERIS) meets the detection and sizing requirements of Regulatory Guide 1.150, as cited in Table 5.2-9. Inner radius examinations are performed from the outside of the nozzle using several compound angle transducer wedges to obtain complete coverage of the required examination volume. Electronic gating used in GERIS system records up to 8 different reflectors simultaneously to assure that all relevant indications are recorded. Appendix 5A demonstrated compliance with Regulatory Guide 1.150.

5.2.4.3.2.2 Visual Examination

Visual examination methods, VT-1, VT-2 and VT-3, shall be conducted in accordance with ASME Section XI, IWA-2210. In addition, VT-2 examinations shall meet the requirements of IWA-5240.

Direct visual, VT-1, examinations shall be conducted with sufficient lighting to resolve a 0.8mm black line on an 18% neutral grey card. Where direct visual, VT-1, examinations are conducted without the use of mirrors or with other viewing aids, clearance (of at least 610mm of clear space) is provided where feasible for the head and shoulders of a man within a working arm's length (508mm) of the surface to be examined.

At locations where leakages are normally expected and leakage collection systems are located (e.g., valve stems and pump seals), the visual, VT-2, examination shall verify that the leakage collection system is operative.

Piping runs shall be clearly identified and laid out such that insulation damage, leaks and structural distress will be evident to a trained visual examiner.

5.2.4.3.2.3 Surface Examination

Magnetic particle and liquid penetrant examination techniques shall be performed in accordance with ASME Section XI, IWA-2221 and IWA-2222, respectively. Direct examination access for magnetic particle (MT) and penetrant (PT) examination is the same as that required for direct visual (VT-1) examination (Subsection 5.2.4.3.2.3), except that

INSERTS FOR PAGE 5.2-17

(F) For the preservice examination, all of the items selected for inservice examination shall be performed once in accordance with ASME Section XI, IWB-2200 with the exception of the examinations specifically excluded by ASME Section XI from preservice requirements, such as VT-3 examination of valve body and pump casing internal surfaces (B-L-2 and B-M-2 examination categories, respectively) and the visual VT-2 examinations for categories B-E and B-P.

(G) Ultrasonic examination of the RPV will be conducted in accordance with applicable ASME Section XI requirements, including qualification of ultrasonic examination systems in accordance with an accepted industry program implementing the rules of Section XI, Appendix VIII.

additional access shall be provided as necessary to enable physical contact with the item in order to perform the examination. Remote MT and PT generally are not appropriate as a standard examination process, however, boroscopes and mirrors can be used at close range to improve the angle of vision. As a minimum, insulation removal shall expose the area of each weld plus at least 152mm from the toe of the weld on each side. Insulation will generally be removed 406mm on each side of the weld.

5.2.4.3.2.4 Volumetric Ultrasonic Direct Examination

Volumetric ultrasonic direct examination shall be performed in accordance with ASME Section XI, IWA-2232. In order to perform the examination, visual eccess to place the head and shoulders within 508mm of the area of interest shall be provided where feasible. Nine inches between adjacent pipes is sufficient spacing if there is free access on each side of the pipes. The transducer dimension has been considered: a 38mm diameter cylinder, 76mm long placed with access at a right angle to the surface to be examined. The ultrasonic examination instrument has been considered as a rectangular box 305 x 305 x 508mm located within 12m from the transducer. Space for a second examiner to monitor the instrument shall be provided if necessary.

Insulation removal for inspection is to allow sufficient room for the ultrasonic transducer to scan the examination area. A distance of 2T plus 152mm where T is pipe thickness, is the minimum required on each side of the examination area.The insulation design generally leaves 406mm on each side of the weld, which exceeds minimum requirements.

5.2.4.3.2.5 Alternative Examination Techniques

As provided by ASME Section XI, IWA-2240, alternative examination methods, a combination of methods, or newly developed techniques may be substituted for the methods specified for a given item in this section, provided that they are demonstrated to be equivalent or superior to the specified method. This provision allows for the use of newly developed examination methods, techniques, etc., which may result in improvements in examination reliability and reductions in personnel exposure.

5.2.4.3.3 Data Recording

Manual data recording will be performed where manual ultrasonic examinations are performed. Electronic data recording and comparision analysis are to be employed with automated ultrasonic examination equipment. Signals form each ultrasonic transducer will be fed into a data acquisition system in which the key parameters of any reflectors will be recorded. The data to be recorded for manual and automated methods are:

(1) Location
(2) Position
(3) Depth below the scanning surface
(4) Length of the reflector
(5) Transducer data including angle and frequency
(6) Calibration data

The data so recorded shall be compared with the results of subsequent examinations to determine the behavior of the reflector. (1H)

5.2.4.4 Inspection Intervals

The inservice inspection intervals for the ABWR will conform to Inspection Program B as described in Section XI, IWB-2412. Except where deferral is permitted by Table IWB-2500-1, the percentages of examinations completed within each period of the interval shall correspond to Table IWB-2412-1. ~~Items selected to be examined within the 10 year intervals are described in Table 5.2-8.~~ (1I)

5.2.4.5 Evaluation of Examination Results

Examination results will be evaluated in accordance with ASME Section XI, IWB-3000 with repairs based on the requirements of IWA-4000 and IWB-4000. Re-examination shall be conducted in accordance with the requirements of IWA-2200. The recorded results shall meet the acceptance standards specified in IWB-3400-1.

5.2.4.6 System Leakage and Hydrostatic Pressure Tests

5.2.4.6.1 System Leakage Tests

As required by Section XI, IWB-2500 for Category B-P, a system leakage test shall be performed

INSERTS FOR PAGE 5.2-17.1

(H) 5.2.4.3.4 Qualification of Personnel and Examination Systems for Ultrasonic Examination

Personnel performing examinations shall be qualified in accordance with ASME Section XI, Appendix VII. Ultrasonic examination systems shall be qualified in accordance with an industry accepted program for implementation of ASME Section XI, Appendix VIII.

(I) An example of the selection of items and examinations to be conducted within the 10-year intervals are described in Table 5.2-8. Supplemental examinations recommended in GE Service Information Letters (SILs) and Rapid Communication Service Information Letters (RICSILs) for previous BWR designs are not applicable to the ABWR. The ABWR design has either eliminated the components addressed by the SIL or RICSIL, e.g., jet pumps, or has eliminated the need for the examination by eliminating creviced designs and using materials resistant to the known degradation mechanisms, such as intergranular stress corrosion cracking, upon which the SIL and RICSIL examinations were based.

in accordance with IWB-5221 on all Class 1 components and piping within the pressure retaining boundary following each refueling outage. For the purposes of the system leakage test, the pressure retaining boundary is defined in Table IWB-2500-1, Category B-P, Note 1. The system leakage test shall include a VT-2 examination in accordance with IWA-5240. The system leakage test will be conducted approximately at the maximum operating pressure and temperature indicated in the applicable process flow diagram for the system as indicated in Table 1.7-1. The system hydrostatic test (Subsection 5.2.4.6.2), when performed is acceptable in lieu of the system leakage test.

5.2.4.6.2 Hydrostatic Pressure Tests

As required by Section XI, IWB-2500 for Category B-P, the hydrostatic pressure test shall be performed in accordance with ASME Section IWB-5222 on all Class 1 components and piping within the pressure retaining boundary once during each 10 year inspection interval. For purposes of the hydrostatic pressure test the pressure retaining boundary is defined in Table IWB-2500-1, Category B-P, Note 1. The system hydrostatic test shall include a VT-2 examination in accordance with IWA-5240. For the purposes of determining the test pressure for the system hydrostatic test in accordance with IWB-5222 (a), the nominal operating pressure shall be the maximum operating pressure indicated in the process flow diagram for the nuclear boiler system, Figure 5.1-3.

5.2.4.7 Code Exemptions

As provided in ASME Section XI, IWB-1220, certain portions of Class 1 systems are exempt from the volumetric and surface examination requirements of IWB-2500. These portions of systems are specifically identified in Table 5.2-8.

5.2.4.8 Relief Requests

5.2.4.8.1 Reactor Pressure Vessel Nozzles

Due to the inherent geometry of the RPV nozzles, some portion of the nozzle-to-vessel weld required volume as specified in ASME Section XI, Table IWB-2500-1 for category B-D, will be inaccessible for ultrasonic examination. The ultrasonic examination is conducted from the outside surface of the RPV and, as such, the outside radius of the nozzle forging limits the movement of the ultrasonic search unit. The typical scan limitation resulting from this geometry is illustrated in Figure 5.2-7c. The extent of the examination coverage limitation for each nozzle will be determined during the preservice examination of the RPV nozzle-to-vessel welds.

5.2.4.8.2 Reactor Pressure Vessel Bottom Head Weld

Access to the bottom head weld for ultrasonic examination is limited due to penetrations in the bottom head for the reactor internal pumps, control rod drives and incore monitors. Partial coverage will be possible. The extent of the examination coverage limitation for each nozzle will be determined during the preservice examination the RPV bottom head weld.

5.2.4.8.3 Reactor Pressure Vessel Bottom Head-to-Shell Weld

Access to the RPV bottom head-to-shell weld for ultrasonic examination is limited due to the proximity of the RPV skirt pedestal on the shell side, and the curved surface of the bottom head itself interferes with examination from the bottom head side of the weld. Only limited examination coverage can be achieved on this weld, however, the actual extent of the examination coverage will be determined during the preservice examination of the RPV bottom head-to-shell weld.

Table 5.2-8

EXAMINATION CATEGORIES

Quality Group	System Number	System Title	System Description	P&ID Diagram	Sec. XI Exam Cat.	Items Examined	Exam Method
A	B11/B21	Reactor Pressure Vessel/ Nuclear Boiler	Reactor Pressure Vessel	Figure 5.1-3			
			Vessel Shell Welds		B-A	Welds	UT (Note 7)
			Vessel Head Welds		B-A	Welds	UT (Note 7)
			Shell-to-Flange Weld		B-A	Weld	UT
			Head-to-Flange Weld		B-A	Weld	UT, MT
			Nozzles for: Main Steam, Feedwater, SD Outlet, CCS(Fldg.) & SD Inlet, SD - RWCU SD Outlet, CCS(Spray) & SD Inlet		B-D	Welds, Inner Radius	UT
			Nozzles for CRD, RIP & Instrumentation		B-E	External Surfaces	VT-2 (Note 8)
			CRD Housing to Middle Flange and Middle Flange to Spool Piece Bolting		B-G-2	Bolts	VT-1
			Closure Head Nuts		B-G-1	Nuts	MT
			Closure Studs		B-G-1	Studs	UT, MT (Note 9)
			Threads in Flange		B-G-1	Threads	UT
			Closure Washers, Bushings		B-G-1		VT-1
			Integral Attachments		B-H	Welds	UT or MT (Note 10)
			Vessel Interior		B-N-1	Vessel	VT-3 (Note 11)

isolatable portions of the following systems: SLC, RHR, HPCF, and RCIC. The relief valves will be selected in accordance with the rules set forth in the ASME Code Section III, Class 1, 2, and 3 components. Other applicable sections of the ASME Code, as well as ANSI, API, and ASTM Codes, will be followed.

5.4.13.2 Description

Pressure relief valves have been designed and constructed in accordance with the same code class as that of the line valves in the system.

Table 3.2-1 lists the applicable code classes for valves. The design criteria, design loading, and design procedure are described in Subsection 3.9.3.

5.4.13.3 Safety Evaluation

The use of pressure-relieving devices will assure that over-pressure will not exceed 10% above the design pressure of the system. The number of pressure-relieving devices on a system or portion of a system has been determined on this basis.

5.4.13.4 (Deleted)

5.4.14 Component Supports

Support elements are provided for those components included in the RCPB and the connected systems.

5.4.14.1 Safety Design Bases

Design loading combinations, design procedures, and acceptability criteria are as described in Subsection 3.9.3. Flexibility calculations and seismic analysis for Class 1, 2, and 3 components are to be confirmed with the appropriate requirements of ASME Code Section III.

Support types and materials used for fabricated support elements are to conform with Sections NF-2000 and NF-3000 of ASME Code Section III. Pipe support spacing guidelines of Table 121.1.4 of ANSI B31.1, Power Piping Code, are to be followed.

5.4.14.2 Description

The use and the location of rigid-type supports, variable or constant spring-type supports, snubbers, and anchors or guides are to be determined by flexibility and seismic/dynamic stress analyses. Component support elements are manufacturer standard items. Direct weldment to thin wall pipe is to be avoided where possible.

5.4.14.3 Safety Evaluation

The flexibility and seismic/dynamic analyses are to be performed for the design of adequate component support systems including all transient loading conditions expected by each component. Provisions are to be made to provide spring-type supports for the initial dead weight loading due to hydrostatic testing of steam systems to prevent damage to this type support.

5.4.14.4 Inspection and Testing

as discussed in Subsection 3.9.2.1.2,

After completion of the installation of a support system, all hanger elements are to be visually examined to assure that they are in correct adjustment to their cold setting position. Upon hot start-up operations, thermal growth will be observed to confirm that spring-type hangers will function properly between their hot and cold setting positions. Final adjustment capability is provided on all hanger or support types. Weld inspections and standards are to be in accordance with ASME Code Section III. Welder qualifications and welding procedures are in accordance with ASME Code Section IX and NF-4300 of ASME Code Section III.

5.4.15 References

1. *Design and Performance of General Electric Boiling Water Reactor Main Steam Line Isolation Valves*, General Electric Co., Atomic Power Equipment Department, March 1969 (APED-5750).

Table 6.2-9 Secondary Containment Penetration List[1]

Penetration Number	Name	Elevation (mm)	Diameter (mm)
1	RCW (B)	-8200	600
2	RCW (B)	-8200	600
3	HPCF	-8200	600
4	SS	-8200	50
5	RD (LCW)	-8200	80
6	RD (SD)	-8200	65
7	RD (HCW)	-8200	150
8	TV	-8200	250
9	RCW (A)	-8200	600
10	RCW (A)	-8200	600
11	RCW (C)	-8200	550
12	RCW (C)	-8200	550
13	HPCF	-8200	600
14	MUWC	-8200	250
15	CRD	-8200	150
16	CRD	-8200	50
17	SPH	-8200	150
18	RCW (B)	-1700	150
19	RCW (B)	-1700	150
20	RCW (B)	-1700	200
21	RCW (B)	-1700	200
22	MS	-1700	80
23	SA	-1700	65
24	IA	-1700	50
25	FP	-1700	150
26	RCW (A)	-1700	150
27	RCW (A)	-1700	150
28	RCW (A)	-1700	200
29	RCW (A)	-1700	200
30	HSR	-1700	150
31	RCW (C)	-1700	100
32	RCW (C)	-1700	100
33	RCW (C)	-1700	200
34	RCW (C)	-1700	200
35	HS	4800	150
36	MS	4800	80
37	LCW (FPC)	4800	150
38	LCW (CUW)	4800	150
39	RCIC	4800	50
40	MS (4)	16191	700
41	FDW (2)	13810	600
42	HVAC Exhaust	27200	*
43	HVAC Supply	31700	*
44	Controlled Access(2)	12300	**
45	Equipment Lock	12300	**
46	Railroad Car Door	12300	**
47	HS	12300	150
48	HWH	12300	150

Table 6.2-9 Secondary Containment Penetration List[1] (Continued)

Penetration Number	Name	Elevation (mm)	Diameter (mm)
49	HWH	12300	150
50	HNCW	12300	200
51	HNCW	12300	200
52	MUWP	4800	150
53	AC	4800	50
54	AC	4800	250
55	HWH	4800	50
56	HWH	4800	50
57	Cabletrays	23500	
58	Cabletrays	12300	
59	Cabletrays	4800	

Note: 1. This Table provided in response to Question 430.34

* These HVAC openings have safety-related isolation valves with both local monitoring and remote (in control room) monitoring.

** These doors are monitored in the control room as per Subsection 13.6.3.4.

SECTION 6.6

CONTENTS (Continued)

TABLES

6.6.7.1 High Energy Piping
6.6.7.2 Erosion-Corrosion

producing the design-basis hydrogen and oxygen has occurred.

(2) The hydrogen generation from metal-water reaction is defined in Regulatory Guide 1.7.

(3) The hydrogen and oxygen generation from radiolysis is defined in Regulatory Guide 1.7.

(4) The ACS establishes an inert atmosphere throughout the primary containment following an outage or other occasions when the containment has been purged with air to an oxygen concentration greater than 3.5 percent.

(5) The ACS maintains the primary containment oxygen concentration below the maximum permissible limit per Regulatory Guide 1.7 during normal, abnormal, and accident conditions in order to assure an inert atmosphere.

(6) The ACS also maintains a slightly positive pressure in the primary containment during normal, abnormal and accident conditions to prevent air (oxygen) leakage into the inerted volumes from the secondary containment, and provides non-essential monitoring of the oxygen concentration in the primary containment to assure a breathable mixture for safe personnel access or an inert atmosphere, as required. Essential monitoring is provided by the containment atmospheric monitoring system (CAMS) as described in Chapter 7.

(7) The drywell and the suppression chamber will be mixed uniformly after the design-basis LOCA due to natural convection and molecular diffusion. Mixing will be further promoted by operation of the containment sprays.

(8) The system is capable of controlling combustible gas concentrations in the containment atmosphere for the design bases LOCA without relying on purging and without releasing radioactive material to the environment.

(9) The system is designed to maintain an inert primary containment after the design-bases LOCA assuming a single-active failure. The backup purge function need not meet this criterion.

(10) Components of the AC system inside the reactor building are protected from postulated missiles and from pipe whip, as required to assure proper action as well as other dynamic effects such as tornado missiles and flooding.

(11) The AC system isolation function has the capability to withstand the dynamic effects associated with the safe shutdown earthquake without loss of function.

(12) The system is designed so that all components subjected to the primary containment atmosphere (inboard isolation valves) are capable of withstanding the temperature and pressure transients resulting from a LOCA. These components will withstand the humidity and radiation conditions in the wetwell or drywell following a LOCA.

(13) The ACS is nonsafety class except as necessary to assure primary containment integrity (penetrations, isolation valves). The ACS and FCS are designed and built to the requirements specified in Section 3.2.

(14) The ACS includes the nitrogen storage tanks, vaporizers, valves and piping carrying nitrogen to the containment, valves and piping from the containment to the SGTS and HVAC (U41) exhaust line, non-safety oxygen monitoring, and all related instruments and controls. The ACS does not include any structures housing or supporting the aforementioned equipment or any ducting in the primary containment.

(15) The system is designed to facilitate periodic inspections and tests. The ACS can be inspected or tested during normal plant conditions.

INSERT (73b)

The nitrogen supplied from the AC system shall be oil-free with a moisture content of less than 2.5 ppm. Filters are provide to remove particulates larger than 5 microns.

ventilation exhaust, the SGTS is automatically actuated. If system operation is not confirmed, the redundant process fan and dryer train are automatically placed into service. In the event a malfunction disables an operating process fan or dryer train, the standby process fan and dryer train are manually initiated.

6.5.1.2.3.2 Manual

The SGTS is on standby during normal plant operation and may be manually initiated before or during primary containment purging (de-inerting) when required to limit the discharge of contaminants to the environment. It may be manually initiated whenever its use may be needed to avoid exceeding radiation monitor setpoints.

6.5.1.2.3.3 Decay Heat Removal

Cooling of the SGTS filters may be required to prevent the gradual accumulation of decay heat in the charcoal. This heat is generated by the decay of radioactive iodine adsorbed on the SGTS charcoal. The charcoal is typically cooled by the air from the process fan.

A water deluge capability is also provided, but primarily for fire protection since redundant process fans are provided for air cooling. Since the deluge is available, it may also be used to remove decay heat for sequences outside the normal design basis. Temperature instrumentation is provided for control of the SGTS process and space electric heaters. This instrumentation may also be used by the operator to [re-]establish a cooling air flow post-accident, if required.

Water is supplied from the fire protection system and is connected to the SGTS via a spool piece.

6.5.1.3 Design Evaluation

6.5.1.3.1 General

(1) A slight negative pressure is normally maintained in the secondary containment by the reactor building HVAC system (Subsection 9.4.5). On SGTS initiation per Subsection 6.5.1.2.3.1, the secondary containment is automatically isolated from the HVAC system.

(2) The SGTS filter particulate and charcoal efficiencies are outlined in Table 6.5-1. Dose analyses of events requiring SGTS operation, described in Subsections 15.6.5 and 15.7.4, indicate that offsite doses are within the limits established by 10 CFR 100.

(3) The SGTS is designated as an engineered safety feature since it mitigates the consequences of a postulated accident by controlling and reducing the release of radioactivity to the environment. The SGTS, except for the deluge, is designed and built to the requirements for Safety Class 3 equipment as defined in Section 3.2, and 10 CFR 50, Appendix B.

The SGTS has independent, redundant active components. Should any active component fail, SGTS functions can be performed by the redundant component. The electrical devices of independent components are powered from separate Class 1E electrical buses.

(4) The SGTS is designed to Seismic Category I requirements as specified in Section 3.2. The SGTS is housed in a Category I structure. All surrounding equipment, components, and supports are designed to appropriate safety class and seismic requirements.

(5) The SGTS design is based on the maximum pressure and differential pressure, maximum integrated dose rate, maximum relative humidity, and maximum temperature expected in secondary containment for the LOCA event.

15

6.5.1.3.2 Sizing Basis

Figure 6.5-2 provides an assessment of the secondary containment pressure after the design-basis LOCA assuming an SGTS fan capacity of 4000 scfm (70°F, 1 atmosphere) per fan and the leakage rates shown in Table 6.5-2. Credit for secondary containment as a fission product control system is only taken if the secondary containment is actually at a negative pressure by considering the potential effect of wind on the ambient pressure in the vicinity of the reactor building. For the ABWR dose analysis, direct transport of containment leakage to the environment was assumed for the first 20 minutes after LOCA event initiation (in addition to the leakage through the MSIVs to the main turbine condenser). Each SGTS fan was sized to

INSERT (15)

A secondary containment draw-down analysis will be performed by the COL applicant to demonstrate the capability of the SGTS to maintain the design negative pressure following a LOCA including inleakage from the open, non-isolated penetration lines identified during construction engineering and the event of the worst single failure of a secondary containment isolation valve to close. (See Subsection 6.5.5.1 for interface requirements).

6.5.4 Ice Condenser as a Fission Product Control System

The GE ABWR does not utilize any kind of an ice condenser feature as a fission product control system.

6.5.5 Interfaces

6.5.5.1 SGTS Performance

The COL applicant will perform a STGS draw-down analysis in accordance with Subsection 6.5.1.3.1 Item(5).

6.6 PRESERVICE AND INSERVICE INSPECTION AND TESTING OF CLASS 2 AND 3 COMPONENTS AND PIPING

This subsection describes the preservice and inservice inspection and system pressure test programs for NRC Quality Groups B and C, i.e., ~~ASME Boiler and Pressure Vessel (B&PV)~~ Code ~~Section III and XI~~ Class 2 and 3 items, respectively.* It describes those programs implementing the requirements of Subsections IWC and IWD of the ASME B&PV Code Section XI. ← 145 A

6.6.1 Class 2 and 3 System Boundaries

The Class 2 and 3 system boundaries for both preservice and inservice inspection programs and the system pressure test program includes all those items within the 3 boundary and applicable items within the 4 boundary, respectively, on the piping and instrumentation drawings (P&IDs). Those boundaries include all or part of the following:

(1) Main steam system
(2) Feedwater system
(3) Reactor core isolation cooling system
(4) High pressure core flooder system
(5) Standby liquid control system
(6) Residual heat removal system.
(7) Reactor water clean up system
(8) Control rod drive system
(9) Supression pool clean-up system
(10) Purified make up water system
(11) Atmospheric control system
(12) Radwaste system
(13) HVAC normal cooling water system
(14) Service air system
(15) High pressure nitrogen gas supply system
(16) Instrument air system
(17) Reactor building cooling water system
(18) Flammability control system
(19) Fuel pool cooling and clean-up system
(20) Reactor service water system

---

* *Items as used in this Section are products constructed under a Certificate of Authorization (NCA-3120) and material (NCA-1220). See Section III, NCA-1000, footnote 2*

6.6.1.1 Class 2 System Boundary Description

Those portions of the systems listed in Subsection 6.6.1 within the Class 2 boundary, ~~as~~ based on ~~described in~~ Regulatory Guide 1.26, Revision 3, for Quality Group B, are as follows:

(1) Portions of the reactor coolant pressure boundary as defined in Subsection 5.2.4.1.1, but which are excluded from the Class 1 boundary pursuant to Subsection 5.2.4.1.2.

(2) Systems or portions of systems important to safety that are designed for reactor shutdown or residual heat removal.

(3) Portions of the steam systems extending from the outermost containment isolation valve up to but not including the turbine stop and bypass valves and connected piping up to and including the first valve that is either normally closed or capable of automatic closure during all modes of normal reactor operation.

(4) Systems or portions of systems that are connected to the reactor coolant pressure boundary and are not capable of being isolated from the boundary during all modes of normal reactor operation by two valves, each of which is normally closed or capable of automatic closure.

(5) Systems or portions of systems important to safety that are designed for (1) emergency core cooling, (2) post accident containment heat removal, or (3) post accident fission product removal.

← 145 B

6.6.1.2 Class 3 System Boundary Description

Those portions of the systems listed in Subsection 6.6.1 within the Class 3 boundary, ~~as~~ based on ~~described in~~ Regulatory Guide 1.26, Revision 3, for Quality Group C, are not part of the reactor coolant pressure boundary but are as follows:

(1) Cooling water systems or portions of cooling water systems important to safety that are designed for emergency core cooling, post-accident containment heat removal, post-accident containment atmosphere cleanup, or residual heat removal from the reactor and from the spent fuel storage pool (including

INSERTS FOR PAGE 6.6-1

145A. The preservice and inservice inspection requirements are defined by 10 CFR, Section 50.55a.

145B. Items (1) through (5) above describe the Class 2 boundary only and are not exemptions as defined by Section XI of the ASME Boiler and Pressure Vessel Code.

primary and secondary cooling systems). Portions of these systems that are required for their safety functions and that do not operate during any mode of normal operation and cannot be tested adequately, however, are included in Class 2.

(2) Cooling water and seal water systems or portions of these systems important to safety that are designed for functioning of components and systems important to safety.

(3) Systems or portions of systems that are connected to the rector coolant pressure boundary and are capable of being isolated from that boundary during all modes of normal reactor operation by two valves each of which is normally closed or capable of automatic closure.

(4) Systems, other than radioactive waste management systems, not covered by items a, b and c above, that contain or may contain radioactive material and whose postulated failure would result in conservatively calculated potential offsite doses (ref. Regulatory Guides 1.3 and 1.4), that exceed 0.5 rem to the whole body or its equivalent to any part of the body.

145 c

6.6.2 Accessibility

All items within the Class 2 and 3 boundaries are designed, to the extent practicable, to provide access for the examinations required by IWC-2500 and IWD-2500. Items for which the design is known to have inherent access restrictions are described in Subsection 6.6.9.

6.6.2.1 Class 2 RHR Heat Exchangers

The physical arrangement of the residual heat removal (RHR) heat exchangers shall, to the extent feasible be conducive to the performance of the required ultrasonic and surface examinations. Removable thermal insulation is provided for those welds and nozzles selected for frequent examination during the inservice inspection. Platforms and ladders are provided as necessary to facilitate examination.

145 d

6.6.2.2 Class 2 Piping, Pumps Valves and Supports

Physical arrangement of piping pumps and valves provide personnel access to each weld location for performance of ultrasonic and surface (magnetic particle or liquid penetrant) examinations and sufficient access to supports for performance of visual, VT-3, examination. Working platforms are provided in some areas to facilitate servicing of pumps and valves. Removable thermal insulation is provided on welds and components which require frequent access for examination or are located in high radiation areas. Welds are located to permit ultrasonic examination from at least one side, but where component geometries permit, access from both sides is provided.

Restrictions: For piping systems and portions of piping systems subject to volumetric and surface examination, the following piping designs are not used:

(1) Valve to valve
(2) Valve to reducer
(3) Valve to tee
(4) Elbow to elbow
(5) Elbow to tee
(6) Nozzle to elbow
(7) Reducer to elbow
(8) Tee to tee
(9) Pump to valve

Straight sections of pipe and spool pieces shall be added between fittings. The minimum length of the spool piece has been determined by using the formulate $L = 2T + 6$ inches, where L equals the length of the spool piece (not including weld preparation) and T equals the pipe wall thickness.

6.6.3 Examination Categories and Methods

6.6.3.1 Examination Categories

The examination category of each item is listed in Table 6.6-1 (provided as an example). The items are listed by system and line number where applicable. Table 6.6-1 also states the method of examination for each item.

145 E

6.6.3.2 Examination Methods

6.6.3.2.1 Visual Examination

Visual Examination Methods, VT-2 and VT-3, shall be conducted in accordance with ASME Section XI, IWA-2210. In addition, VT-2 examinations shall also meet the requirements of IWA-5240.

INSERTS FOR PAGE 6.6-2

145C. Items (1) through (4) above describe the Class 3 boundary only and are not exemptions as defined by Section XI of the ASME Boiler and Pressure Vessel Code.

145D. Items such as nozzle-to-vessel welds often have inherent access restrictions when vessel internals are installed therefore the preservice examination shall be performed on these items prior to installation of internals which would interfere with examination.

145E. For the preservice examination, all of the items selected for inservice examination shall be performed once in accordance with ASME Section XI, IWC-2200 an IWD-2200, with the exception of the examinations specifically excluded by ASME Section XI from preservice requirements, such as the visual VT-2 examinations for Category C-H, D-A, D-B and D-C.

At locations where leakages are normally expected and leakage collection systems are located, (e.g., valve stems and pump seals), the visual, VT-2, examination shall verify that the leakage collection system is operative.

Piping runs shall be clearly identified and laid out such that insulation damage, leaks and structural distress will be evident to a trained visual examiner.

6.6.3.2.2 Surface Examination

Magnetic Particle and Liquid Penetrant examination techniques shall be performed in accordance with ASME Section XI, IWA-2221 and IWA-2222, respectively. For direct examination access for magnetic particle (MT) and penetrant (PT) examination, a clearance (of at least 24 inches of clear space) is provided where feasible for the head and shoulders of a man within a working arm's length (20 inches) of the surface to be examined. In addition, access shall be provided as necessary to enable physical contact with the item as necessary to perform the examination. Remote MT and PT generally are not appropriate as a standard examination process, however, borescopes and mirrors can be used at close range to improve the angle of vision. As a minimum, insulation removal shall expose the area of each weld plus at least six inches from the toe of the weld on each side. Insulation will generally be removed 16 inches on each side of the weld.

6.6.3.2.3 Volumetric Ultrasonic Direct Examination

Volumetric ultrasonic direct examination shall be performed in accordance with ASME Section XI, IWA-2232. In order to perform the examination, visual access to place the head and shoulder within 20 inches of the area of interest shall be provided where feasible. Nine inches between adjacent pipes is sufficient spacing if there is free access on each side of the pipes. The transducer dimension has been considered: a 1 1/2 inch diameter cylinder, 3 inches long placed with the access at a right angle to the surface to be examined. The ultrasonic examination instrument has been considered as a rectangular box 12 x 12 x 20 inches located within 40 feet from the transducer. Space for a second examiner to monitor the instrument shall be provided if necessary.

Insulation removal for inspection is to allow sufficient room for the ultrasonic transducer to scan the examination area. A distance of 2T plus 6 inches, where T is the pipe thickness, is the minimum required on each side of the examination area. The insulation design generally leaves 16 inches on each side of the weld, which exceeds minimum requirements.

6.6.3.2.4 Alternative Examination Techniques

As provided by ASME Section XI, IWA-2240, alternative examination methods, a combination of methods, or newly developed techniques may be substituted for the methods specified for a given item in this section, provided that they are demonstrated to be equivalent or superior to the specified method. This provision allows for the use of newly developed examination methods, techniques, etc., which may result in improvements in examination reliability and reductions in personnel exposure.

6.6.3.2.5 Data Recording

Manual data recording will be performed where manual ultrasonic examinations are performed. If automated systems are used, electronic data recording and comparison analysis are to be employed with automated ultrasonic examination equipment. Signals from each ultrasonic transducer would be fed into a data acquisition system in which the key parameters of any reflectors will be recorded. The data to be recorded for manual and automated methods are:

(1) location;
(2) position;
(3) depth below the scanning surface;
(4) length of the reflector;
(5) transducer data including angle and frequency; and
(6) calibration data.

The data so recorded shall be compared with the results of subsequent examinations to determine the behavior of the reflector.

145 F

6.6.4 Inspection Intervals

6.6.4.1 Class 2 Systems

The inservice inspection intervals for Class 2 systems will conform to Inspection Program B as

INSERT FOR PAGE 6.6-3

(45F) 6.6.3.2.6 Qualification of Personnel and Examination Systems for Ultrasonic Examination

Personnel performing examinations shall be qualified in accordance with ASME Section XI, Appendix VII. Ultrasonic examination systems shall be qualified in accordance with an industry accepted program for implementation of ASME Section XI, Appendix VIII.

described in Section XI, IWC-2412. Except where deferral is permitted by Table IWC-2500-1, the percentages of examinations completed within each period of the interval shall correspond to Table IWC-2412-1. ~~Items selected to be examined within the 10 year intervals are selected in accordance with the requirements of Table IWC-2500-1 from those listed in Table 6.6-1.~~

145 G

6.6.4.2 Class 3 Systems

The inservice inspection intervals for Class 3 systems will conform to Inspection Program B as described in Section XI, IWD-2412. Except where deferral is permitted by Table IWD-2500-1, the percentages of examinations completed within each period of the interval shall correspond to Table IWD-2412-1. ~~Items selected to be examined within the 10 year intervals are selected in accordance with the requirements of Table IWD-2500-1 from those listed in Table 6.6-1.~~

145 H

6.6.5 Evaluation of Examination Results

Examination results will be evaluated in accordance with ASME Section XI, IWC-3000 for Class 2 components, with repairs based on the requirements of IWA-4000 and IWC-4000. Examination results will be evaluated in accordance with ASME Section XI, IWD-3000 for Class 3 components, with repairs based on the requirements of IWA-4000 and IWD-4000.

6.6.6 System Pressure Tests

6.6.6.1 System Inservice Test

As required by Section XI, IWC-2500 for category C-H and by IWD-2500 for categories D-A, D-B and D-C, a system inservice test shall be performed in accordance with IWC-5221 on Class 2 systems, and IWD-5221 on Class 3 systems, which are required to operate during normal operation. The system inservice test shall include all Class 2 or 3 components and piping within the pressure retaining boundary and shall be performed once during each inspection period as defined in Tables IWC-2412-1 and IWD-2412-1 for Program B. For the purposes of the system inservice test of Class 2 systems, the pressure retaining boundary is defined in Table IWC-2500-1, Category C-H, Note 7. For the purposes of the system inservice test for Class 3 systems, the system boundary is defined in Note 1 of Table IWD-2500-1, for categories D-A, D-B and D-C. The system inservice test shall include a VT-2 examination in accordance with IWA-5240, except that, where portions of a system are subject to system pressure tests associated with two different functions, the VT-2 examination shall only be performed during the test conducted at the higher of the test pressures. The system inservice test will be conducted at approximately the maximum operating pressure and temperature indicated in the applicable process flow diagram for the system as indicated in Table 1.7-1. The system hydrostatic test (Subsection 5.2.4.6.2), when performed is acceptable in lieu of the system inservice test.

6.6.6.2 System Functional Test

As required by Section XI, IWC-2500 for category C-H and by IWD-2500 for categories D-A, D-B and D-C, a system functional test shall be performed in accordance with IWC-5221 on Class 2 systems, and IWD-5221 on Class 3 systems, which are not required to operate during normal operation but for which a periodic system functional test is performed. The system functional test shall include all Class 2 or 3 components and piping within the pressure retaining boundary and shall be performed once during each inspection period as defined in Tables IWC-2412-1 and IWD-2412-1 for Program B. For the purposes of the system functional test of Class 2 systems, the pressure retaining boundary is defined in Table IWC-2500-1, Category C-H, Note 7. For the purposes of the system functional test for Class 3 systems, the system boundary is defined in Note 1 of Table IWD-2500-1, categories D-A, D-B and D-C. The system inservice test shall include a VT-2 examination in accordance with IWA-5240, except that, where portions of a system are subject to system pressure tests associated with two different functions, the VT-2 examination shall only be performed during the test conducted at the higher of the test pressures. The system functional test will be conducted at the nominal operating pressure and temperature indicated in the applicable process flow diagram for the functional test for each system as indicated in Table 1.7-1. The system hydrostatic test (Subsection 5.2.4.6.2), when performed is acceptable in lieu of the system inservice test.

6.6.6.3 Hydrostatic Pressure Tests

As required by Section XI, IWC-2500 for Category B-P, the hydrostatic pressure test shall be

INSERTS FOR PAGE 6.6-4

145 G. An example of the selection of Code Class 2 items and examinations to be conducted within the 10-year intervals are described in Table 5.2-8.

145 H. An example of the selection of Code Class 3 items and examinations to be conducted within the 10-year intervals are described in Table 5.2-8.

performed in accordance with ASME Section IWC-5222 on all Class 2 components and piping within the pressure retaining boundary once during each 10 year inspection interval. For purposes of the hydrostatic pressure test, the pressure retaining boundary is defined in Table IWB-2500-1, Category B-P, Note 1. The system hydrostatic test shall include a VT-2 examination in accordance with IWA-5240. For the purposes of determining the test pressure for the system hydrostatic test in accordance with IWB-5222 (a), the system design pressure as indicated on the applicable piping and instrumentation diagram for the system, as shown in Table 1.7-1, shall be used for P_{sv} in all cases.

6.6.7 Augmented Inservice Inspection

6.6.7.1 High Energy Piping

All high energy piping between the containment isolation valves are subject to the following additional inspection requirements:

All circumferential welds shall be 100 percent volumetrically examined each inspection interval as defined in Subsection 6.6.3.2.3. Further, accessibility, examination requirements and procedures shall be as discussed in Subsections 6.6.2, 6.6.3 and 6.6.5, respectively. Piping in these areas shall be seamless, thereby eliminating all longitudinal welds.

145
1

6.6.8 Code Exemptions

As provided in ASME Section XI, IWC-1220 and IWD-1220, certain portions of Class 2 and 3 systems are exempt from the volumetric and surface and visual examination requirements of IWC-2500 and IWD-2500. These portions of systems are specifically identified in Table 6.6-1

6.6.9 Relief Requests

6.6.9.1 Class 2 Hydrostatic Test Pressure

For portions of Class 2 systems, which cannot be isolated from the reactor vessel, such as the branch connection of line 25A-NB-728 to 50A-NB-129, the system hydrostatic test pressure shall be in accordance with the system hydrostatic test pressure requirements for the Class 1 system.

6.6.9.2 RHR Heat Exchanger Nozzle-to-Shell Welds

Due to the inherent geometry of vessel nozzles some of the weld required volume as specified in ASME Section XI, Table IWC-2500 for category C-B, may not be accessible for ultrasonic examination. The examination is conducted from the outside surface of the vessel and, as such, the outside radius of the nozzle forging may limit the movement of the ultrasonic search unit. The extent of the examination coverage limitation for each nozzle will be determined during the preservice examination of the vessel-to-nozzle welds.

INSERT FOR PAGE 6.6-5

145I. 6.6.7.2 Erosion-Corrosion

Piping systems determined to be susceptible to single-phase erosion-corrosion shall be subject to a program of nondestructive examinations to verify the system structural integrity. The examination schedule and examination methods shall be determined in accordance with applicable regulations and regulatory documents, such as NRC Bulletin 87-01, and applicable rules of Section XI of the ASME Boiler and Pressure Vessel Code.

6.7 HIGH PRESSURE NITROGEN GAS SUPPLY SYSTEM

6.7.1 Functions

The high pressure nitrogen gas supply system is divided into two independent divisions, with each division containing a safety-related emergency stored nitrogen supply. The essential stored nitrogen supply is Safety Class 3, Seismic Category I, designed for operation of the main steam S/R valve ADS function accumulators.

The function of the nonsafety-related, makeup nitrogen gas supply system is:

(1) relief function accumulators of main steam S/R valves,

(2) pneumatically operated valves and instruments inside the PCV,

(3) leak detection system radiation monitor calibration

(4) ADS function accumulators to compensate for the leakage from main steam S/R solenoid valves during normal operation

6.7.2 System Description

Nitrogen gas for the essential system is supplied from high pressure nitrogen gas storage bottles. Nitrogen gas for the nonessential makeup system is supplied from the nitrogen gas evaporator via the makeup line to the atmospheric control (AC) system. The essential system is separated into two divisions. There are tielines between the nonessential and each division of the essential system. Each tieline has a motor operated shutoff valve. For details, see Figure 6.7-1 and Table 6.7-1.

Each division of the essential system has ten bottles. Normally, outlet valves from five of the ten bottles are kept open. Each division has a pressure control valve to depressurize the nitrogen gas from the bottles.

The bottles are mechanically restrained to preclude generation of high-pressure missiles during an SSE. The bottles are also covered by a heavy steel plate, which serves as a barrier to potential missiles.

Flow rate and capacity requirements are divided into an initial requirement and a continuous supply. An initial requirement for each ADS SRV provides for actuations of the valve against drywell pressure. Fifty gallon accumulators supplied for each main steam ADS SRV actuator fulfill the steam valve requirement. The continuous supply is divided into safety and nonsafety portions.

Compressed nitrogen at a rate adequate to make up the nitrogen leakage of each serviced valve is provided by the safety portion. This assumes an air leakage rate for each valve of 1 scfh for a period of at least seven days. The essential system with associated lines, valves and fittings are classified as Safety Class 3, Seismic Category I.

The nonsafety portion provides compressed nitrogen at a rate adequate to recharge the ADS SRV accumulators. The nonessential system has two pressure control valves to depressurize the nitrogen gas from the AC system. One is to depressurize to 200 psi for the SRV accumulators and the other is to depressurize to 100 psi for other pneumatic uses.

The continuous supply portion of the pneumatic system, extending from the AC system to the isolation valve prior to the essential system is not safety related.

Nonsafety piping and valves of the system are designed to ANSI B31.1, Power Piping Code, and the requirements of Quality Group D of Regulatory Guide 1.26. Pressure vessels and heat exchangers are designed to ASME Section VIII, Division I.

System design pressure is 200 psig with the system design temperature at 150°F.

6.7.3 System Evaluation

Vessels, piping and fittings of the safety portion of the system are designed to Seismic

INSERT (7.3)

The nitrogen supply system shall supply nitrogen which is oil-free with a moisture content of less than 2.5 ppm.

9.3.9 Hydrogen Water Chemistry System

9.3.9.1 Design Bases

9.3.9.1.1 Safety Design Basis

The hydrogen water chemistry (HWC) system is non-nuclear, non-safety-related and is required to be safe and reliable, consistent with the requirement of using hydrogen gas. The hydrogen piping in the turbine building shall be designed to Seismic Category I requirements to comply with BTP 9.5-1.

9.3.9.1.2 Power Generation Design Basis

BWR reactor coolant is demineralized water, typically containing 100 to 200 parts per billion (ppb) dissolved oxygen from the radiolytic decomposition of water. To mitigate the potential for intergranular stress corrosion cracking (IGSCC) of sensitized austenitic stainless steels, the dissolved oxygen in the reactor water can be reduced to less than 20 ppb by the addition of hydrogen to the feedwater. The amount of hydrogen required is in the range of 1.0 to 1.5 ppm. The exact amount required depends on many factors including incore recirculation rates. The amount required will be determined by tests performed during the initial operation of the plant.

The concentration of hydrogen and oxygen in the main steam line and eventually in the main condenser is altered in this process. This leaves an excess of hydrogen in the main condenser that would not have equivalent oxygen to combine with in the offgas system. To maintain the offgas system near its normal operating characteristics, a flow rate of oxygen equal to approximately one-half the injected hydrogen flow rate is injected in the offgas system upstream of the recombiner.

The HWC system utilizes the guidelines given in EPRI report NP-5283-SR-A, "Guidelines for Permanent BWR Hydrogen Water Chemistry Installation".

9.3.9.2 System Description

The HWC system, illustrated in Figure 9.3-8, is composed of hydrogen and oxygen supply systems, systems to inject hydrogen in the feedwater and oxygen in the offgas and subsystems to monitor the effectiveness of the HWC system. These systems monitor the oxygen levels in the offgas system, the feedwater system, the lower plenum region and the CUW ~~RWCU~~ inlet, hydrogen and pH levels in the feedwater system, the lower plenum region and the CUW ~~RWCU~~ inlet, and crack growth of pre-cracked samples in water from the lower plenum region.

The hydrogen supply system will be site dependent. Hydrogen can be supplied either as a high pressure gas or as a cryogenic liquid. Hydrogen and oxygen can also be generated on site by the dissociation of water by electrolysis. The HWC hydrogen supply system is integrated with the generator hydrogen supply system to save the cost of having separate gas storage facilities for both systems.

The oxygen supply system will be site dependent. A single oxygen supply system could be provided to meet the requirements of HWC system and the condensate oxygen injection system described in Subsection 9.3.10.

9.3.9.3 Safety Evaluation

The operation of the HWC system is not necessary to assure:

(1) The integrity of the reactor coolant pressure boundary,

(2) The capability to shut down the reactor; or

(3) The capability to prevent or mitigate the consequences of events which could result in potential offsite exposures.

The HWC system is used, along with other measures, to reduce the likelihood of corrosion failures which would adversely affect plant availability. The means of storing and handling hydrogen shall utilize the guidelines in EPRI NP-5283-SR-A, "Guidelines for Permanent BWR Hydrogen Water Chemistry Installations".

9.3.9.4 Inspection and Testing Requirements

The HWC system is proved operable during the initial operation of the plant. During a refueling or maintenance outage, hydrogen injection is not required. System maintenance or testing can be performed during such periods.

100a and EPRI report NP-4947-SR, "BWR Hydrogen Water Chemistry Guidelines: 1987 Revision," October 1988.

100b and oxygen

9.3.9.5 Instrumentation and Controls

Automatic control features in the HWC system minimize the need for operator attention and improve performance. These are:

(1) Automatic variation of hydrogen and oxygen flow rates with reactor power level.

(2) Automatic oxygen injection rate change delay. This function is also augmented as a function of reactor power level.

(3) Automatic shutdown on several alarms.

(4) Isolation on system power loss, operator restart.

(5) Reprogrammable alarms and controller electronics.

(6) Hydrogen and oxygen flow monitor correction function to compensate for nonlinearities.

The recommended trips of the oxygen and hydrogen injection systems include:

(1) Reactor scram

(2) Low or high residual oxygen in the off-gas

(3) High area hydrogen concentration

(4) Low oxygen injection system supply pressure

(5) High hydrogen flow

The instrumentation provided includes:

(1) Flow monitors for measurement of hydrogen and oxygen flow rates.

(2) Hydrogen area monitor sensors to detect any hydrogen to the atmosphere.

(3) Pressure gages for measurement of hydrogen and oxygen supply pressures and instrument air pressure.

(4) An oxygen analyzer for measuring the percent oxygen leaving the offgas recombiner.

(5) Sensors for measuring dissolved oxygen content.

(6) Sensors for measuring pH and dissolved hydrogen.

(7) A system for verifying the effectiveness of HWC by measuring electrochemical potential (ECP) and crack growth rate.

9.3.10 Oxygen Injection System

9.3.10.1 Design Bases

The oxygen injection system is designed to add sufficient oxygen to the Condensate System to suppress corrosion and corrosion product release in the condensate and feedwater systems. Experience has shown that the preferred feedwater oxygen concentration is 20 to 50 ppb. During shutdown and startup operation the feedwater oxygen concentration is usually much above the 20 to 50 ppb range. However, during power operation, deaeration in the main condenser may reduce the condensate oxygen concentration below 20ppb, thus, requiring that some oxygen be added. The amount required is up to approximately 5 cubic feet per hour.

9.3.10.2 System Description

The oxygen supply consists of high pressure gas cylinders ~~or a liquid tank~~. A condensate oxygen injection module is provided with pressure regulators and associated piping, valves, and controls to depressurize the gaseous oxygen and route it to the condensate injection modules. There are check valves and isolation valves between the condensate injection modules and the condensate lines downstream of the condensate demineralizers and the optional injection point upstream of the filters. (101)

The flow regulating valves in this system are operated from the main control room. The oxygen concentration in the condensate/feedwater system is monitored by analyzers in the sampling system (Subsection 9.3.2). An operator will make changes in the oxygen injection rate in response to changes in the condensate/feedwater concentration. An automatic control system is not required because instantaneous changes in oxygen injection rate are not required.

INSERT (101)

The oxygen injection system shall use the guidelines for gaseous oxygen injection systems in EPRI report NP-5283-SR-A, "Guidelines for Permanent Hydrogen Water Chemistry Installations - 1987 Revision," September 1987.

9.5.13.5 Vendor Specific Design of Diesel Generator Auxiliaries

The vendor-specific diesel generator support systems (i.e., the D/G fuel oil system, the D/G cooling water system, the D/G starting air system, the D/G lubrication system, the D/G combustion air intake and exhaust system) shall be reviewed for differences in design with those discussed in Subsections 9.5.4 through 9.5.8, respectively. A discussion of such differences shall be provided.

Specific NRC requested information lists as follows:

81 (1) ~~Type of fuel transfer pump,~~ (Deleted)

82 (2) Provision for stick gauges on fuel storage tanks,

(3) Description of engine cranking devices,

89 (4) Duration of cranking cycle and number of engine revolutions ~~and~~ per start attempt,

92 (5) Lubrication system design criteria ~~and protective features.~~ (pump flows, operating pressure temperature differentials, cooling system heat removal capabilities, electric heater characteristics),

(6) Selection of a combustion air flow capacity sufficient to assure complete combustion,

89 (7) Volume and design pressure of the air receivers (sufficient for 5 start cycles per receiver), and

(8) Compressor size (sufficient discharge flow to recharge the system in 30 minutes or less).

9.5.13.6 Diesel Generator Cooling Water System Design Flow and Heat Removal Requirements

A table shall be provided which identifies the design flow and heat removal requirements for the diesel generator cooling water system. It shall include the design heat removal capacities of all the coolers or heat exchangers in the system.

Specific NRC requested information lists as follows:

(1) Type of jacket water circulating pumps (i.e., motor-driven or others),

86 (2) Type of temperature sensors, (use "Amot" brand or equal per NUREG/CR-0660, Page V-17, Recommendation under Item 4),

(3) Expansion tank capacity,

(4) NPSH of jacket water circulating pump, and

95 (5) Cooling water loss estimates.

9.5.13.7 Fire Rating for Penetration Seals

The applicant referencing the ABWR design shall provide 3-hour fire rated penetration seals for all high energy piping or, as a minimum, state those conditions when such seals cannot be provided and what will be installed as a substitute. The detail design shall provide completely equivalent construction to tested wall assemblies or testing will be required.

9.5.13.8 Diesel Generator Requirements

(1) the diesel generator operating procedures for a particular diesel-engine make and model shall require loading of the engine up to a minimum of 40% of full load (or lower load per manufacturer's recommendation) for 1 hour after up to 8 hours of continuous no-load or light load operation.

(2) selection of diesel generator shall include prudent component design with dust tight enclosures. Construction guidelines shall include provisions for minimizing accumulation of dust and dirt into equipment.

(3) the diesel generator operating procedure shall include provisions to avoid as much as possible or otherwise restrict the no-load or low-load operation of the engine/generator for prolonged periods of time: or operate the engine at nearly full-load following every no-load or low-load (20% or less) operation lasting for a period of 30 minutes or more.

9.5.13.9 Applicant Fire Protection Program

The following areas are out of the ABWR Standard Plant design scope, and shall be included in the applicant fire protection program.

(1) Main transformer

(2) Equipment entry lock

(3) Fire protection pumphouse

(4) Ultimate heat sink

430.315 The applicant's fire protection program shall comply with the SRP Section 9.5.1, with ability to bring the plant to safe shutdown condition following a complete fire burnout without a need for recovery.

9.5.13.10 HVAC Pressure Calculations

430.20 The applicant referencing the ABWR design shall provide pressure calculations and confirm capability during pre-operational testing of the smoke control mode of the HVAC systems as described in Subsection 9.5.1.0.6.

9.5.13.11 Plant Security Systems Criteria

The design of the security system shall include an evaluation of its impact on plant operation, testing, and maintenance. This evaluation shall assure that the security restrictions for access to equipment and plant regions is compatible with required operator actions during all operating and emergency modes of operation (i.e., loss of offsite power, access for fire protection, health physics, maintenance, testing and local operator). In addition, this evaluation shall assure that:

910.10 (a) There are no areas within the Nuclear Island where communication with central and secondary alarm stations is not possible;

(b) Portable security radios will not interfere with plant monitoring equipment;

(c) Minimum isolation zone and protected area illumination capabilities cannot be defeated by sabotage actions outside of the protected area; and,

(d) Electromagnetic interference from plant equipment startups or power transfers will not create nuisance alarms or trip security access control systems.

9.5.13.12 Fire Hazard Analysis

A compliance review of the as built design against the assumptions and requirements stated in the fire hazard analysis (Appendix 9A) shall be conducted. Any non compliance shall be documented as being required and acceptable on the basis of the Fire Hazard Analysis, Appendix 9A, and the Fire Hazard Probabilistic Risk Assessment, Appendix 19M.

9.5.13.13 Diesel fuel refueling procedures

Procedures shall be established to verify that the day tank is full prior to refilling the storage tank. This minimizes the likelihood of sediment obstruction of fuel lines and any deleterious impacts on diesel generator operation.

9.5.14 References

1. Stello, Victor, Jr., *Design Requirements Related To The Evolutionary Advanced Light Water Reactors (ALWRS)*, Policy Issue, SECY-89-013, The Commissioners, United States Nuclear Regulatory Commission, January 19, 1989.

2. Cote, Authur E., *NFPA Fire Protection Handbook*, National Fire Protection Association, Sixteenth Edition.

3. *Design of Smoke Control Systems for Buildings*, American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc., September 1983.

4. *Recommended Practice for Smoke Control Systems*, NFPA 92A, National Fire Protection Association, 1988.

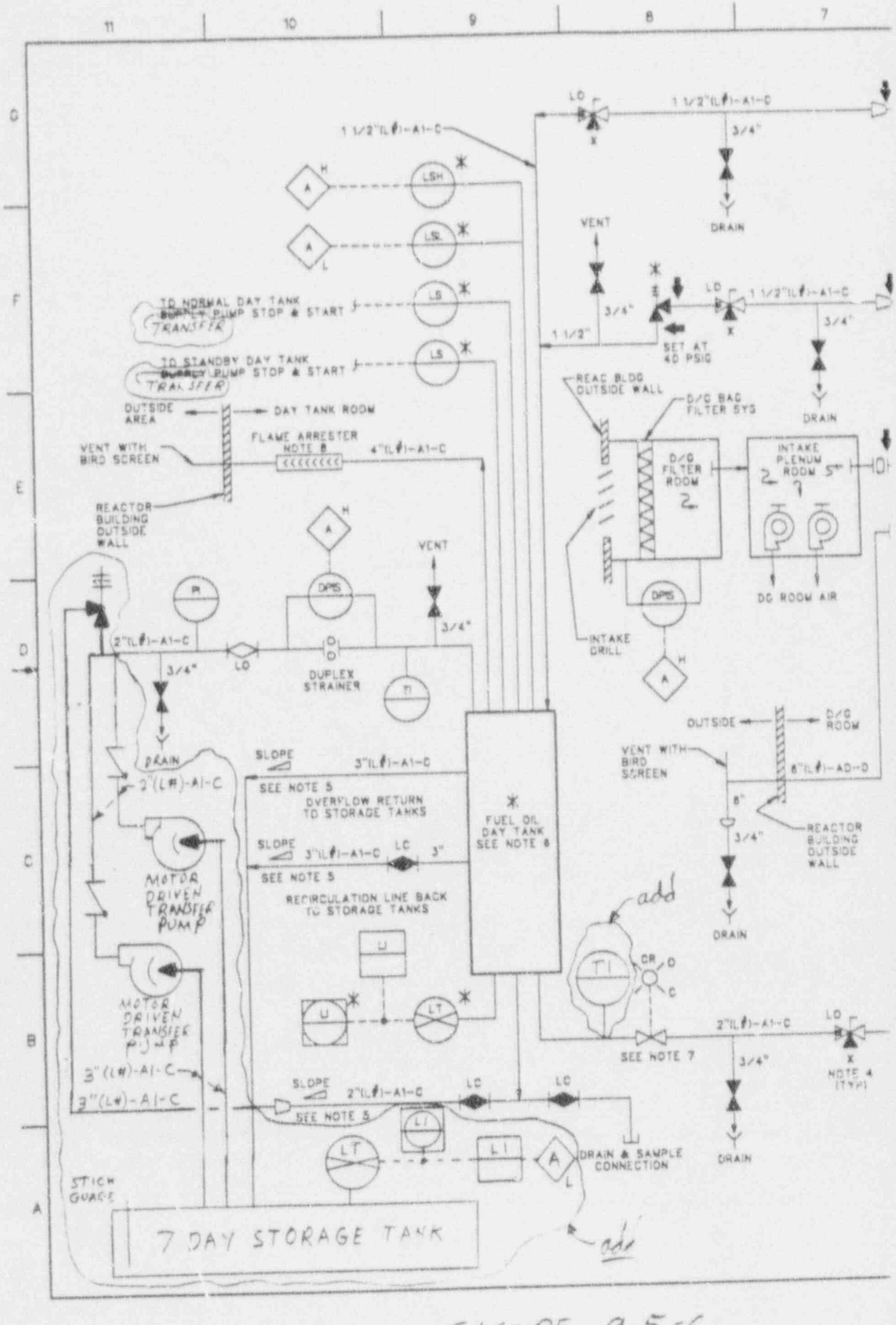

1 1/2"(L#)-A1-C
LO
3/4"
DRAIN
VENT
LSH
LSL
LS
TO NORMAL DAY TANK SUPPLY PUMP STOP & START
TRANSFER
TO STANDBY DAY TANK SUPPLY PUMP STOP & START
TRANSFER
SET AT 40 PSIG
OUTSIDE AREA
DAY TANK ROOM
REAC BLDG OUTSIDE WALL
D/G BAG FILTER SYS
VENT WITH BIRD SCREEN
FLAME ARRESTER NOTE 8
4"(L#)-A1-C
D/G FILTER ROOM
INTAKE PLENUM ROOM
REACTOR BUILDING OUTSIDE WALL
DG ROOM AIR
PI
DPIS
2"(L#)-A1-C
DUPLEX STRAINER
TI
INTAKE GRILL
OUTSIDE
D/G ROOM
8"(L#)-AD-D
SLOPE
3"(L#)-A1-C
SEE NOTE 5
OVERFLOW RETURN TO STORAGE TANKS
FUEL OIL DAY TANK SEE NOTE 6
3"(L#)-A1-C
RECIRCULATION LINE BACK TO STORAGE TANKS
MOTOR DRIVEN TRANSFER PUMP
add
SEE NOTE 7
NOTE 4 (TYP)
LT
LI
DRAIN & SAMPLE CONNECTION
STICK GUAGE
7 DAY STORAGE TANK

FIGURE 9.5-6

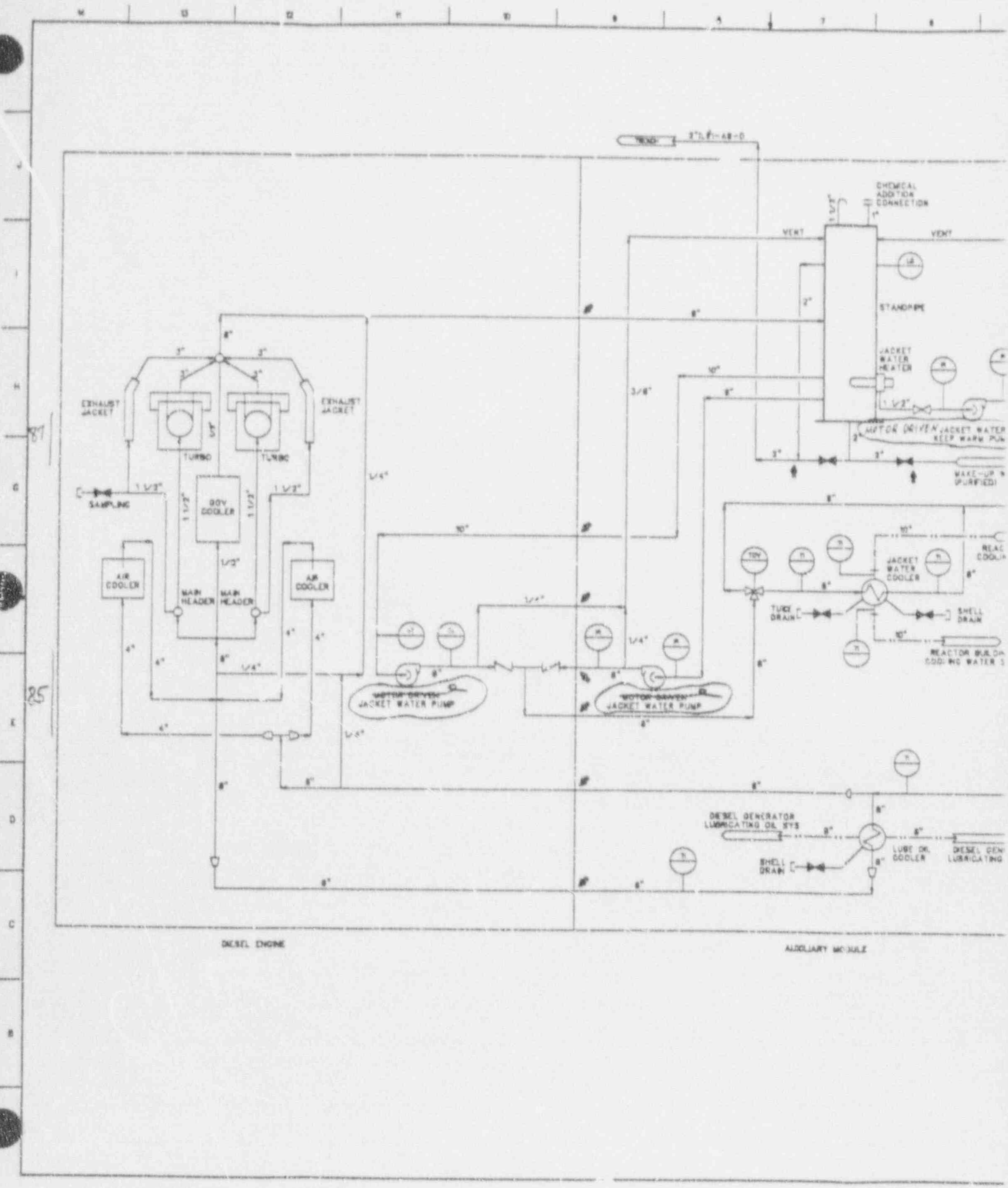
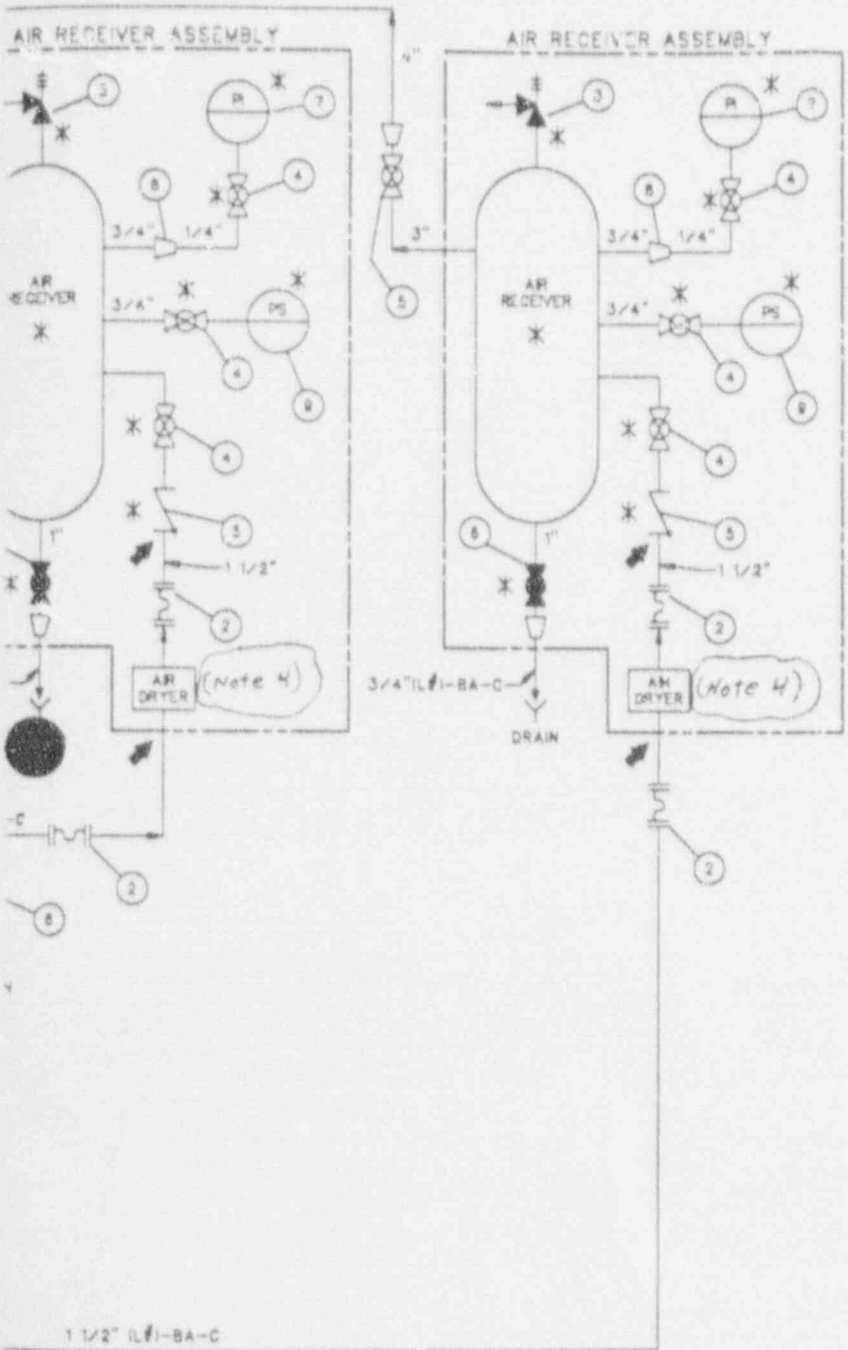


Figure 9.5-7 STANDBY DIE

6	5	4	3	2	1



NOTES:

1. EQUIPMENT WITHIN DIESEL ENGINE OUTLINE FURNISHED ON ENGINE BY SELLER.
2. * DESIGNATED EQUIPMENT FURNISHED BY DIESEL GENERATOR SELLER. CLASSIFICATION IS SAFETY CLASS 3, QUALITY GROUP C.
3. FUTURE LINE NUMBERS ARE REPRESENTED BY "(L#)" TO BE SUPPLIED AT FINAL DESIGN STAGE.
4. Air dryers shall be equipped with pre and after filters to remove oil, waste, dust and any pipe scale from the air stream. 88

LEGEND:

(1) STARTING AIR COMPRESSOR IS MOTOR DRIVEN
(2) FLEXIBLE CONNECTION
(3) RELIEF VALVE
(4) SERVICE VALVE
(5) CHECK VALVE
(6) DRAIN VALVE
(7) PRESSURE INDICATOR
(8) REDUCER
(9) PRESSURE SWITCH (AIR COMPRESSOR CONTROL)

◄ --- DENOTES PIPING SPEC CHANGE

MPL NO. R43-1050

430.266, 430.286

91-120-23

Figure 9.5-8 STANDBY DIESEL GENERATOR STARTING AIR SYSTEM

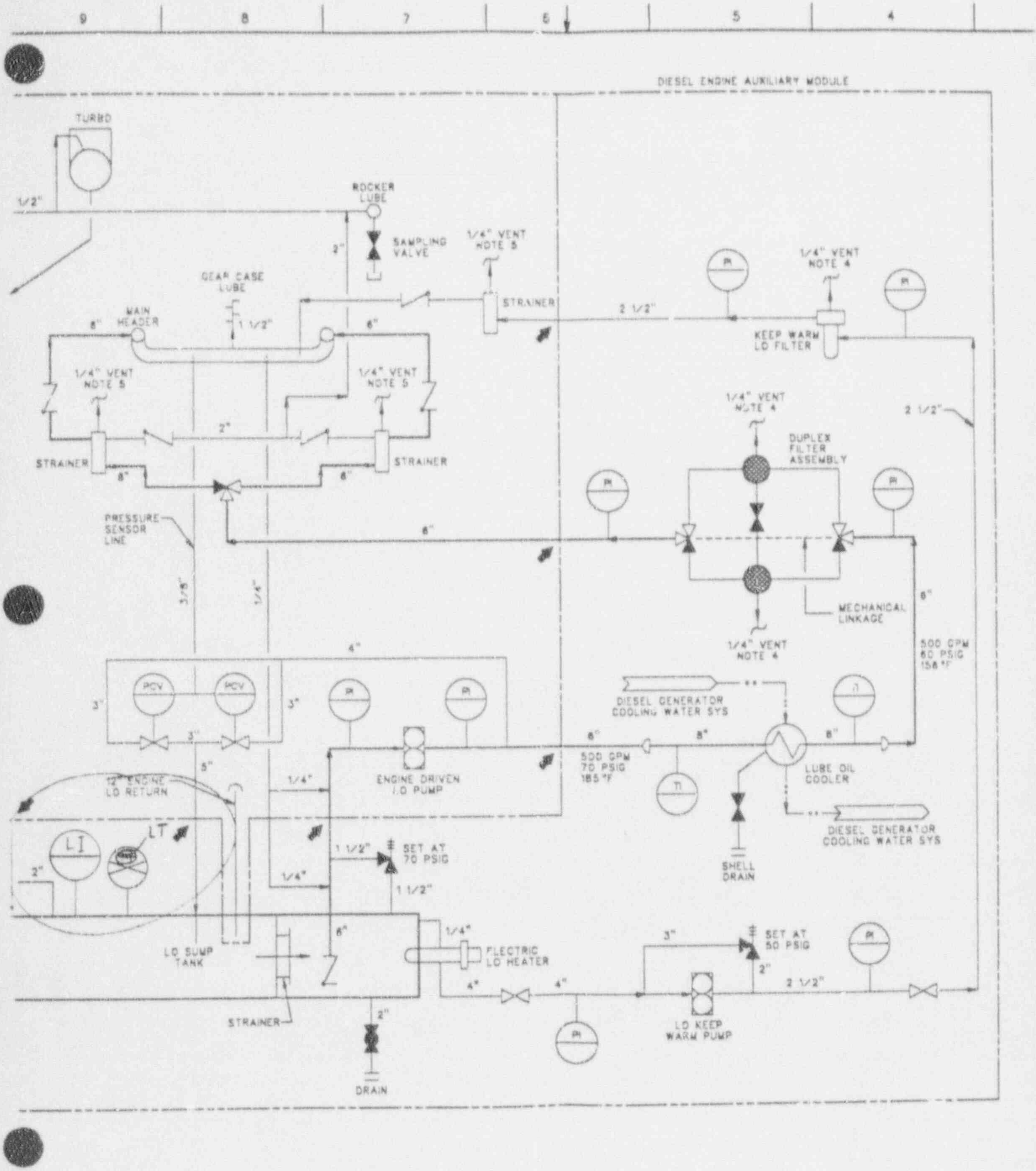
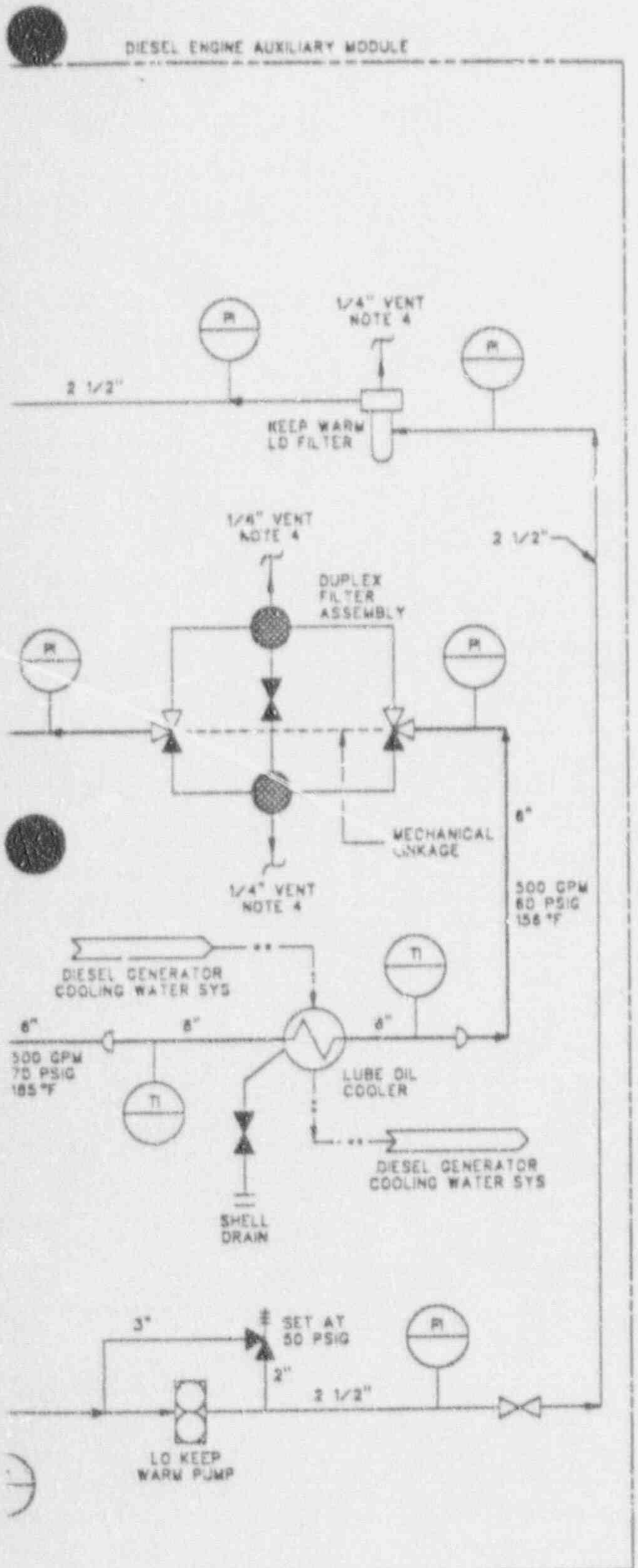


Figure 9.5–9 STANDBY DI

91

5	4	3	2	1



NOTES:

1. ALL EQUIPMENT, PIPING, INSTRUMENTS & CONTROLS WITHIN DIESEL ENGINE OUTLINE AND AUXILIARY MODULE OUTLINE ARE FURNISHED BY THE DIESEL ENGINE SELLER EXCEPT FOR SUMP TANK VENT.
2. ALL EQUIPMENT, PIPING AND INSTRUMENTS (AND PIPING) WITHIN AUXILIARY MODULE OUTLINE IS ASME SECTION III CLASS 3. COMPONENTS WITHIN THE DIESEL ENGINE OUTLINE SHALL MEET THE REQUIREMENTS OF ANSI B31.1 AND PRESSURE TESTED TO 1.5 TIMES DESIGN PRESSURE.
3. FOR SPECIFICS OF DIESEL GENERATOR CONTROL SYSTEMS, SEE SELLER'S (SHALL BE) CONTROL PANEL SCHEMATICS.
4. FILTER AND STRAINER VENTS ARE TO BE CONNECTED INDIVIDUALLY TO LO SUMP TANK TOP WITHOUT VALVES.
5. ENGINE STRAINERS ARE TO BE CONNECTED INDIVIDUALLY WITHOUT VALVES TO ENGINE GEAR CASE.
6. FUTURE LINE NUMBERS ARE REPRESENTED BY "(L#) TO BE SUPPLIED AT FINAL DESIGN STAGE.

93

LEGEND:

◄ --- DENOTES PIPING SPEC CHANGE

MPL NO. R43-1080

430.266, 430.291

91-120-24

Figure 9.5-9 STANDBY DIESEL GENERATOR LUBRICATING OIL SYSTEM

being cleaned, emptied or refilled. The service run for each polisher vessel is terminated by either high differential pressure across the vessel or high conductivity or sodium content in the polisher effluent water. Alarms for each of these parameters are provided on the local control panel.

The local control panel is equipped with the appropriate instruments and controls to allow the operators to perform the following operations:

(1) Remove an exhausted polisher from service and replace it with a standby unit

(2) Transfer the resin inventory of any polisher vessel into the resin receiver tank for mechanical cleaning or disposal.

(3) Process the as received resin through the ultrasonic resin cleaner as it is transfered from the receiver tank to the storage tank.

(4) Transfer the resin storage tank resins to any polisher vessel.

(5) Transfer exhausted resin from the receiver tank to the radwaste system.

On termination of a service run, the exhausted polisher vessel is taken out of service, and the standby unit is placed in service by remote manual operation from the local control panel. The resin from the exhausted vessel is transferred to the resin receiver tank and replaced by a clean resin bed that is transferred from the resin storage tank. A final rinse of the new bed is performed in the polisher by
281.10 condensate full flow recycle to the condenser before it is placed in service. The rinse is monitored by conductivity analyzers, and the process is terminated when the required minimum rinse has been completed and normal clean bed conductivity is obtained.

Through periodic condensate makeup and reject, the condensate storage tank water inventory is processed through the CCS and tank water quality is maintained as required for condensate makeup to the cycle and miscellaneous condensate supply services. The diagram of the condensate storage and transfer system is illustrated in Figure 10.4-5.

The condensate cleanup and related support systems wastes are processed by the radwaste system as described in Chapter 11.

10.4.6.3 Evaluation

condensate system corrosion products and impurities from condenser leakage in addition to

The CCS does not serve or support any safety function and has no safety design basis.

The condensate cleanup system removes some radioactive material, activated corrosion products and fission products that are carried-over from the reactor. While these radioactive sources do not affect the capacity of the resin, the concentration of such radioactive material requires shielding (see Chapter 12). Vent gases and other wastes from the condensate cleanup system are collected in controlled areas and sent to the radwaste system for treatment and/or disposal. Chapter 11 describes the activity level and removal of radioactive material from the condensate system.

The condensate cleanup system complies with Regulatory Guide 1.56, *Maintenance of Water Purity in Boiling Water Reactors*, and EPRI NP-4947-SR, "BWR Hydrogen Water Chemistry Guidelines: 1987 Revision, October 1988.

The condensate cleanup system and related support facilities are located in non-safety related buildings. As a result, potential equipment or piping failures can not affect plant safety.

10.4.6.4 Tests and Inspections

Preoperational tests are performed on the condensate cleanup system to ensure operability, reliability, and integrity of the system. Each polisher vessel and system support equipment can be isolated during normal plant operation to permit testing and maintenance.

10.4.6.5 Instrumentation Applications

Conductivity elements are provided for the system influent and for each polisher vessel effluent. System influent conductivity detects condenser leakage; whereas, polisher effluent conductivities provide indication of resin exhaustion. The polisher effluent conductivity elements also monitor the quality of the condensate that is recycled to the condenser after processing through a standby vessel before it is returned to service. Differential pressure is monitored across each polisher vessel and each vessel discharge resin strainer to detect blockage of flow. The flow through each polisher is monitored and used as control input to assure even distribution of condensate flow through all operating vessels and by correlation with the vessel pressure drop, to

designs. During the construction and testing phases of the plant cycle GE personnel are onsite to offer consultation and technical direction with regard to GE supplied systems and equipment. The GE resident site manager is responsible for all GE supplied equipment disposition and as the senior NSSS vendor representative onsite is the official site spokesman for GE. He coordinates with the plant owner's normal and augmented plant staff for the performance of his duties which are as follows:

(1) reviewing and approving all test procedures, changes to test procedures, and test results; [INSERT A]

(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 (SCG). [INSERT B]

14.2.2.4 Others

Other concerned parties, outside the plant staff organization, such as the architect-engineer, the constructor, the turbine-generator supplier, and vendors of other system and equipment, will be involved in the testing program to various degrees. Such involvement may be in a direct role in the startup group as discussed above or in an indirect capacity offering consultation or technical direction concerning the testing, operation, or resolution of problems or concerns with equipment and systems for which they are responsible or are uniquely familiar with.

14.2.2.5 Interrelationships and Interfaces

Effective coordination between the various site organizations involved in the test program is achieved through the SCG which is composed of representatives of the plant owner/operator, 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.

14.2.3 Test Procedures

In general, testing during all phases of the initial test program is conducted using detailed, step by step written procedures to control the conduct of each test. Such test procedures specify testing prerequisites, describe desired initial conditions, include appropriate methods to direct and 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. The procedures will be developed and reviewed by personnel with appropriate technical backgrounds and experience. This includes the participation of principal design organizations in the establishment of test ~~performance requirements and acceptance criteria~~. [INSERT C] Available information on operating and testing experiences of operating power reactors will be factored into test procedures as appropriate. Test procedures will be reviewed by the SCG and will receive final approval by designated plant management personnel. Approved test procedures for satisfying the commitments of this chapter will be made available to the NRC staff approximately 60 days prior to their intended use; [INSERT D]

14.2.4 Conduct of Test Program

The initial test program is conducted by the startup group in accordance with the startup administrative manual. This manual contains the administrative procedures and requirements that govern the activities of the startup group and their interfaces with other organizations. The startup administrative manual receives the same level of review and approval as do other plant administrative procedures. It defines the specific format and content of preoperational and startup test procedures as well as the review and approval process for both initial procedures and subsequent revisions or changes. The startup manual also specifies the process for

14.2.2.3 General Electric Company

INSERT A

for equipment and systems within the GE scope of supply;

INSERT B

[Note: The official designation of this group may differ for the plant owner/operator referencing the ABWR Standard Plant design and SCG is used throughout this discussion for illustrative purposes only]

14.2.3 Test Procedures

INSERT C

Specifically, GE will provide the plant owner/operator referencing the ABWR Standard Plant design with scoping documents (i.e. preoperational and startup test specifications) containing testing objectives and acceptance criteria applicable to its scope of design responsibility. Such documents shall also include, as appropriate, delineation of specific plant operational conditions at which tests are to be conducted, testing methodologies to be utilized, specific data to be collected, and acceptable data reduction techniques.

INSERT D

for preoperational tests and 60 days prior to scheduled fuel loading for power ascension tests.

review and approval of test results and for resolution of failures to meet acceptance criteria and of other operational problems or design deficiencies noted. It describes the various phases of the initial test program and establishes the requirements for progressing from one phase to the next as well as those for moving beyond selected hold points or milestones within a given phase. It also describes the controls in place that will assure the as-tested status of each system is known and that will track modifications, including retest requirements, deemed necessary for systems undergoing or already having completed specified testing. Additionally, the startup manual delineates the qualifications and responsibilities of the different positions within the startup group. The startup administrative procedures are intended to supplement normal plant administrative procedures by addressing those concerns that are unique to the startup program or that are best approached in a different manner. To avoid confusion, the startup program will attempt to be consistent with normal plant procedure where practical. The plant staff will typically carry out their duties according to normal plant procedures. However, in areas of potential conflict with the goals of the startup program, the startup manual or the individual test procedures will address the required interface.

14.2.5 Review, Evaluation, and Approval of Test Results

Individual test results are evaluated and reviewed by cognizant members of the startup group. Test exceptions or acceptance criteria violations are communicated to the affected and responsible organizations who will help resolve the issues by suggesting corrective actions, design modifications, and retests. GE and others outside the plant staff organization, as appropriate, will have the opportunity to review the results for conformance to predictions and expectations. Test results, including final resolutions, are then reviewed and approved by designated startup group supervisory personnel. Final approval is obtained from the SCG and the appropriate level of plant management as defined in the startup administrative manual. The SCG and the designated level of plant management will also have responsibility for final review and approval of overall test phase results and of that for selected milestones or hold points within the test phases.

14.2.6 Test Records

Initial test program results are compiled and maintained according to the startup manual, plant administrative procedures, and applicable regulatory requirements. Test records that demonstrate the adequacy of safety-related components, systems and structures ~~should~~ shall be retained for the life of the plant. Retention periods for other test records will be based on consideration of their usefulness in documenting initial plant performance characteristics.

14.2.7 Conformance of Test Program with Regulatory Guides

The NRC Regulatory Guides listed below were used in the development of the initial test program and the applicable tests comply with these guides except as noted. The applicable revisions of the regulatory guides listed below can be found in Table 1.8-20.

(1) Regulatory Guide 1.68--*Initial Test Programs for Water-Cooled Nuclear Power Plants.*

(2) Regulatory Guide 1.68.1--*Preoperational and Initial Startup Testing of Feedwater and Condensate Systems for Boiling Water Reactor Power Plants.*

(3) Regulatory Guide 1.68.2--*Initial Startup Test Program to Demonstrate Remote Shutdown Capability for Water-Cooled Nuclear Power Plants.*

(4) Regulatory Guide 1.68.3--*Preoperational Testing of Instrument and Control Air Systems.*

(5) Regulatory Guide 1.20--*Comprehensive Vibration Assessment Program for Reactor Internals During Preoperation and Initial Startup Testing.*

(6) Regulatory Guide 1.41--*Preoperational Testing of Redundant Onsite Electric Power Systems to Verify Proper Load Group Assignments.*

(7) Regulatory Guide 1.52--*Design, Testing, and Maintenance Criteria for Engineered-Safety-Feature Atmosphere Cleanup System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants.*

(8) Regulatory Guide 1.56--*Maintenance of Water Purity in Boiling Water Reactors.*

(9) Regulatory Guide 1.95--*Protection of Nuclear Power Plant Control Room Operators Against an Accidental Chlorine Release.*

(10) Regulatory Guide 1.108--*Periodic Testing of Diesel Generators Used as Onsite Electric Power Systems at Nuclear Power Plants.*

(11) Regulatory Guide 1.139--*Guidance for Residual Heat Removal.*

(12) Regulatory Guide 1.140--*Design, Testing and Maintenance Criteria for Normal Ventilation Exhaust System Air Filtration and Absorbtion Units of Light Water Cooled Nuclear Power Plants.*

14.2.8 Utilization of Reactor Operating and Testing Experience in the 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 ABWR plants have the benefits of experience acquired with the successful and safe startup of more than 30 previous BWR/1/2/3/4/5/6 plants. The operational experience and knowledge gained from these plants and other reactor types has been factored into the design and test specifications of GE supplied systems and equipment that will be demonstrated during the preoperational and startup test programs. Additionally, reactor operating and testing experience of similar nuclear power plants obtained from NRC Licensee Event Reports and through other industry sources will be utilized to the extent practicable in developing and carrying out the initial test program.

14.2.9 Trial Use of Plant Operating and Emergency Procedures

To the extent practicable throughout the preoperational and initial startup test program, test procedures will 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.

A testing procedure utilizing an operating, emergency, or abnormal procedure will reference the procedure directly, extract a series of steps from the procedure, or both in a way that is optimum to accomplishing the above goals while efficiently performing the specified testing.

14.2.10 Initial Fuel Loading and Initial Criticality

Fuel loading and initial criticality are conducted in a very controlled manner in accordance with specific written procedures as part of the startup test phase (see Subsection 14.2.12.2). Approval for commencement of fuel loading ~~typically~~ is granted by the NRC, ~~via the issuance of an operating license,~~ after all prerequisite testing has been satisfactorily completed. However, there may be unforeseen circumstances that arise that would prevent the completion of all preoperational testing (including the review and approval of the test results) that would not necessarily justify the delay of fuel loading. Under such circustances, the applicant referencing the ABWR design may decide to request permission from the NRC to proceed with fuel loading. If portions of any preoperational tests are intended to be conducted, or their results approved, after commencement of fuel loading, then the following shall be documented in such a request: (1) list each test; (2) state which portions of each test will be delayed until after fuel loading; (3) provide technical justification for delaying these portions; and (4) state when each test will be completed and the results approved.

14.2.10.1 Pre-Fuel Load Checks

Once the plant has been declared ready to load fuel, there are a number of specific checks that ~~should~~ be made prior to proceeding. These include a final review of the preoperational test results and the status of any design changes, work packages, and/or retests that were initiated as a result of exceptions noted during this phase. Also, the technical specifications surveillance program requirements, as described in Chapter 16, shall be instituted at this time to assure the operability of systems required for fuel loading. Just prior to the initiation ~~of fuel loading~~ the proper vessel water level and chemistry ~~should~~ be verified and the calibration and response of nuclear instruments should be checked.

shall

14.2.10.2 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 being identified by number before being placed in the correct coordinate position. The procedure controlling this movement will specify that shutdown margin and subcritical checks be made at predetermined intervals throughout the loading, thus ensuring safe loading increments. In-vessel neutron monitors provide continuous indication 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.

14.2.10.3 Pre-Criticality Testing

Prior to initial criticality the shutdown margin ~~should~~ be verified for the fully loaded core. The control rods ~~should~~ be functional and scram tested with the fuel in place. The post fuel load flow test of the reactor internals vibration assessment program ~~should~~ be conducted at this time as well. Additionally, a final verification that the required technical specification surveillances have been performed ~~should~~ be made.

14.2.10.4 Initial Criticality

Initial criticality shall be achieved in an orderly, controlled fashion following specific detailed procedures in an approved rod withdrawal sequence. Core neutron flux shall be continuously monitored during the approach to criticality and periodically compared to predictions to allow early detection and evaluation of potential anomalies.

14.2.11 Test Program Schedule

The schedule, relative to the initial fuel load date, for conducting each major phase of the initial test program will be provided by the applicant ~~for the construction permit or operating license~~. This includes the timetable for generation, review, and approval of procedures as well as the actual testing and analysis of results. As a minimum, at least 9 months should be allowed for conducting the preoperational phase prior to the fuel loading date and at least 3 months should be allowed for conducting the startup and power ascension testing that commences with fuel loading. To allow for NRC review, test procedure preparation will be scheduled such that approved procedures are available approximately 60 days prior to their intended use or 60 days prior to fuel load for power ascension test procedures. Although there is considerable flexibility available in the sequencing of testing within a given phase there is also a basic order that will result in the most efficient schedule. During the preoperational phase, testing should be performed as system turnover from construction allows. However, the interdependence of systems should also be considered so that common support systems, such as electrical power distribution, service and instrument air, and the various makeup water and cooling water systems, are tested as early as possible. Sequencing of testing during the startup phase will depend primarily on specified power and flow conditions and intersystem prerequisites. To the extent practicable, the schedule should establish that, prior to exceeding 25% power, the test requirements will be met for those plant structures, systems, and components that are relied on to prevent, limit, or mitigate the consequences of postulated accidents. Additionally, testing ~~should~~ be sequenced so that the safety of the plant is never totally dependent on untested systems, components, or features. The detailed testing schedule will be generated and maintained at the job site so that it may be updated and continually optimized to reflect actual progress and subsequent revised projections.

14.2.12 Individual Test Descriptions

To insure that the tests are conducted in accordance with established acceptance criteria, the plant and system preoperational and startup test specifications will be made available to the NRC resident site inspector.

14.2.12.1 Preoperational Test Procedures

The following general descriptions relate the 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.

14.2.11 Test Program Schedule

INSERT E

Power ascension testing will be conducted in essentially three phases: 1) initial fuel loading and open vessel testing; 2) Testing during nuclear heatup to rated temperature and pressure; and, 3) power operation testing from 5% to 100% rated power. Further, power operation testing will be divided into three sequential testing plateaus as shown on Figure 14.2-1. The testing plateaus consist of low power testing at less than 25% power, mid power testing up to about 75% power between approximately the 50% and 75% rod lines, and high power testing along the 100% rod line up to rated power. Thus, there will be a total of five different testing plateaus designated as described on Figure 14.2-1. Table 14.2-1 indicates in which testing plateaus the various power ascension tests will be performed. Although the order of testing within a given plateau is somewhat flexible, the normal recommended sequence of tests would be: 1) core performance analysis; 2) steady state tests; 3) control system tuning; 4) system transient tests; and, 5) major plant transients (including trips). Also, for a given testing plateau, testing at lower power levels should generally be performed prior to that at higher power levels. The detailed testing schedule will be generated by the applicant referencing the ABWR Standard Plant design and will be made available to the NRC prior to actual implementation. The schedule will then be ~~and~~ maintained at the job site so that it may be updated and continually optimized to reflect actual progress and subsequent revised projections.

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

[INSERT F] The preoperational tests anticipated for the ABWR Standard Plant are listed and described in the following paragraphs. Testing of systems outside the scope of the ABWR Standard Plant, but that may have related design and therefore testing requirements, are discussed in Subsection 14.2.13, along with other interface requirements related to the initial test program.

14.2.12.1.1 Nuclear Boiler System Preoperational Test

(1) Purpose

To verify that all pumps, valves, actuators, instrumentation, trip logic, alarms, annunciators, and indications associated with the nuclear boiler system function as specified.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. All required interfacing systems shall be available, as needed, to support the specified testing and the appropriate system configurations.

(3) General Test Methods and Acceptance Criteria

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) verification that all sensing devices respond to actual process variables and provide alarms and trips at specified values;

(b) proper operation of system instrumentation and any associated logic, including that of the automatic depressurization system (ADS);

(c) proper operation of MSIVs and main steamline drain valves, including verification of closure time in the isolation mode, and test mode, if applicable;

(d) verification of SRV and MSIV accumulator capacity;

(e) proper operation of SRV air piston actuators and discharge line vacuum breakers;

(f) verification of the acceptable leak tightness and overall integrity of the reactor coolant pressure boundary via the leakage rate and/or hydrstatic testing as described in Section 5.2.4.6.1 and 5.2.4.6.2 respectively; and

(g) proper system instrumentation and equipment operation while powered from primary and alternate sources, including transfers, and in degraded modes for which the system and/or components are expected to remain operational.

Other checks ~~should~~ shall be performed, as appropriate, to demonstrate that design requirements, such as those for sizing or installation, are met via as built calculations, visual inspections, review of qualification documentation or other methods. For instance, SRV setpoints and capacities ~~should~~ shall be verified from certification or bench tests to be consistent with applicable requirements. Additionally, proper installation and setting of supports and restraints for SRV discharge piping will be verified as part of the testing described in 14.2.12.1.51.

14.2.12.1.2 Reactor Recirculation System Preoperational Test

(1) Purpose

To verify the proper operation of the reactor recirculation system at conditions approaching rated volumetric flow, including the reactor internal pumps (RIPs) and motors, and the equipment associated with the motor cooling, seal purge, and inflatable shaft seal subsystems.

14.2.12.1 Preoperational Test Procedures

INSERT F

Specific testing to be performed and the applicable acceptance criteria for each preoperational test ~~are~~ will be documented in detailed test procedures to be made available to the NRC approximately 60 days prior to their intended use. Preoperational testing will be in accordance with the detailed system specifications and associated equipment specifications for equipment in those systems (provided as part of scoping documents to be supplied by GE and others as described in subsection 14.2.3). The tests demonstrate that the installed equipment and systems perform within the limits of these specifications. To insure that the tests are conducted in accordance with established methods and appropriate acceptance criteria, the plant and system preoperational test specifications will also be made available to the NRC.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. Cooling water from the reactor building cooling water system and seal purge flow from the CRD hydraulic system shall be available. The recirculation flow control system ~~should~~ Shall be sufficiently tested

to support RIP operation. Other interfacing systems shall be available, as needed, to support the specified testing and the corresponding system configurations. Reactor vessel internals should be capable of being subjected to rated volumetric core flow.

(3) General Test Methods and Acceptance Criteria

Testing of the recirculation system should be coordinated closely with that of the recirculation flow control system (Subsection 14.2.12.1.3) in order to adequately demonstrate proper integrated system response and operation. Also, the preoperational phase of the reactor internals vibration assessment program (Subsection 14.2.12.1.52) involves extended operation of the recirculation system and should be scheduled accordingly so as to optimize overall plant integrated testing.

The scope and intensity of the preoperational testing of the recirculation system and associated support subsystems will be limited by the unavailability of nuclear heating. Comprehensive testing of the system at rated temperature and pressure will be performed during the startup phase.

Performance should be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic and instrument channel trip;

(b) proper functioning of instrumentation and alarms used to monitor system operation and availability;

(c) proper operation of system valves under expected operating conditions;

(d) proper operation of pumps and motors in all normal design operating modes as well as any specified special testing configurations;

(e) acceptable pump NPSH under the most limiting design flow conditions;

(f) proper system flow rates including individual pump capacity and discharge head;

(g) proper manual and automatic system operation and margin to actuation of protective devices;

(h) proper operation of interlocks and equipment protective devices in pump and motor controls;

(i) proper operation of permissive, prohibit and bypass functions;

(j) proper system operation while powered from primary and alternate sources, including transfers, and in degraded modes for which the system is expected to remain operational;

(k) proper operation of the recirculation motor seal purge subsystem over the full range of RPV pressures including the proper functioning of the main header pressure control valve and proper distribution of seal purge flow to individual pumps and motors;

(l) proper functioning of the recirculation motor cooling subsystem and its ability to remove design heat loads from each RIP motor via the dedicated heat exchangers;

(m) proper functioning of the recirculation motor inflatable shaft seal subsystem and its ability to provide a temporary backup sealing mechanism for each pump motor shaft during recirc motor maintenance or removal;

(n) acceptable pump/motor vibration levels and system piping movements during both transient and steady state operation; and

(o) acceptable reactor vessel internals flow induced vibration levels per the requirements of Subsection 14.2.12.1.52.

System operation is considered acceptable when the observed/measured performance charac-

teristics, from the testing described above, meet the applicable design specifications.

14.2.12.1.3 Recirculation Flow Control System Preoperational Test

(1) Purpose

To verify that the operation of the recirculation flow control system, including that of the adjustable speed drives, RIP trip and runback logic, and the core flow measurement subsystem, is as specified.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. All required interfacing systems shall be available, as needed, to support the specified testing and the corresponding system configurations.

(3) General Test Methods and Acceptance Criteria

Some portions of the recirculation flow control system testing should will likely be performed in conjunction with that of the recirculation system, as described in Subsection 14.2.12.1.2. Close coordination of the testing specified for the two systems is required in order to demonstrate the proper integrated system response and operation.

Performance should shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic and instrument channel trip including recirculation pump trip (RPT) and runback circuitry, (RPT testing will specifically include its related ATWS function);

(b) proper functioning of instrumentation and alarms used to monitor system operation and availability;

(c) proper functioning of the core flow measurement subsystem;

(d) proper operation of control systems in all design operating modes and all levels of controls;

(e) proper operation of the adjustable speed drives;

(f) ability of the control system to communicate properly with equipment and controllers in other systems;

(g) proper control of pump motor start sequence;

(h) proper operation of interlocks and equipment protective devices;

(i) proper operation of permissive, prohibit and bypass functions; and

(j) proper system operation while powered from primary and alternate sources, including transfers, and in degraded modes for which the system is expected to remain operational.

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications.

14.2.12.1.4 Feedwater Control System Preoperational Test

(1) Purpose

To verify proper operation of the feedwater control system, including individual components such as controllers, indicators, and controller software settings such as gains and function generator curves.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedures and has approved the initiation of testing. Preoperational tests must be completed on lower level controllers that do not strictly belong to the feedwater control system but that may affect system response. All feedwater control system com-

ponents ~~should~~ shall have an initial calibration in accordance with vendor instructions. All required interfacing systems ~~should~~ shall be available, as needed, to support the specified testing and the appropriate system configurations.

(3) General Test Methods and Acceptance Criteria

Testing of the feedwater control system during the preoperational phase may be limited by the absence of an acceptable feedwater recirculation flow path. Comprehensive flow testing will be conducted during startup phase.

Performance ~~should~~ shall be observed and recorded during a series of individual component and overall system response tests to demonstrate the following:

(a) proper operation of instrumentation and controls in all combinations of logic and instrument channel trips including verification of setpoints;

(b) proper functioning of instrumentation and alarms used to monitor system operation and status;

(c) proper operation of system valves, including timing and stroke, in response to control demands (including the reactor water cleanup system dump valve response to the low flow controller);

(d) proper operation of interlocks and equipment protective devices in pump and valve controls;

(e) proper operation of permissive, prohibit, and bypass functions;

(f) proper system operation while powered from primary and alternate sources, including transfers, and in degraded modes for which the system is expected to remain operational; and

(g) proper communication and interface with other control systems and related equipment.

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications.

14.2.12.1.5 Standby Liquid Control System Preoperational Test

(1) Purpose

To verify that the operation of the standby liquid control (SLC) system, including pumps, tanks, control, logic, and instrumentation, is as specified.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. Valves should be previously bench tested and other precautions relative to positive displacement pumps taken. The reactor vessel ~~should~~ shall be available for injecting demineralized water. All required interfacing systems shall be available, as needed, to support the specified testing and the appropriate system configurations.

(3) General Test Methods and Acceptance Criteria

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic and instrument channel trip;

(b) proper functioning of instrumentation and alarms used to monitor system operation and availability;

(c) proper operation of system valves, including timing, under expected operating conditions;

(d) proper operation of pumps and motors in all design operating modes;

(e) proper operation of the tank heaters and proper mixing of the neutron absorber solution;

(f) proper system flow paths and flow rates including pump capacity and discharge head (with demineralized water substituted for the neutron absorber mixture);

(g) proper pump motor start sequence and margin to actuation of protective devices;

(h) proper operation of interlocks and equipment protective devices in pump and valve controls;

(i) proper operation of permissive, prohibit, and bypass functions;

(j) proper system operation while powered from primary and alternate sources, including transfers, and in degraded modes for which the system is expected to remain operational; and

(k) acceptability of pump/motor vibration levels and system piping movements during both transient and steady state operation.

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications.

14.2.12.1.6 Control Rod Drive System Preoperational Test

(1) Purpose

To verify that the control rod (CRD) system, including the CRD hydraulic and fine motion control subsystems, functions as designed.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. The control blades ~~should~~ shall be installed and ready to be stroked and scrammed. Reactor building cooling water, instrument air, and other required interfacing systems shall be available, as needed, to support the specified testing and the corresponding system configurations.

Additionally, the rod control and information system shall be functional when needed, with the applicable portion of its specified preoperational testing complete.

(3) General Test Methods and Acceptance Criteria

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper functioning of instrumentation and alarms used to monitor system operation and status;

(b) proper communication with, and response to demands from, the rod control and information system and the reactor protection system, including that associated with alternate rod insertion (ATWS), alternate rod-in (post-scram), and select control rod run-in unctions;

(c) proper functioning of system valves, including purge water pressure control valves, under expected operating conditions;

(d) proper operation of CRD hydraulic subsystem pumps and motors in all design operating modes;

(e) acceptable pump NPSH under the most limiting design flow conditions;

(f) proper pump motor start sequence and margin to actuation of protective devices;

(g) proper system flow paths and flow rates including sufficient pump capacity and discharge head;

(h) proper operation of interlocks and equipment protective devices in pump, motor, and valve controls;

(i) proper operation of permissive, prohibit, and bypass functions;

(j) proper system operation while powered from primary and alternate sources, including transfers, and in degraded modes for which the system is expected to remain operational;

(k) acceptability of pump/motor vibration levels and system piping movements during both transient and steady state operation;

(l) proper operation of fine motion motors and drives and associated control units, including verification of acceptable normal insert and withdraw timing;

(m) proper operation of hydraulic control units and associated valves including CRD scram timing demonstrations against atmospheric pressure.

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications.

14.2.12.1.7 Rod Control and Information System Preoperational Test

(1) Purpose

To verify that the rod control and information system (RC&IS) functions as designed.

(2) Prerequisites

The construction tests, including initial check-out of RC&IS software, have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing.

(3) General Test Methods ~~and Acceptance~~ Criteria

Performance ~~should~~ shall be observed and recorded during a series of tests to demonstrate the following:

(a) proper operation of rod blocks and associated alarms and annunciators in all combinations of logic and instrument channel trip including all positions of the reactor mode switch;

(b) proper operation of control rod run-in logic including that associated with ARI (ATWS), SCRRI and normal post-SCRAM follow-in;

(c) proper functioning of instrumentation used to monitor CRD system status such as rod position indication instrumentation and that used to monitor continuous full-in and rod/drive separation status;

(d) proper operation of RC&IS software including verification of gang and group assignments and predictor-comparator, rod worth limiter, and banked position withdrawal sequence functions; and

(e) proper communication with interfacing systems such as the power generation control system, the automatic power regulator, and the automatic rod block monitor.

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications.

14.2.12.1.8 Residual Heat Removal System Preoperational Test

(1) Purpose

To verify the proper operation of the residual heat removal (RHR) system under its various modes of operation: core cooling, shutdown cooling, wetwell and drywell spray, suppression pool cooling, and supplemental fuel pool cooling.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. The reactor vessel shall be intact and capable of receiving injection flow from the various modes of RHR. The

(3) General Test Methods and Acceptance Criteria

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests that includes all modes of RHR system operation in order to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic and instrument channel trip;

(b) proper functioning of system instrumentation and alarms used to monitor system operation and availability, including that intended to alert operators when high pressure-low pressure interface valves are not full closed with the reactor coolant system at high pressure;

(c) proper operation of system valves, including timing, under expected operating conditions;

(d) proper operation of pumps and motors in all design operating modes;

(e) acceptable pump NPSH under the most limiting design flow conditions;

(f) proper system flow paths and flow rates including pump capacity and discharge head and time to rated flow;

(g) proper operation of containment spray modes including verfication that spray nozzles, headers and piping are free of debris;

(h) proper pump motor start sequence and margin to actuation of protective devices;

(i) proper operation of interlocks and equipment protective devices in pump and valve controls, including valve interlocks and controls designed to protect low pressure portions of the system from the reactor coolant system at high pressure;

(j) proper operation of permissive, prohibit, and bypass functions;

(k) proper system operation while powered from primary and alternate sources, including transfers, and in degraded modes for which the system is expected to remain operational;

(l) acceptability of pump/motor vibration levels and system piping movements during both transient and steady state operation; and

(m) proper operation of pump discharge line keep fill system(s) and its ability to prevent damaging water hammer during system transients.

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications.

14.2.12.1.9 Reactor Core Isolation Cooling System Preoperational Test

(1) Purpose

Verify that the operation of the reactor core isolation cooling (RCIC) system, including the turbine, pump, valves, instrumentation, and control, is as specified.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. A temporary steam supply shall be available for driving the RCIC turbine. The turbine instruction manual shall be reviewed in detail in order that precautions relative to turbine operation are followed. All required interfacing systems shall be available, as needed, to support the specified testing and the corresponding system configurations.

(3) General Test Methods and Acceptance Criteria

The RCIC turbine should first be tested while disconnected from and then while coupled to the pump. The intent of this preoperational test is to test the RCIC system to the extent possible. However, since preoperational testing is performed utilizing a temporary steam supply the attainable RCIC pump flow may be limited. Should this prevent any specified testing from being completed successfully, such cases will be documented and scheduled for completion during the power ascension test phase.

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic and instrument channel trip;

(b) proper functioning of instrumentation and alarms used to monitor system operation and availability;

(c) proper operation of system valves, including timing, under expected operating conditions;

(d) proper operation of turbine and pump in all design operating modes;

(e) acceptable pump NPSH under the most limiting design flow conditions;

(f) proper system flow paths and flow rates including pump capacity, discharge head and time to rated flow;

(g) proper manual and automatic system operation and margin to actuation of protective devices;

(h) proper operation of interlocks and equipment protective devices in turbine, pump, and valve controls;

(i) proper operation of permissive, prohibit, and bypass functions;

(j) proper system operation while powered from primary and alternate sources, including transfers, and in degraded modes for which the system is expected to remain operational. Included ~~should~~ be a demonstration of RCIC system ability to start without the aid of AC power, except for RCIC DC/AC inverters; an evaluation of RCIC operation beyond its design basis during an extended loss of AC power to it and its support systems and verification of RCIC DC component operability when the non-RCIC station batteries are disconnected;

(k) acceptability of pump/turbine vibration levels and system piping movements during both transient and steady state operation;

(l) proper operation of the barometric condenser condensate pump and vacuum pump;

(m) the ability of the system to swap pump suction source from the condensate storage pool to the suppression pool without interrupting system operation; and

(n) proper operation of the pump discharge line keep fill system and its ability to prevent damaging water hammer during system transients.

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications (while accounting for the limitations imposed by the temporary steam supply).

14.2.12.1.10 High Pressure Core Flooder System Preoperational Test

(1) Purpose

To verify the operation of the high pressure core flooder (HPCF) system, including related auxiliary equipment, pumps, valves, instrumentation and control, is as specified.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. The suppression pool and condensate storage pool ~~should~~ be available as HPCF pump suction sources and the reactor vessel ~~should~~ be sufficiently intact to receive HPCF injection flow. The required interfacing systems ~~should~~ be available, as needed, to support the specified testing and the appropriate system configurations.

(3) General Test Methods and Acceptance Criteria

Performance ~~should~~ be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic

(2) Prerequisites

System construction testing has been successfully completed.

(3) General Test Methods and Acceptance Criteria

Since this system is the primary communication interface between the various plant systems it should be adequately tested during the preoperational phase testing performed on those interconnected systems. Provided the construction testing and the associated system testing has been successfully completed as it relates to proper operation of the multiplexing system no specific additional testing should be necessary.

System performance would then be considered acceptable provided all design specifications are met.

14.2.12.1.13 Leak Detection and Isolation System Preoperational Test

(1) Purpose

To verify proper response and operation of the leak detection and isolation system (LDS) logic.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedures and has approved the initiation of testing. The required AC and DC electrical power sources should be operational and the appropriate interfacing systems shall be available as required to support the specified testing.

(3) General Test Methods and Acceptance Criteria

Since the leak detection and isolation system is comprised mostly of logic, the checks of valve response and timing and the testing of sensors will be performed as part of, or in conjunction with, the various systems with which they are associated. These systems include RHR, RCIC, RWCU, main steam, feedwater, recirculation, radiation monitoring, nuclear boiler, drywell cooling and the drywell sumps.

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and controls in all combinations of logic and instrument channel trip;

(b) proper functioning of indicators, annunciators, and alarms used to monitor system operation and status;

(c) proper operation of leakoff and drainage measurement functions such as those associated with the reactor vessel head flange, drywell cooler condensate, and various primary system valves;

(d) proper response of related system valves, including timing, under expected operating conditions;

(e) proper interface with related systems in regards to the input and output of leak detection indications and isolation initiation commands;

(f) proper operation of bypass switches and related logic; and

(g) proper system operation while powered from primary and alternate sources, including transfers, and in degraded modes for which the system is expected to remain operational.

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications.

14.2.12.1.14 Reactor Protection System Preoperational Test

(1) Purpose

To verify proper operation of the reactor protection system (RPS) including complete channel logic and response time.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedures and has approved the initiation of testing. The rod control system, instrument air system, and the required AC and DC electrical power sources are operational. All other required interfacing systems shall be available, as needed, to support the specified testing.

(3) General Test Methods and Acceptance Criteria

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and controls in all combinations of logic and instrument channel trip including those associated with all positions of the reactor mode switch;

(b) proper functioning of instrumentation and alarms used to monitor sensor and channel operation and availability;

(c) proper calibration of primary sensors;

(d) proper trip and alarm settings;

(e) operability of bypass switches including related logic;

(f) proper operation of permissive and prohibit interlocks;

(g) proper system operation while powered from primary and alternate sources, including transfers, and in degraded modes for which the system is expected to remain operational; and

(h) acceptability of instrument channel response times, as measured from each applicable process variable (except for neutron sensors) to the de-energization of the scram pilot valve solenoids.

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications.

The ability of the system to scram the reactor within a specified time must be demonstrated in conjunction with the CRD system preoperational test (Subsection 14.2.12.1.6).

14.2.12.1.15 Neutron Monitoring System Preoperational Test

(1) Purpose

To verify the proper operation of the neutron monitoring system (NMS) including fixed incore startup and power range detectors, traversing incore probes (TIPs) and related hardware and software.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. All startup range neutron monitor subsystem components and power range neutron monitor subsystem components have been calibrated per vendor instructions. Additionally, all required interfacing systems ~~should~~ shall be available, as needed, to support the specified testing.

(3) General Test Methods and Acceptance Criteria

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic and instrument channel trip including rod block and scram signals feeding the rod control system and the reactor trip system, respectively;

(b) proper functioning of instrumentation, displays, alarms, and annunciators used to monitor system operation and status;

(c) proper operation of detectors and associated cabling, preamplifiers, and power supplies;

(d) proper operation of TIP drive mechanisms and indexers;

(e) proper operation of interlocks and equipment protective devices including those associated with the TIP indexers and drive control units;

(f) proper operation of permissive, prohibit, and bypass functions;

(g) proper system operation while powered from primary and alternate sources, including transfers, and in degraded modes for which the system is expected to remain operational;

(h) proper operation of system and subsystem self-test diagnostic and calibration functions;

(i) the ability to communicate and interface with appropriate plant systems and between NMS subsystems; and

(j) the ability to generate core flow biased trip setpoints from core plate differential pressure measurements.

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications.

14.2.12.1.16 Process Computer System Preoperational Test

(1) Purpose

To verify the proper operation of the process computer system (PCS) including the performance monitoring and control system (PMCS) and the power generation control system (PGCS) and their related functions.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. All programming ~~should~~ shall be complete and initial software diagnostic checks determined acceptable. The required input and output devices and various system interfaces ~~should~~ shall be connected and available, as needed, for supporting the specified testing configurations.

(3) General Test Methods and Acceptance Criteria

Proper performance of system hardware and software will be verified by a series of individual and integral tests that include the following demonstrations:

(a) proper connection and calibration of all analog and digital signals;

(b) proper operation of data logging and plotting features;

(c) verification of computer printouts and CRT displays;

(d) proper communication and interface with other plant equipment, computers and control systems;

(e) verification of proper data flow and processing and of calculational accuracy;

(f) proper operation of calibration and surveillance support functions; and

(g) proper operation of operator guidance and prompting functions, including alarms and status messages, in all operating modes for plant startup, shutdown and power maneuvering iterations.

Much of the testing performed during the preoperational phase is done utilizing simulated conditions and inputs via system hardware and software. Final system performance during live conditions will be evaluated during the startup phase.

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications.

14.2.12.1.17 Automatic Power Regulator Preoperational Test

(1) Purpose

To verify proper operation of the automatic power regulator (APR) over the range of required operating modes.

(2) Prerequisites

The software programming and initial diagnostic testing has been completed and the SCG has reviewed the test procedure and has approved the initiation of testing. The process computer system, rod control and information system, recirc flow control system, turbine control system, and other required system interfaces shall be available to support the specified system testing.

(3) General Test Methods and Acceptance Criteria

The APR is a top level controller that interfaces with various lower level controllers and systems. APR testing, therefore, should be closely coordinated with testing of related interfacing and affected systems. Such testing should include the following demonstrations:

(a) proper operation of instrumentation and controls in all combinations of logic for all modes of operation including transfers;

(b) proper functioning of annunciators, alarms, and displays used to monitor system operation or status;

(c) verification of proper data flow and processing including the accuracy of calculations and control algorithms; and

(d) proper communication and interface with other control systems and related supporting and monitoring functions.

System operation is considered acceptable when the observed performance meets the applicable design specifications.

14.2.12.1.18 Remote Shutdown System Preoperational Test

(1) Purpose

Verify the feasibility and operability of intended remote shutdown functions from the remote shutdown panel and other local and remote locations outside the main control room which will be utilized during the remote shutdown scenario.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. Additionally, control power should be supplied to the remote shutdown panel and the required system and component interfaces shall be available, as needed, to support the specified testing.

(3) General Test Methods and Acceptance Criteria

The remote shutdown system (RSS) consists of the control and instrumentation available at the dedicated remote shutdown panel(s) and other local and remote locations intended to be used during the remote shutdown scenario.

Much of the specified testing can be accomplished in conjunction with, or as part of, the individual system and component preoperational testing. However, the successful results of such testing should be documented as part of this test. Performance should be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper functioning of the control and instrumentation associated with the RSS;

(b) proper operation of pumps and valves including establishment of system flow paths using RSS control;

(c) proper functioning of RSS transfer switches including verification of proper override of main control room functions;

(d) proper operation of prohibit and permissive interlocks and bypass functions after transfer of control;

(e) proper system operation while powered from primary and alternate electrical sources; and

(f) the ability to establish and maintain communication among personnel stationed throughout the plant who would be performing the remote shutdown operation.

RSS operation is considered acceptable when the observed and measured performance meets the applicable design specifications.

14.2.12.1.19 Reactor Water Cleanup System Preoperational Test

(1) Purpose

To verify that the operation of the reactor water cleanup system (CUW), including pumps, valves, and filter/demineralizer equipment, is as specified.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. Filter aid and resin material ~~should~~ shall be available. Reactor building cooling water, instrument air, CRD purge supply, and other required interfacing systems shall be available, as needed, to support the specified testing and the appropriate system configurations. Special provisions may be required for testing the CUW system in the vessel head spray mode.

(3) General Test Methods and Acceptance Criteria

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and controls in all combinations of logic and instrument channel trip including those associated with the leak detection and isolation system;

(b) proper functioning of instrumentation and alarms used to monitor system operation and availability;

(c) proper operation of system valves, including timing, under expected operating conditions;

(d) proper operation of pumps and motors in all design operating modes;

(e) acceptable pump NPSH under the most limiting design flow conditions;

(f) proper system flow paths and flow rates including pump capacity and discharge head;

(g) proper pump motor start sequence and margin to actuation of protective devices;

(h) proper operation of interlocks and equipment protective devices in pump and valve controls;

(i) proper operation of permissive, prohibit, and bypass functions;

(j) proper system operation while powered from primary and alternate sources, including transfers, and in degraded modes for which the system is expected to remain operational;

(k) acceptability of pump/motor vibration levels and system piping movements during both transient and steady state operation; and

(l) proper operation of the reactor water cleanup filter/demineralizers and associated support facilities.

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications. Proper operation of sampling stations and displays will be demonstrated per Subsection 14.2.12.1.22.

14.2.12.1.20 Suppression Pool Cleanup System Preoperational Test

(1) Purpose

To verify that the operation of the suppression pool cleanup system (SPCU) is as speci

fied in all required operating modes.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. The fuel pool and suppression pool shall be adequately filled and the appropriate filter/demineralizer support facilities and other system interfaces available, as needed, to support the specified testing.

(3) General Test Methods and Acceptance Criteria

The suppression pool and fuel pool share common water treatment facilities. The suppression pool cleanup system has a dedicated pump for circulating water to and from the suppression pool and through the common filter/demineralizer. However, the shared filter/demineralizer facilities are considered part of the fuel pool cooling and cleanup system. Therefore, this preoperational test should be closely coordinated with that of Subsection 14.2.12.1.21.

Performance should be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic and instrument channel trip;

(b) proper functioning of instrumentation and alarms used to monitor system operation and availability;

(c) proper operation of system valves, including timing, under expected operating conditions;

(d) proper operation of pump and motor in all design operation modes;

(e) acceptable pump NPSH under the most limiting design flow conditions;

(f) proper system flow paths and flow rates including pump capacity and discharge head;

(g) proper pump motor start sequence and margin to actuation of protective devices;

(h) proper operation of interlocks and equipment protective devices in pump and valve controls;

(i) proper operation of permissive, prohibit, and bypass functions;

(j) proper system operation while providing the specified intersystem refill capabilities; and

(k) acceptability of pump/motor vibration levels and system piping movements during both transient and steady state operation.

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications.

14.2.12.1.21 Fuel Pool Cooling and Cleanup System Preoperational Test

(1) Purpose

To verify that the operation of the fuel pool cooling and cleanup (FPC) system, including the pumps, heat exchangers, controls, valves, and instrumentation, is as specified.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. The required interfacing systems shall be available, as needed, to support the specified testing and the appropriate system configurations.

(3) General Test Methods and Acceptance Criteria

Performance should be observed and recorded during a series of individual component and

integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic and instrument channel trip, including isolation and bypass of the nonsafety related fuel pool cleanup filter/demineralizers;

(b) proper functioning of instrumentation and alarms used to monitor system operation and availability, including those associated with pool water level;

(c) proper operation of system valves, including timing, under expected operating conditions;

(d) proper operation of pumps and motors in all design operating modes;

(e) acceptable pump NPSH under the most limiting design flow conditions;

(f) proper system flow paths and flow rates including pump capacity and discharge head;

(g) proper pump motor start sequence and margin to actuation of protective devices;

(h) proper operation of interlocks and equipment protective devices in pump, motor, and valve controls;

(i) proper operation of permissive, prohibit, and bypass functions;

(j) proper system operation while powered from primary and alternate sources, including transfers, and in degraded modes for which the system is expected to remain operational;

(k) acceptability of pump/motor vibration levels and system piping movements during both transient and steady state operation;

(l) proper functioning of pool antisiphon devices and acceptable nonleakage from pool drains, sectionalizing devices, and gaskets or bellows;

(m) proper functioning of the system in conjunction with the RHR system in the supplemental fuel pool cooling mode; and

(n) proper operation of filter/demineralizer units and their associated support facilities.

Integrated system testing with flow to and from the fuel pool cleanup subsystem will be performed in conjunction with the appropriate portions of the suppression pool cleanup system preop described in Subsection 14.2.12.1.20.

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications.

14.2.12.1.22 Plant Process Sampling System Preoperational Test

(1) Purpose

To verify the proper operation and the accuracy of equipment and techniques to be used for on-line and periodic sampling and analysis of overall reactor water chemistry as well as that of indvidual plant process streams, including the post accident sampling system (PASS).

(2) Prerequisites

Construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. Adequate laboratory facilities and appropriate analytical procedures shall be in place.

(3) General Test Methods and Acceptance Criteria

Performance ~~should~~ shall be observed and recorded during a series of tests to demonstrate the following:

(a) proper operation of on-line sampling and monitoring equipment considering calibration, indication and alarm/functions including reactor water conductivity instrumentation;

calibration, indication, and alarms;

(b) the capability of obtaining grab samples of designated process streams at the desired locations;

(c) proper functioning of personnel protective devices at local sampling stations; and

(d) the adequacy and accuracy of sample analysis methods.

The above tests should be performed using actual process streams where practicable. System operation is considered acceptable when the observed/measured performance characteristics meet the applicable design specifications.

14.2.12.1.23 Process Radiation Monitoring System Preoperational Test

(1) Purpose

To verify the ability of the process radiation monitoring system (PRMS) to indicate and alarm normal and abnormal radiation levels, and to initiate, if appropriate, isolation and/or cleanup systems upon detection of high radiation levels in any of the process streams that are monitored.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. The various process radiation monitoring subsystems, including preamplifiers, power supplies, indicator and trip units, and sensors and converters, have been calibrated according to vendor instructions. The required interfacing systems shall be available, as needed, to support the specified testing.

(3) General Test Methods and Acceptance Criteria

The PRMS consists of a number of subsystems that monitor various liquid and gaseous process streams, building and area ventilation exhausts, and plant and process effluents. The offgas system and the main steam lines are also monitored.

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated subsystem tests to demonstrate the following:

(a) proper calibration of detector assemblies and associated equipment using a standard radiation source or portable calibration unit;

(b) proper functioning of indicators, recorders, annunciators, and alarms;

(c) proper system trips in response to high radiation and downscale/inoperative conditions;

(d) proper operation of permissive, prohibit, interlock, and bypass functions; and

(e) proper operation of primary and backup sampling functions.

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications.

14.2.12.1.24 Area Radiation Monitoring System Preoperational Test

(1) Purpose

To verify the ability of the area radiation monitoring (ARM) system to indicate and alarm normal and abnormal general area radiation levels throughout the plant.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. Indicator and trip units, power supplies, and sensor/converters have been calibrated according to vendor instructions.

(3) General Test Methods and Acceptance Criteria

Performance should be observed and recorded during a series of individual component and integrated subsystem tests to demonstrate the following:

(a) proper calibration of detector assemblies and associated equipment using a standard radiation source or portable calibration unit;

(b) proper functioning of indicators, recorders, annunciators, and alarms;

(c) proper system trips in response to high radiation and downscale/inoperative conditions; and

(d) proper operation of permissive, prohibit, interlock, and bypass functions.

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications.

14.2.12.1.25 Dust Radiation Monitoring System Preoperational Test

(1) Purpose

To verify the ability of the dust radiation monitoring system to indicate and alarm normal and abnormal airborne radiation levels throughout the plant.

(2) Prerequisites

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

(3) General Test Methods and Acceptance Criteria

Performance ~~should~~ be observed and recorded during a series of individual component and integrated subsystem tests to demonstrate the following:

(a) proper calibration of detector assemblies and associated equipment using a standard radiation source or portable calibration unit;

(b) proper functioning of indicators, recorders, annunciators, and alarms;

(c) proper system trips in response to high radiation and downscale/inoperative conditions;

(d) proper operation of permissive, prohibit, interlock, and bypass functions; and

(e) proper operation of filtering and sampling equipment.

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications.

14.2.12.1.26 Containment Atmospheric Monitoring System Preoperational Test

(1) Purpose

To verify the ability of the containment atmospheric monitoring system (CAMS) to monitor oxygen, hydrogen, and gross gamma radiation levels in the wetwell and drywell airspace regions of the primary containment.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. Initial system and component setup has been accomplished per vendor instructions.

(3) General Test Methods and Acceptance Criteria

The containment atmosphere monitoring system consists of radiation, oxygen, and hydrogen monitoring subsystems. Performance of each of these subsystems ~~should~~ be observed and recorded during a series of individual component and integrated subsystem tests to demonstrate the following:

Shall

(a) proper calibration of detector assemblies and associated equipment using a standard source or portable calibration unit;

(b) proper functioning of indicators, recorders, annunciators, and alarms including those monitoring system availability;

(c) proper system trips in response to high setpoint and downscale/inoperative conditions;

(d) proper operation of permissive, prohibit, interlock, and bypass functions;

(e) proper initiation and operation of detection and sampling functions including pump start and valve sequencing, if appropriate, in response to a LOCA signal; and

(f) proper operation of calibration gas supply systems and self calibration functions.

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications.

14.2.12.1.27 Instrument Air and Station Service Air Systems Preoperational Tests

(1) Purpose

To verify the ability of the instrument air and service air systems (IA and SA) to provide the design quantities of clean dry compressed air to user systems and components.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. Primary and backup electrical power, the supplied system and components loads, and other required system interfaces are available, as needed, to support the specified testing.

(3) General Test Methods and Acceptance Criteria

The instrument air system and the service air system are specified as separate systems. However, since they are so closely related the preop test requirements are essentially the same.

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic and instrument channel trip;

(b) proper functioning of instrumentation and alarms [illegible] to monitor system operation and ava[illegible];

(c) proper operation of system valves, including timing, under expected operating conditions;

(d) proper operation of compressors and motors in all design operating modes;

(e) ability of compressor(s) to maintain receiver at specified pressure(s) and to recharge within specified time under design loading conditions;

(f) proper system flow paths and acceptable flow rates to individual loads at specified temperatures and pressures under design loading conditions, including a determination that the total air demand at steady state conditions, including leakage for the system, is in accordance with design;

(g) proper compressor start sequence (including load and unload) and margin to actuation of protective devices;

(h) proper operation of interlocks and equipment protective devices in compressor and valve controls;

(i) proper operation of permissive, prohibit, and bypass functions;

(j) proper system operation while powered from primary and alternate sources, including transfers, and in degraded modes for which the system is expected to remain operational;

(k) acceptability of compressor/motor vibration levels and system piping movements during both transient and steady state operation;

(l) the ability of the air to meet end use cleanliness requirements with respect to oil, water, and particulate matter content;

(m) continued operability of supplied loads in response to credible failures that result in an increase in the supply system pressure;

(n) proper "failure" (open, close, or as is) of supplied components to both instantaneous (pipe break) and slow (plugging or freezing) simulated air losses (per Regulatory Guide 1.68.3); and

(o) the ability of the service air system to act as backup to the instrument air system.

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications.

14.2.12.1.28 High Pressure Nitrogen Gas Supply System Preoperational Test

(1) Purpose

To verify the ability of the high pressure nitrogen gas supply system (HPIN) to furnish compressed nitrogen gas to user systems at design quantity and quality.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. User system loads and other required system interfaces shall be available, as needed, to support the specified system testing.

(3) General Test Methods and Acceptance Criteria

Performance shall ~~should~~ be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic and instrument channel trip;

(b) proper functioning of instrumentation and alarms used to monitor system operation and availability;

(c) proper operation of system valves, including timing, under expected operating conditions;

(d) ability to maintain receiver(s) at specified pressure(s) under design loading conditions;

(e) proper system flow paths and acceptable flow rates to individual loads at specified temperatures and pressures under design loading conditions;

(f) proper operation of interlocks and equipment protective devices;

(g) proper operation of permissive, prohibit, and bypass functions;

(h) proper system operation while powered from primary and alternate sources, including transfers, and in degraded modes for which the system is expected to remain operational;

(i) acceptability of vibration levels and system piping movements during both transient and steady state operation;

(j) the ability of the nitrogen gas to meet end use cleanliness requirements with respect to oil, water, and particulate matter content; and

when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications.

14.2.12.1.29 Reactor Building Cooling Water System Preoperational Test

(1) Purpose

To verify proper operation of the reactor building cooling water system (RCW) including its ability to supply design quantities of cooling water, at the specified temperatures, to essential and nonessential loads, as appropriate, during normal, abnormal, and accident conditions.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. Primary and backup power, reactor building service water, instrument air, and other required supporting systems shall be available, as needed, for the specified testing configurations. The cooled components should be operational and operating to the extent possible during heat exchanger performance evaluation.

(3) General Test Methods and Acceptance Criteria

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic and instrument channel trip;

(b) proper functioning of instrumentation and alarms used to monitor system operation and availability;

(c) proper operation of system valves, including timing, under expected operating conditions;

(d) proper operation of pumps and motors in all design operating modes;

(e) acceptable pump NPSH under the most limiting design flow conditions;

(f) proper system and component flow paths, flow rates, and pressure drops, including pump capacity and discharge head;

(g) proper pump motor start sequence and margin to actuation of protective devices;

(h) proper operation of interlocks and equipment protective devices in pump and valve controls;

(i) proper operation of permissive, prohibit, and bypass functions;

(j) proper system operation while powered from primary and alternate sources, including transfers, and in degraded modes for which the system is expected to remain operational. This includes isolation/shedding of nonessential loads and divisional interties when a LOCA signal is present;

(k) acceptability of pump/motor vibration levels and system piping movements during both transient and steady state operation;

(l) proper operation of system surge tanks and chemical addition tanks and their associated functions; and

(m) acceptable performance of heat exchangers, to the extent practical.

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications. Due to the possibility of insufficient heat loads during the preop phase, the final system flow balancing and heat exchanger performance evaluation may need to be performed during the startup phase.

14.2.12.1.30 Plant Makeup Water System(s) Preoperational Test

(1) Purpose

To verify the ability of the plant make-up water system(s) to resupply the designated plant systems with water of the design quantity and quality for each such system.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. Final interconnection with the supplied systems is complete and those systems are ready to accept transfer of design quantities of makeup water.

(3) General Test Methods and Acceptance Criteria

System performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic;

(b) proper functioning of instrumentation and alarms used to monitor system operation and status;

(c) proper operation of pumps, motors, and valves under expected operating conditions;

(d) proper functioning of interlocks and equipment protective devices in pump, motor, and valve controls;

(e) the adequacy of system flow paths and flow rates including pump and tank capacities;

(f) proper functioning of chemical addition and water treatment facilities and equipment;

(g) proper functioning of freeze protection devices, if applicable; and

(h) acceptability of pump and motor vibration levels and system piping movements during both transient and steady state operations.

System operation is considered acceptable if the observed/measured performance characteristics meet the applicable design specifications.

14.2.12.1.31 Hot Water Heating System Preoperational Test

(1) Purpose

Verify the ability of the hot water heating system to provide hot water to the appropriate HVAC systems in order to maintain the specified design temperatures within the various building rooms and areas.

(2) Prerequisites

The construction tests have been completed and the SCG has reviewed the test procedure and has approved the initiation of testing. Electrical power, the appropriate heating source(s), the various HVAC systems heating coils, and other required interfacing systems shall be available, as needed, to support the specified testing.

(3) General Test Methods and Acceptance Criteria

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic and instrument channel trip;

(b) proper functioning of instrumentation and alarms used to monitor system operation;

(c) proper operation of system valves under expected operating conditions;

(d) proper operation of pumps and motors in all design operating modes;

(e) acceptable pump NPSH under the most limiting design flow conditions;

(f) proper system flow paths and flow rates including pump capacity and discharge head;

(g) proper pump motor start sequence and margin to actuation of protective devices;

(h) proper operation of interlocks and equipment protective devices in pump, motor and valve controls;

(i) proper operation of permissive, prohibit, and bypass functions; and

(j) acceptability of pump/motor vibration levels and system piping movements during both transient and steady state operation.

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications. It may not be possible to fully evaluate heat exchanger and heating coil performance during the preoperational test phase because of process temperature limitations.

14.2.12.1.32 HVAC Emergency Chilled Water System Preoperational Test

(1) Purpose

To verify the ability of the HVAC emergency chilled water system (HECW) to supply the design quantities of chilled water at the specified temperatures to the various cooling coils of the HVAC systems serving rooms and areas containing essential systems and equipment.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. Normal and auxiliary electrical power, reactor building cooling water, applicable HVAC system cooling coils, and other required system interfaces shall be available, as needed, to support the specified system testing.

(3) General Test Methods and Acceptance Criteria

Performance ~~should~~ Shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic and instrument channel trip;

(b) proper functioning of instrumentation and alarms used to monitor system operation and availability;

(c) proper operation of system valves, including isolation functions, under expected operating conditions;

(d) proper operation of pumps and motors in all design operating modes;

(e) acceptable pump NPSH under the most limiting design flow conditions;

(f) proper system flow paths and flow rates to all supplied loads including pump capacity and discharge head;

(g) proper pump motor start sequence and margin to actuation of protective devices;

(h) proper operation of interlocks and equipment protective devices in pump and valve controls;

(i) proper operation of permissive, prohibit, and bypass functions;

(j) proper system operation while powered from primary and alternate sources, including transfers, and in degraded modes for which the system is expected to remain operational;

(k) acceptability of pump/motor vibration levels and system piping movements during both transient and steady state operation; and

(l) proper functioning of system surge tank and chemical addition features.

System operation is considered acceptable when the observed/measured performance

characteristics, from the testing described above, meet the applicable design specifications.

14.2.12.1.33 HVAC Normal Chilled Water System Preoperational Test

(1) Purpose

To verify the ability of the HVAC normal chilled water system (HNCW) to supply the design quantities of chilled water at the specified temperatures to the various cooling coils of the HVAC systems serving rooms and areas containing nonessential equipment and systems.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. Primary and auxiliary electrical power, the associated cooling water system(s), the applicable HVAC system cooling coils, and other required system interfaces shall be available, as needed, to support the specified system testing.

(3) General Test Methods and Acceptance Criteria

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic and instrument channel trip;

(b) proper functioning of instrumentation and alarms used to monitor system operation and availability;

(c) proper operation of system valves, including isolation functions, under expected operating conditions;

(d) proper operation of pumps and motors in all design operating modes;

(e) acceptable pump NPSH under the most limiting design flow conditions;

(f) proper system flow paths and flow rates to all supplied loads including pump capacity and discharge head;

(g) proper pump motor start sequence and margin to actuation of protective devices;

(h) proper operation of interlocks and equipment protective devices in pump and valve controls;

(i) proper operation of permissive, prohibit, and bypass functions;

(j) proper system operation while powered from primary and alternate sources, including transfers, and in degraded modes for which the system is expected to remain operational;

(k) acceptability of pump/motor vibration levels and system piping movements during both transient and steady state operation; and

(l) proper functioning of system surge tank and chemical addition features.

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications.

14.2.12.1.34 Heating, Ventilation, and Air Conditioning Systems Preoperational Test

(1) Purpose

To verify the ability of the various HVAC systems to establish and maintain the specified environment, with regards to temperature, pressure, and airborne particulate level, in the applicable rooms, areas, and buildings throughout the plant, supporting essential and nonessential equipment and systems.

(2) Prerequisites

The construction tests, including initial flow balancing, have been successfully

completed and the SCG has reviewed the test procedure(s) and has approved the initiation of testing. Additionally, the normal and backup electrical power sources, the applicable heating, cooling, and chilled water systems, and any other required system interfaces shall be available, as needed, to support the specified testing.

(3) General Test Methods and Acceptance Criteria

There are numerous HVAC systems in the plant, located throughout the various buildings. Each system typically consists of some combination of supply and exhaust air handling units and local cooling units, and the associated fans, dampers, valves, filters, heating and cooling coils, and control and instrumentation. The HVAC systems to be tested ~~should~~ shall include the following: those supporting the reactor building rooms containing the emergency diesel generators and the ECCS pumps and heat exchangers; those serving the electrical equipment rooms of the control building; those supporting the divisional cooling water rooms; those supporting the turbine/generator auxiliaries, those serving the secondary containment and the general areas of the control building, reactor building and turbine building; and the dedicated systems of the drywell and the main control room (including the control room habitability function).

Since the various HVAC systems are similar in design of equipment and function, they are subject to the same basic testing requirements.

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic and instrument channel trip;

(b) proper functioning of instrumentation and alarms used to monitor system operation and availability;

(c) proper operation of system valves and dampers, including isolation functions, under expected operating conditions;

(d) proper operation of fans and motors in all design operating modes;

(e) proper system flow paths and flow rates including individual component and total system capacities and overall system flow balancing;

(f) proper operation of interlocks and equipment protective devices;

(g) proper operation of permissive, prohibit, and bypass functions;

(h) proper system operation while powered from primary and alternate sources, including transfers, and in degraded modes for which the system is expected to remain operational;

(i) the ability to maintain the specified positive or negative pressure(s) in the designated rooms and areas and to direct local and total air flow, including any potential leakage, relative to the anticipated contamination levels;

(j) the ability of exhaust, supply, and recirculation filter units to maintain the specified dust and contamination free environment(s);

(k) the ability of the control room habitability function to detect the presence of smoke and/or toxic gas and to remove or prevent in-leakage of such;

(l) proper operation of HEPA filters and charcoal adsorber sections, if applicable, including relative to the in-place testing requirements of Regulatory Guide 1.140 regarding visual inspections and airflow distribution, DCP penetration and bypass leakage testing;

(m) the ability of the heating and cooling coils to maintain the specified thermal environment(s) while considering the heat loads present during the preop test phase; and

(n) the ability of primary and secondary containment HVAC systems to provide

To verify the ability of the atmospheric control system (ACS) to establish and maintain the specified inert atmosphere in the primary containment during all expected plant conditions.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. The primary and secondary containments ~~should be~~ are intact, their HVAC systems operational, and all other required interfaces available, as needed, to support the specified testing.

(3) General Test Methods ~~and~~ Acceptance Criteria

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic;

(b) proper functioning of instrumentation and alarms used to monitor system operation and availability;

(c) proper operation of system valves, including timing, under expected operating conditions;

(d) proper nitrogen/air flow paths and flow rates both into and out of the primary containment;

(e) proper operation of interlocks and equipment protective devices;

(f) proper operation of permissive, prohibit, and bypass functions; and

(g) proper system operation while powered from primary and alternate sources, including transfers, and in degraded modes for which the system is expected to remain operational.

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications.

14.2.12.1.36 Standby Gas Treatment System Preoperational Test

(1) Purpose

To verify the ability of the standby gas treatment system (SGTS) to establish and maintain a negative pressure within the secondary containment and to adequately filter the resultant exhaust air flow.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. The primary and secondary containments are intact and the appropriate interfacing systems are available as required to support the specified testing.

(3) General Test Methods ~~and~~ Acceptance Criteria

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic and instrument channel trip;

(b) proper functioning of instrumentation and alarms used to monitor system operation and availability;

(c) proper operation of system valves and dampers, including timing, under expected operating conditions;

(d) proper operation of exhaust fans in all design operating modes;

(e) efficiency of HEPA filters and leak

tightness of charcoal adsorber section per Regulatory Guide 1.5;

(f) proper system and component flow paths and flow rates including overall system flow balance;

(g) ability to maintain the specified negative pressure in the secondary containment;

(h) proper operation of interlocks and equipment protective devices;

(i) proper operation of permissive, prohibit, and bypass functions;

(j) proper operation of heaters, demister, and moisture seperator equipment; and

(k) proper system operation while powered from primary and alternate sources, including transfers, and in degraded modes for which the system is expected to remain operational.

Refer also to Subsection 6.5.1.4.1.

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications.

14.2.12.1.37 Containment Isolation Valve Leakage Rate Tests

Description of and criteria for preoperational leakage rate tests of containment isolation valves are given in Subsection 6.2.6.3.

14.2.12.1.38 Containment Penetration Leakage Rate Tests

Description of and criteria for preoperational leakage rate tests of containment penetrations are given in Subsection 6.2.6.2.

14.2.12.1.39 Containment Airlock Leakage Rate Tests

Description of and criteria for preoperational leakage rate tests of containment airlocks are given in Subsection 6.2.6.2.

14.2.12.1.40.1 Containment Integrated Leakage Rate Test

Description of and criteria for containment integrated leakage rate tests are given in Subsection 6.2.6.1.

14.2.12.1.40.2 Containment Structural Integrity Test

Description of and criteria for the required containment structural integrity test is given in Subsection 3.8.1.7.1.

14.2.12.1.41 Pressure Suppression Containment Bypass Leakage Tests

Test procedures are identical to those used for other penetrations under isolation conditions as discussed in Subsection 6.2.6.2

14.2.12.1.42 Containment Isolation Valve Functional and Closure Timing Tests

Preoperational functional and closure timing tests of containment isolation valves is discussed in Subsection 6.2.4.

14.2.12.1.43 Wetwell-to-Drywell Vacuum Breaker System Preoperational Test

(1) Purpose

To verify proper functioning of the wetwell-to-drywell vacuum breakers.

(2) Prerequisites

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

(3) General Test Methods and Acceptance Criteria

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of vacuum breaker valves and system logic including verification of opening and closing setpoints and timing;

power conditions

(c) proper functioning of valve positive closure devices including verification of adequate valve leak tightness; and

(d) proper functioning of vacuum breaker test features.

System operation is considered acceptable when the observed/measured performance characteristics meet the applicable design specifications.

14.2.12.1.44 Primary Containment Monitoring Instrumentation Preoperational Test

(1) Purpose

To verify the proper operation of instrumentation used for long term monitoring of the drywell and wetwell atmospheres and suppression pool temperature and level during both normal operations and accident conditions in the primary containment.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. The suppression pool shall be filled and expected to undergo measurable level and temperature changes at some point during the scheduled testing. The required interfacing systems and components are available, as needed, to support the specified testing. Additionally, any parallel testing to be performed in conjunction with the testing of this subsection is appropriately scheduled.

(3) General Test Methods and Acceptance Criteria

A description of the instrumentation required for containment monitoring is presented in Subsection 6.2.1.7. Preoperational testing of these instruments will be performed in conjunction with the testing of the applicable systems. Only that instrumentation requiring special considerations is discussed below.

Performance ~~should~~ Shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper tracking of drywell pressure by all instrument channels during containment integrated leak rate testing;

(b) proper response of all suppression pool level instrumentation during actual changes in pool level;

(c) proper tracking by all suppression pool temperature instrument channels of an actual change in pool temperature;

(d) proper functioning of associated indicators, recorders, annunciators, and alarms including those monitoring instrumentation status; and

(e) proper system trips in response to the appropriate high and/or low setpoints and inoperative conditions.

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications.

14.2.12.1.45 Electrical Systems Preoperational Test

The total plant electrical distribution network is described in Chapter 8 and is comprised of the following systems:

(1) unit auxillary AC power system;
(2) unit Class 1E AC power system;
(3) safety system logic and control system power system;
(4) instrument power system;
(5) uninterruptible power system;
(6) unit auxillary DC power system; and
(7) unit class 1E DC power system.

Because of the similarities in their design and function, the testing requirements for these systems, and their respective components, can be divided into the four general categories as described below. The specific testing required for each system is described in the applicable design and testing specifications.

14.2.12.1.45.1 DC Power Supply System Preoperational Test

(1) Purpose

To verify the ability of DC power supply systems to supply highly reliable, uninterruptable power for instrumentation, logic, control, lighting and other normal and emergency loads that must remain operational during and after a loss of AC power.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedures and has approved the initiation of testing. All interfacing systems and equipment required to support system operation shall be available, as needed, for the specified testing configurations.

(3) General Test Methods and Acceptance Criteria

The DC power supply systems consist of essential and nonessential equipment, including batteries, battery chargers, inverters, static transfer switches, and associated instrumentation and alarms, that is used to supply both normal and emergency loads. Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated systems tests to demonstrate the following:

(a) capability of each battery bank to supply its design load for the specified time without the voltage dropping below minimum battery or cell limits;

(b) capability of each battery charger to fully recharge its associated battery (or bank), from the discharged state, within the specified time while simultaneously supplying the specified loads;

(c) verification that actual loading of each DC bus is consistent with battery sizing assumptions;

(d) verification that each DC bus meets the specified level of redundancy and electrical independence for its particular application;

(e) proper functioning of transfer devices, breakers, cables and inverters (including load capability);

(f) proper calibration and trip settings of protective devices, including relaying, and proper operation of permissive and prohibit interlocks;

(g) proper operation of instrumentation and alarms associated with under voltage, over voltage, and ground conditions; and

(h) proper operation of emergency DC lighting, including capacity of self contained batteries.

14.2.12.1.45.2 Emergency AC Power Distribution System Preoperational Test

(1) Purpose

To verify the ability of the Class 1E AC power distribution system to provide both manual and fully automatic means for supplying and regulating AC power to safety equipment, from both offsite and onsite sources, via independent distribution subsystems for each redundant Class 1E load group.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. All interfacing systems and equipment required to support system operation shall be available, as needed, for the specified testing configurations.

(3) General Test Methods and Acceptance Criteria

The Class 1E AC power distribution system is comprised of the equipment required for transformation, conversion, and regulation of voltage to the essential busses, the switchgear and motor control required for the individual loads served, and the coordinated system protective relaying. Performance ~~should~~ shall be observed and recorded during

a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of initiating, transfer, and trip devices;

(b) proper operation of relaying and logic, including load shedding features;

(c) proper operation of equipment protective devices, including permissive and prohibit interlocks;

(d) proper operation of instrumentation and alarms used to monitor system and equipment status (including availability);

(e) proper operation and load carrying capability of breakers, motor controllers, switchgear, transformers, and cables;

(f) that a sufficient level of redundancy and electrical independence exists as specified for each application;

(g) the capability to transfer between onsite and offsite power sources as per design;

(h) the ability of emergency and vital loads to start in the proper sequence and to operate properly under simulated accident conditions, while powered from either preferred or standby sources, and over the specified range of available bus voltage, and

(i) the adequacy of the plant emergency and essential lighting systems.

14.2.12.1.45.2 Emergency Diesel Generator Preoperational Test

(1) Purpose

To demonstrate the capability of the emergency diesel generators to provide highly reliable emergency electrical power during normal and simulated accident conditions when normal offsite power sources are unavailable, and 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

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. All interfacing systems and equipment required to support system operation shall be available, as needed, for the specified testing configuration. Additionaly, sufficient diesel fuel should be available on site to perform the scheduled tests.

(3) General Test Methods and Acceptance Criteria

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper automatic startup and operation of the diesel generators upon simulated loss of a-c voltage and attainment of the required frequency and voltage within the specified time limits;

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

(c) proper operation of the diesel generators during load shedding, load sequencing, and load rejection, including a test of the loss of the largest single load and of the complete loss of load, verifying that voltage and frequency are maintained within design limits and that overspeed limits are not exceeded;

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

(e) that a LOCA signal will initiate termination of parallel operations (test or manual transfer) and that the diesel

generator will continue to run unloaded and available;

(f) 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) 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 2-hour load rating as described in Reg Guide 1.108 including verification that the diesel cooling systems function within design limits, and the diesel generator HVAC system maintains the diesel generator room within design limits;

(h) functional capability at operating temperature conditions by reperforming the tests in (a) and (b) above immediately after completion of the 24-hour load test per (g) above;

(i) the ability to synchronize the diesel generators with offsite power while connected to the emergency load, transfer the load from the diesel generators to the offsite power, isolate the diesel generators, and restore them to standby status;

(j) that the rate of fuel consumption and the operation of any fuel oil supply pumping or transfer devices, while operating at the design-basis accident load, are such that the requirements for 7-day storage inventory are met for each diesel generator;

(k) that all permissive and prohibit interlocks, controls, and alarms (both local and remote) operate in accordance with design specifications;

(l) acceptable diesel generator reliability during starting and loading sequences as described in Reg. Guide 1.108;

(m) proper operation and correct setpoints for initiating and trip devices and verification of system logic not tested otherwise; and

(n) proper operation of auxiliary systems such as those used for starting, cooling, heating, ventilating, lubricating, and fueling the diesel generators.

14.2.12.1.45.4 Normal AC Power Distribution System Preoperational Test

(1) Purpose

To verify the ability of the normal AC power distribution system to provide a means for supplying AC power to nonessential equipment, from both onsite and offsite sources, via the appropriate distribution network(s).

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. All interfacing systems and equipment required to support system operation shall be available, as needed, for the specified testing configurations.

(3) General Test Methods and Acceptance Criteria

The normal AC power distribution system is comprised of the equipment used for transformation, conversion, regulation, and distribution of voltage to plant nonessential equipment during normal operation. Performance ~~should~~ Shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of initiating, transfer, and trip devices;

(b) proper operation of relaying and logic, including load shedding features;

(c) proper operation of equipment protective devices, including permissive and prohibit interlocks;

(d) proper operation of instrumentation and alarms used to monitor system and equipment status;

(e) proper operation and load carrying capability of breakers, motor controllers, switchgear, transformers, and cables;

(f) sufficient level of redundancy and electrical independence as specified for each application; and

(g) the capability to transfer between onsite and offsite power sources as per design.

Performance of each of the various plant electrical systems is considered acceptable when the testing described above demonstrates that the requirements of the applicable design and testing specifications have been met.

14.2.12.1.46 Integrated ECCS Loss of Offsite Power (LOP)/LOCA Preoperational Test

(1) Purpose

To verify the proper integrated ECCS and plant electrical system response to a simulated LOP/LOCA condition and to verify the independence of the redundant onsite divisional power sources and their associated load groups.

(2) Prerequisites

The preoperational tests of the plant electrical system, including diesel generators, and the ECCS and related auxiliary systems, have been successfully completed. The reactor vessel shall be ready to accept design ECCS injection flow, all ECCS pumps shall have an adequate suction source, the diesel generators should have sufficient fuel available, and essential DC power shall be available. All other required systems shall also be available, as needed, to support the specified integrated testing.

(3) General Test Methods and Acceptance Criteria

For each combination of divisional load groups, two at a time (A and B, B and C, A and C), with the other divisional load group completely isolated from both onsite and offsite power sources (including DC sources), simulate a divisional bus under-voltage condition (LOP) followed immediately by a LOCA signal and verify the following:

(a) that the appropriate divisional diesel generators automatically start, reach rated speed and voltage, and connect to their respective divisional buses according to design and within the specified time;

(b) that all relaying and interlocks related to the LOP/LOCA condition operate properly including the specified shedding and sequencing of sources and loads;

(c) that all divisional loads operate as designed in response to the LOP/LOCA condition, including establishment of the appropriate divisional ECCS flow to the vessel within the specified time; and

(d) that all loads and electrical busses associated with the isolated divisional load group remain deenergized.

The test of each combination ~~should~~ shall be of sufficient duration to allow establishment of stable operating conditions such that any adverse conditions which might result from improper load group assignment (e.g., lack of forced cooling of a vital component or system) would be detected.

After the proper response of each divisional combination has been separately demonstrated the integrated response of all ECCS and electrical divisions ~~should~~ shall be demonstrated by simulating a complete loss of offsite power and LOCA condition and then verifying items (a) through (d) above for all three diesel generators and load groups as they respond and operate simultaneously.

Performance is acceptable when the above testing demonstrates that the applicable design specifications have been met.

14.2.12.1.47 Plant Communications System Preoperational Test

(1) Purpose

To verify the proper operation and adequacy of all plant communications systems and methods that will be used during normal and abnormal operations including those needed to carry out the plant emergency plan.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. Initial system and component settings (gains, volumes, etc.) should be adjusted based on expectations of the acoustic environment and background noise levels for each location and for all modes of operation.

(3) General Test Methods and Acceptance Criteria

The communications systems to be tested include the plant PA system, all hardwired systems within the plant, portable radio systems to be used within the plant boundary, normal and dedicated communications links to outside agencies, and the plant emergency alarms. Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper functioning of all transmitters and receivers without excessive interference levels;

(b) proper operation of all controls, switches, and interfaces including silencing and muting features;

(c) proper isolation and independence of various channels and systems;

(d) proper operation of systems under multiple user and fully loaded conditions as per design;

(e) proper operation of plant emergency alarms;

(f) audibility of speakers and receivers under anticipated background noise levels;

(g) the ability to establish the required communications with outside agencies; and

(h) proper functioning of dedicated use systems and of those systems expected to function under abnormal conditions such as loss of electrical power or shutdown from outside the control room scenarios.

System operation is considered acceptable when the observed/measured performance characteristics meet the applicable design specifications.

14.2.12.1.48 Fire Protection System Preoperational Test

(1) Purpose

To verify the ability of the fire protection system to detect and alarm the presence of combustion, smoke or fire within the plant and to initiate the appropriate suppression systems or devices.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. The required electrical power and make-up water sources, and other appropriate interfaces and support systems, are available as needed for the specified testing.

(3) General Test Methods and Acceptance Criteria

The fire protection system is but one part of the overall fire protection program. This program is the integrated effort involving components, procedures, and personnel utilized in carrying out all activities of fire protection, in accordance with Criterion 3 of 10CFR50, Appendix A. It includes systems and components, facility design, fire prevention, detection, annunciation, confinement, suppression, adminis-

trative controls, fire brigade organization, training, quality assurance, inspection, testing, and maintenance. The fire protection program begins with the initial design of all plant systems and equipment and of the buildings and structures in which they are located. A detailed analysis is then performed on this design to identify, qualify, and quantify all potential fire hazards, and their consequences, within the plant. Specific fire protection equipment is then added, where needed, when individual component design and features such as physical separation, walls, doors, and other barriers and passive devices, do not completely fulfill the requirements of the fire protection program.

The majority of the effort involved in demonstrating that the requirements of the overall fire protection program are met will be through analysis and documentation. Preoperational testing of the fire protection system will mainly be limited to the equipment and facilities designed for the detection, annunciation, and suppression of fires. This testing ~~should~~ Shall include the following demonstrations:

(a) proper operation of instrumentation and equipment in all combinations of logic and control;

(b) proper functioning of prohibit and permissive interlocks and equipment protective devices;

(c) proper operation of system valves, pumps, and motors under expected operating conditions;

(d) proper system and component flow paths, flow rates and capacities;

(e) proper operation of water based suppression systems such as spray, sprinkler, deluge, and hose devices and of other suppression systems such as those utilizing halon, carbon dioxide, foams and dry chemicals, including both manually and automatically actuated systems;

(f) proper operation of freeze protection devices, if applicable;

(g) proper functioning of smoke, heat and flame detection devices;

(h) proper operation of both local and remote alarms including those interfacing with outside agencies; and

(i) proper operation of primary and secondary electrical power sources including fire protection system diesel generators.

System operation is considered acceptable when the observed and measured performance characteristics, from the testing described above, meet the applicable design specifications.

14.2.12.1.49 Radioactive Liquid Drainage and Transfer Systems Preoperational Tests

(1) Purpose

To verify the proper operation of the various equipment and pathways which make up the radioactive liquid drainage and transfer system within the Nuclear Island.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure(s) and has approved the initiation of testing. An adequate supply of demineralized water, the necessary electrical power, and other required interfacing systems shall be available, as needed, to support the specified testing.

(3) General Test Methods and Acceptance Criteria

The testing described below consists of that of the equipment and pathways for the drainage and transfer of radioactive and potentially radioactive liquids within the plant. Also included are dedicated systems for the handling of liquids that require special collection and disposal considerations such as detergents.

Performance should be observed and recorded during a series of individual component and integrated system tests to demonstrate the

following:

(a) proper operation of equipment controls and logic including prohibit and permissive interlocks;

(b) proper operation of equipment protective features and automatic isolation functions;

(c) proper functioning of instrumentation and alarms used to monitor system operation and status;

(d) acceptable system and component flow paths and flow rates including pump capacities and sump or tank volumes;

(e) proper operation of system pumps, valves, and motors under expected operating conditions;

(f) proper functioning of drains and sumps including those dedicated for handling of specific agents such as detergents; and

(g) proper calibration and operation of radiation detectors and monitors.

System operation is considered acceptable when the observed and measured performance characteristics, from the testing described above, meet the applicable design specifications.

14.2.12.1.50 Fuel-Handling and Reactor Component Servicing Equipment Preoperational Test

(1) Purpose

To verify proper operation of the fuel handling and reactor component servicing equipment. This includes cranes, hoists, grapples, trolleys, platforms, hand tools, viewing aids, and other equipment used to lift, transport, or otherwise manipulate fuel, control rods, neutron instrumentation, and other in-vessel, under-vessel, and drywell components. Also included is equipment needed to lift and relocate structures and components necessary to provide access to fuel, vessel internals, and reactor components during the refueling and servicing operations.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. The required electrical power sources and sufficient lighting shall be available under-vessel, in the drywell, and on the refueling floor. The refueling floor (including the upper pools and reactor cavity) and drywell and under-vessel areas shall be capable of supporting load and travel testing of the various cranes, bridges, and hoists. Other interfacing systems shall be available as required to support the specified testing.

(3) General Test Methods and Acceptance Criteria

Fuel handling and reactor component servicing equipment testing described herein includes that of the reactor building crane, refueling bridge, auxiliary platform, and the associated hoists and grapples, as well as other lifting and rigging devices. Also included are specialized hand tools and viewing aids. Fuel pool cooling and cleanup functions are tested as described in Subsection 14.2.12.1.21. The HVAC systems serving the refueling floor and drywell are tested as described in Subsection 14.2.12.1.34.

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation for each crane, bridge, trolley, or platform through its full travel and at up to its maximum speed including verification of braking action and overspeed or overtravel protection devices;

(b) proper operation of the various cables, grapples, and hoists including brakes, limit switches, load cells, and other equipment protective devices;

14.2.12.1.52 Reactor Vessel Flow-Induced Vibration Preoperational Test

(1) Purpose

To collect information needed to verify the adequacy of the reactor internals design, manufacture, and assembly with respect to the potential effects of flow induced vibration. Instrumentation of major components and the flow tests and inspections will provide assurance that excessive vibration amplitudes, if they exist, will be detected at the earliest possible time. The data collected will also help establish the margin to safety associated with steady state and anticipated transient conditions and will help confirm the pretest analytical vibration calculations. This testing will fulfill the preoperational requirements of Regulatory Guide 1.20 for a vibration measurement and inspection program for prototype reactor internals.

(2) Prerequisites

The initial vibration analysis computations and specification of acceptance criteria should be complete. These results should be utilized to define final inspection and measurement programs. Preoperational testing of the recirculation system should be sufficiently complete to ensure safe operation of the reactor internal pumps at rated volumetric flow for the duration of the scheduled flow testing. This includes all required auxiliary systems. All reactor vessel components and structures should be installed and secured as designed in expectation of being subjected to rated volumetric core flow. This includes the steam separator assembly and reactor vessel head but excludes the steam dryer. Also, during the flow testing, the control blades shall either be removed or be fully withdrawn and motion inhibited. The assembly and disassembly of vessel internals should be choreographed such that structures and components requiring inspection are accessible at the proper times. The required sensors shall be installed and calibrated prior to the flow testing. All other systems, components, and structures shall be available, as required, to support the reactor vessel internals vibration assessment program.

(3) General Test Methods and Acceptance Criteria

The reactor internals vibration assessment program consists of three parts: a vibration analysis program, a vibration measurement program, and an inspection program. The vibration analysis portion is performed on the final design, prior to the preoperational test, and the results are used to develop the measurement and inspection portions of the program. The preoperational test therefore consists of an instrumented flow test and pre-and post-test inspections as described in the following paragraphs:

(a) Pre-flow Vessel Inspection

The preflow inspection is performed primarily to establish and document the status of vessel internal structures and components. Some of the inspection requirements may be met by normal visual fabrication inspections. The majority of the inspection requirements will be met by visual and remote observations of the installed reactor internals in a flushed and drained vessel. The following types of structures and components should be included in the vessel internals inspection program:

(1) major load bearing elements including lateral, vertical and torsional supports;

(2) locking and bolting components whose failure could adversely affect structural integrity;

(3) known or potential contact surfaces;

(4) critical locations as identified by the vibration analysis program; and

(5) interior surfaces for evidence of loose parts or foreign material.

(b) Flow testing

The preoperational flow test will be performed at rated volumetric core flow

with the vessel internals completely intact with the exception of the fuel bundles, the control blades (unless fully withdrawn), and the steam dryer assembly. A post fuel load, subcritical flow test will be performed later on the complete reactor assembly unless it is shown analytically or experimentally that the preoperational results are already conservatively bounding. Additionally internals vibration will be measured during individual component or system preoperational testing where operation my result in significant vibrational excitation of reactor internals, such as HPCF testing.

The duration of preoperational testing at the various flow configurations ~~should~~ shall ensure that each critical component is subjected to at least 10^6 cycles of vibration, as calculated using the lowest frequency for which the component is expected to experience a significant structural response.

(c) Post Flow Vessel Inspection

The post flow inspection shall be performed after the resultant vibrational excitation from the preoperational flow testing described above. The structures and components inspected shall be the same as specified for the preflow inspection. Visual and remote observations are performed after the vessel has been depressurized and drained. Inspection of critical surfaces and components ~~should~~ shall be performed prior to any disassembly required for access to other internal structures.

(d) Acceptance Criteria

The acceptance criteria are generated as part of the analytical portion of the program in terms of maximum vibrational response levels of overall structures and components and translated to specific sensor locations.

Reactor vessel internals vibration is considered acceptable when results of the measurement program correlate and compare favorably with those of the analysis program, and, when the results of the inspections show no signs of defects, loose parts, extraneous material, or excessive wear due to flow testing, and are consistent with the results obtained from the analysis and measurement programs.

14.2.12.1.53 Condensate and Feedwater Systems Preoperational Test

(1) Purpose

To verify proper operation of the various components that comprise the condensate and feedwater systems and their capability to deliver the required flow from the condenser hotwell to the nuclear boiler system.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure(s) and has approved the initiation of testing. The required interfacing systems shall be available as needed, to support the specified testing. For all flow testing their shall be an adequate suction source available and an appropriate flow path established.

(3) General Test Methods and Acceptance Criteria

Preoperational testing of the condensate and feedwater systems will include the piping, components, and instrumentation between the condenser and the nuclear boiler but not the condensate filters or demineralizers nor the feedwater heaters, which will be tested separately per the specific discussions provided for those features.

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic and instrument channel trip;

(b) proper functioning of instrumentation and alarms used to monitor system operation and availability;

(c) proper operation of system valves, including timing, under expected operating conditions;

(d) proper operation of pumps and motors in all design operating modes;

(e) acceptable pump NPSH under the most limiting design flow conditions;

(f) proper system flow paths and flow rates including pump capacity and discharge head;

(g) proper pump motor start sequence and margin to actuation of protective devices;

(h) proper operation of interlocks and equipment protective devices in pump, motor, and valve controls;

(i) proper operation of permissive, prohibit, and bypass functions;

(j) proper system operation while powered from primary and alternate sources, including transfers, and in degraded modes for which system components are expected to remain operational;

(k) acceptability of pump/motor vibration levels and system piping movements during both transient and steady state operation; and

(l) proper operation of controllers for pump drivers and flow control valves including those in minimum flow recirculation lines.

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications.

14.2.12.1.54 Condensate Cleanup System Preoperational Test

(1) Purpose

To verify proper operation of the condensate filters and demineralizers and the associated support facilities.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. The condensate system ~~should~~ shall be operational with an established flow path capable of supporting full condensate filter and demineralizer flow. Adequate supplies of ion exchange resin should be available and the radwaste system ~~should~~ shall be capable of processing the expected quantities of water and spent resins. Other required interfacing systems should also be available, as needed, to support the specified testing.

(3) General Test Methods and Acceptance Criteria

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic and instrument channel trip;

(b) proper functioning of instrumentation and alarms used to monitor system operation and status;

(c) proper operation of system valves, including timing, under expected operating conditions;

(d) proper individual vessel and overall system flow rates and pressure drops including bypass capabilities (for both filter and demineralizer units);

(e) proper operation of interlocks and equipment protective devices;

(f) proper operation of permissive, prohibit, and bypass functions;

(g) the ability to perform on-line exchange of standby and spent filter units and demineralizer vessels; and

(h) proper operation of filter and demineralizer support facilities such as those used for regeneration of resins or for handling of wastes.

System operation is considered acceptable when the observed/measured performance characteristics meet the applicable design specifications.

14.2.12.1.55 Reactor Water Chemistry Control Systems Preoperational Test

(1) Purpose

To verify proper operation of the various chemical addition systems designed for actively controlling the reactor water chemistry, including the oxygen injection system, the zinc injection passivation system, the iron ion injection system, and the hydrogen water chemistry system.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure(s) and has approved the initiation of testing. The required interfacing systems shall be available, as needed, to support the specified testing. The appropriate vendor precautions shall be followed with regards to the operation of the affected sytems and componenets and for the actual reactor water chemistry given the existing reactor operating state.

(3) General Test Methods and Acceptance Criteria

Preoperational testing of these systems will concentrate on verifying proper operation of the equipment skids and the various individual components. Actual chemical injection demonstrations and/or simulations shall be limited to only those cases where it is deemed practicable or appropriate with regards to the aforementioned precautions.

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests (to the extent possible) to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic and instrument channel trip;

(b) proper functioning of instrumentation and alarms used to monitor system operation and availability;

(c) proper operation of system valves, including timing and sequencing, under expected operating conditions;

(d) proper system flow paths, flow rates and pressures;

(e) proper operation of system interlocks and equipment protective devices; and,

(f) proper operation of permissive, prohibit, and bypass functions;

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications.

14.2.12.1.56 Condenser Air Removal System Preoperational Test

(1) Purpose

To verify the ability for the mechanical vacuum pumps and the steam jet air ejectors to establish and maintain a vacuum in the main condenser as per design.

(2) Prerequisites

Construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. The main condenser ~~should~~ shall be intact and steam ~~should~~ shall be available from the auxiliary boiler or some other temporary source. Other required interfacing systems shall be available, as needed, to support the specified testing.

(3) General Test Methods and Acceptance Criteria

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic and instrument channel trip;

(b) proper functioning of instrumentation and alarms used to monitor system operation and status;

(c) proper operation of system valves, including timing, under expected operating conditions;

(d) proper operation of the mechanical vacuum pumps including the ability to establish the required vacuum within the design time frame;

(e) proper operation of the steamjet air ejectors including their ability to maintain the specified vacuum in the main condenser (while accounting for the source of the driving steam used);

(f) proper pump motor start sequence and margin to actuation of protective devices;

(g) proper operation of interlocks and equipment protective devices in pump, motor, and valve controls; and

(h) proper operation of permissive, prohibit, and bypass functions;

Operation is acceptable when the observed/measured performance characteristics meet the applicable design specifications.

14.2.12.1.57 Offgas System Preoperational Test

(1) Purpose

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

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. Additionally, instrument air, electrical power, cooling water, and other required system interfaces shall be available, as needed, to support the specified testing.

(3) General Test Methods and Acceptance Criteria

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic and instrument channel trip;

(b) proper functioning of instrumentation and alarms used to monitor system operation and availability;

(c) proper operation of system valves, including isolation features, under expected operating conditions;

(d) proper operation of components in all design operating modes;

(e) proper system and component flow paths and flow rates;

(f) proper operation of interlocks and equipment protective devices;

(g) proper operation of permissive, prohibit, and bypass functions; and

(h) proper system operation while powered from primary and alternate sources, including transfers, and in degraded modes for which the system is expected to remain operational.

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications.

14.2.12.1.58 Hotwell Level Control System Preoperational Test

(1) Purpose

To verify design level control capability in the main condenser hotwell.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. The condenser, condensate storage tank, condensate pumps, and associated valves and piping shall be operational and the other required interfacing systems shall be available, as needed, to support the specified testing.

(3) General Test Methods and Acceptance Criteria

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of system components in all combinations of logic and in response to all expected controller demands;

(b) proper functioning of instrumentation and alarms used to monitor system operation and status;

(c) proper operation of system valves including stroke and timing; and

(d) the ability to maintain the desired hotwell condensate inventory in conjunction with the condensate storage and transfer system.

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications.

14.2.12.1.59 Condensate Storage and Transfer System Preoperational Test

(1) Purpose

To verify the ability of the condensate storage and transfer system to provide an adequate reserve of condensate quality water for make-up to the condensate system, as a preferred suction source for the RCIC and HPCS systems, and for other uses as designed.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. All required interfacing systems shall be available, as needed, to support the specified testing.

(3) General Test Methods and Acceptance Criteria

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic;

(b) proper functioning of permissive and prohibit interlocks;

(c) proper functioning of instrumentation and alarms used to monitor system operation and status including CST volume and/or level;

(d) proper operation of freeze protection devices, if applicable; and

(e) the ability of the system to provide desired flow rates and volumes to the applicable systems and/or components.

Operation is considered acceptable when the observed/measured performance characteristics meet the applicable design specifications.

14.2.12.1.60 Circulating Water System Preoperational Test

(1) Purpose

To verify the proper operation of the circulating water system and its ability to circulate cooling water from the ultimate heat

sink through the tubes of the main condenser in sufficient quantities to condense the steam exhausted from the main turbine under all expected operating conditions.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. The main condenser, ultimate heat sink, appropriate electrical power source(s) and other required interfacing systems shall be available, as needed, to support the specified testing.

General Test Methods and Acceptance Criteria

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic and instrument channel trip;

(b) proper functioning of instrumentation and alarms used to monitor system operation and availability;

(c) proper operation of system valves, including timing, under expected operating conditions;

(d) proper operation of pumps and motors in all design operating modes;

(e) acceptable pump NPSH under the most limiting design flow conditions;

(f) proper system flow paths and flow rates including pump capacity and discharge head;

(g) proper pump motor start sequence and margin to actuation of protective devices;

(h) proper operation of interlocks and equipment protective devices in pump and valve controls;

(i) proper operation of permissive, prohibit, and bypass functions;

(j) proper operation of freeze protection devices, if applicable;

(k) proper system operation while powered from primary and alternate sources, including transfers, and in degraded modes for which the system is expected to remain operational; and

(l) acceptability of pump/motor vibration levels and system piping movements during both transient and steady state operation.

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications. However, due to the lack of significant heat loads during the preoperational test phase, condenser and ultimate heat sink performance evaluation will be performed during the startup phase with the turbine-generator on line.

14.2.12.1.61 Reactor Service Water System Preoperational Test

(1) Purpose

To verify proper operation of the reactor service water (RSW) system and its ability to supply design quantities of cooling water to the RCW system heat exchangers.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. Primary and backup electrical power, the RCW system (including heat exchangers), instrument air, and other required interfacing systems shall be available, as needed, to support the specified testing.

(3) General ~~Test~~ Methods and Acceptance Criteria

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic and instrument channel trip;

(b) proper functioning of instrumentation and alarms used to monitor system operation and availability;

(c) proper operation of system valves, including timing, under expected operating conditions;

(d) proper operation of pumps and motors in all design operating modes;

(e) acceptable pump NPSH under the most limiting design flow conditions;

(f) proper system flow paths and flow rates including pump capacity and discharge head;

(g) proper pump motor start sequence and margin to actuation of protective devices;

(h) proper operation of interlocks and equipment protective devices in pump, motor and valve controls;

(i) proper operation of permissive, prohibit, and bypass functions;

(j) proper operation of freeze protection devices, if applicable;

(k) proper system operation while powered from primary and alternate sources, including transfers, and in degraded modes for which the system is expected to remain operational; and

(l) acceptability of pump/motor vibration levels and system piping movements during both transient and steady state operation.

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications. The heat exchangers which serve as the interface with the RCW system are considered part of that system and will be tested as such. However, due to the probability of insufficient heat loads during the preoperational test phase, it is likely that heat exchanger performance verification will be delayed until the startup phase.

14.2.12.1.62 Turbine Building Cooling Water System Preoperational Test

(1) Purpose

To verify proper operation of the turbine building cooling water (TCW) system and its ability to supply design quantities of cooling water, at the specified temperatures, to designated plant loads.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. Primary and backup power, turbine service water (TSW), instrument air, and other required supporting systems shall be available, as needed, for the specified testing configurations. The cooled components should be operational and operating to the extent possible during heat exchanger performance evaluation.

(3) General Test Methods ~~and~~ Acceptance Criteria

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic and instrument channel trip;

(b) proper functioning of instrumentation and alarms used to monitor system operation and availability;

(c) proper operation of system valves, including timing, under expected operating conditions;

(d) proper operation of pumps and motors in all design operating modes;

(e) acceptable pump NPSH under the most limiting design flow conditions;

(f) proper system and component flow paths, flow rates, and pressure drops, including pump capacity and discharge head;

(g) proper pump motor start sequence and margin to actuation of protective devices;

(h) proper operation of interlocks and equipment protective devices in pump and valve controls;

(i) proper operation of permissive, prohibit, and bypass functions;

(j) proper system operation while powered from primary and alternate sources, including transfers, and in degraded modes for which the system is expected to remain operational;

(k) acceptability of pump/motor vibration levels and system piping movements during both transient and steady state operation;

(l) proper operation of system surge tanks and chemical addition tanks and their associated functions; and

(m) acceptable performance of TCW system heat exchangers, to the extent practical.

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications. Due to the possibility of insufficient heat loads during the preop phase, the final system flow balancing and heat exchanger performance evaluation may have to be performed during the startup phase.

14.2.12.1.63 Turbine Service Water System Preoperational Test

(1) Purpose

To verify the ability of the turbine service water (TSW) system to supply design quantities of cooling water to the TCW heat exchangers.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. Primary and backup electrical power, TCW system heat exchangers, instrument air, and other required interfacing systems shall be available, as needed, to support the specified testing.

(3) General Test Methods ~~and~~ Acceptance Criteria

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic and instrument channel trip;

(b) proper functioning of instrumentation and alarms used to monitor system operation and availability;

(c) proper operation of system valves, including timing, under expected operating conditions;

(d) proper operation of pumps and motors in all design operating modes;

(e) acceptable pump NPSH under the most limiting design flow conditions;

(f) proper system flow paths and flow rates including pump capacity and discharge head;

(g) proper pump motor start sequence and margin to actuation of protective devices;

(h) proper operation of interlocks and equipment protective devices in pump and valve controls;

(i) proper operation of permissive, prohibit, and bypass functions;

(j) proper operation of freeze protection devices, if applicable;

(k) proper system operation while powered from primary and alternate sources, including transfers, and in degraded modes for which the system is expected to remain operational; and

(l) acceptability of pump/motor vibration levels and system piping movements during both transient and steady state operation.

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications. The heat exchangers which serve as the interface with the TBCWS are considered part of that system and will be tested as such. However, due to the probability of insufficient heat loads during the preoperational test phase, it is likely that heat exchanger performance verification will be delayed until the startup phase.

14.2.12.1.64 Main Turbine Control System Preoperational Test

(1) Purpose

To verify proper operation of the turbine control system which includes the turbine stop valves, control valves, intermediate stop and intercept valves, and their associated actuators and hydraulic control.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. The steam bypass and pressure control system shall be operational and other required interfacing systems shall be available, as needed, to support the specified testing.

(3) General Test Methods and Acceptance Criteria

Performance ~~should~~ Shall be observed and recorded during a series of component and system tests to demonstrate the following:

(a) proper functioning of instrumentation and equipment in all combinations of logic and instrument channel trip;

(b) proper operation of instrumentation and alarms used to monitor system operation and status;

(c) proper operation of main stop and control valves and intermediate stop and intercept valves in normal control, trip and test modes (including timing);

(d) proper operation of valve auxiliaries such as hydraulic fluid systems, including pumps and accumulators, and power supplies; and

(e) proper interface with (i.e. response and feedback to) the steam bypass and pressure control system.

Operation is considered acceptable when the observed/measured performance characteristics meet the applicable design specifications.

14.2.12.1.65 Main Turbine Bypass System Preoperational Test

(1) Purpose

To verify proper operation of the turbine bypass system which includes the main turbine bypass valves and their associated actuators and hydraulic control.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. The steam bypass and pressure control system shall be operational and other required interfacing system shall be available, as needed, to support the specified testing.

(3) General Test Methods and Acceptance Criteria

Performance ~~should~~ Shall be observed and recorded during a series of component and system tests to demonstrate the following:

(a) proper functioning of instrumentation and equipment in all combinations of logic and instrument channel trip;

(b) proper operation of instrumentation and alarms used to monitor system operation and status;

(c) proper operation of main turbine bypass valves in normal control, trip and test modes (including timing);

(d) proper operation of valve auxiliaries such as hydraulic fluid systems, including pumps and accumulators, and power supplies; and

(e) proper interface with (i.e. response and feedback to) the steam bypass and pressure control system.

Operation is considered acceptable when the observed/measured performance characteristics meet the applicable design specifications.

14.2.12.1.66 Steam Bypass and Pressure Control System Preoperational Test

(1) Purpose

To verify proper operation of the steam bypass and pressure control system (SBPCS) including, as appropriate, higher level control of the turbine bypass system, the turbine control system, and the recirc flow control system.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. The preoperational tests have been completed on the turbine bypass and control systems (including the EHC system) to extent necessary to support integrated system testing and all SBPCS components have been initially calibrated in accordance with vendor instructions. The required supporting systems and equipment shall be available, as needed, for the specified testing configurations.

(3) General Test Methods and Acceptance Criteria

The SBPCS is primarily an electronic control system. It does not include any large mechanical equipment (i.e. turbine stop, control and bypass valves) nor any associated hydraulic actuators, but does provide for their integrated control. System preoperational testing will be limited to demonstrations without (or with significantly reduced, from a temporary source) turbine steam flow. Comprehensive steam flow testing will be conducted during the startup phase.

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system test to demonstrate the following:

(a) proper operation of instrumentation and controls in all combinations of logic and instrument channel trip, including verification of setpoints;

(b) proper functioning of instrumentation and alarms used to monitor system operation and availability;

(c) proper operation of associated valves, including timing and stroke, in response to control system demands;

(d) proper operation of interlocks and equipment protective devices;

(e) proper operation of permissive, prohibit, and bypass functions;

(f) proper system operation while powered from primary and alternate sources, including transfers, and in degraded modes for which the system is expected to remain operational; and

(g) proper communication and interface with other equipment and control systems.

System operation is considered acceptable when the observed/ measured performance characteristics, from the testing described above, meet the applicable design specifications

14.2.12.1.67 Feedwater Heater and Drain System Preoperational Test

(1) Purpose

To verify proper operation of the feedwater heaters and their associated drains including heater level control capabilities.

(2) Prerequisites

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

testing. All required interfacing systems shall be available, as needed, to support the specified testing.

(3) General Test Method and Acceptance Criteria

The feedwater heater and drain system includes the feedwater heaters, internal and external drain coolers, normal and emergency dump valves, shell and tube side isolation valves, shell side vents and safety relief valves, and associated instrumentation, control and logic.

Performance ~~should~~ Shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic and instrument channel trip;

(b) proper functioning of instrumentation and alarms used to monitor system operation and status;

(c) proper operation of system valves and actuators under expected operating conditions;

(d) proper operation of interlocks and equipment protective devices;

(e) proper operation of permissive, prohibit, and bypass functions; and

(f) proper operation of heater level controls including response of the associated drain/dump valves.

Operation is acceptable when the observed/measured performance characteristics meet the applicable design specifications.

14.2.12.1.68 Extraction Steam System Preoperational Test

(1) Purpose

To verify proper operation of th components which comprise the extraction steam system.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. All required interfacing systems shall be available, as needed, to support the specified testing.

(3) General Test Methods and Acceptance Criteria

Comprehensive testing of the extraction steam system will require the turbine generator to be on line with a substantial amount of steam flow available. Since significant steam flow conditions are dependent on nuclear heating,the preoperational phase testing that is possible will be limited. Performance ~~should~~ Shall be observed and recorded during a series of component and system tests to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic and instrument channel trip;

(b) proper functioning of instrumentation and alarms used to monitor system operation and status;

(c) proper operation of system valves under expected operating conditions including response of air assisted nonreturn check valves to a turbine trip signal;

(d) proper operation of interlocks and equipment protective devices; and

(e) proper operation of permissive, prohibit, and bypass functions.

Operation is acceptable when the observed/measured performance characteristics meet the applicable design specifications.

14.2.12.1.69 Moisture Seperator/Reheater System Preoperational Test

(1) Purpose

To verify proper operation of the turbine moisture sperator/ reheaters (MSRs) and their

associated drain pathways, steam extraction lines, and isolation and non-return check valves.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. All required interfacing systems shall be available, as needed, to support the specified testing.

(3) General Test Methods and Acceptance Criteria

The MSRs include both a moisture seperator and reheater compartment each with their owndrains, shell and tube side isolation valves, shell side vents and safety relief valves, and associated instrumentation, control and logic.

Comprehensive testing of the extraction steam system will require the turbine generator to be on line with a substantial amount of steam flow available. Since significant steam flow conditions are dependent on nuclear heating, the preoperational phase testing that is possible will be limited.

Performance ~~should~~ shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic and instrument channel trip;

(b) proper functioning of instrumentation and alarms used to monitor system operation and status;

(c) proper operation of system valves and actuators (including isolation and non-return check valves) under expected operating conditions;

(d) proper operation of interlocks and equipment protective devices;

(e) proper operation of permissive, prohibit, and bypass functions; and

(f) proper operation of moisture seperator and reheater compartment drain pathways.

Operation is acceptable when the observed/measured performance characteristics meet the applicable design specifications.

14.2.12.1.70 Main Turbine and Auxiliaries Preoperational Test

(1) Purpose

To verify that the operation of the main turbine and its auxiliariy systems, including the gland sealing system, lube oil system, turning gear, supervisory instrumentation, and turbine protection system (including overspeedprotection), is as specified. Testing of the turbine valves and associated control systems is specified separately (elsewhere).

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. To the extent practicable, a temporary steam supply shall be available for driving the turbine. The turbine instruction manual shall be reviewed in detail in order that precautions relative to turbine operation are followed. All required interfacing systems shall be available, as needed, to support the specified testing and the corresponding system configurations.

(3) General Test Methods and Acceptance Criteria

Since preoperational testing is performed utilizing a temporary steam supply, the extent to which the turbine itself can be tested may be limited. Therefore, the testing effort at this stage will concentrate on assuring that the necessary turbine auxiliaries are functioning properly.

Performance ~~should~~ shall be observed and recorded during a series of individual component, subsystem and integrated system tests (to the extent possible) to demonstrate the following, with regrads to both the turbine and its auxiliaries:

(a) proper operation of instrumentation and equipment in all combinations of logic and instrument channel trip;

(b) proper functioning of instrumentation and alarms used to monitor system operation and availability, including the turbine supervisory instrumentation;

(c) proper operation of system pumps and valves in all design operating modes;

(d) proper system flow paths, flow rates and pressures (particularly with regards to the lube oil and gland sealing steam systems);

(e) proper operation of interlocks and equipment protective devices in variousturbine, pump, and valve controls (including the various primary and backup turbine overspeed protection devices);

(f) proper operation of permissive, prohibit, and bypass functions;

(g) proper operation while powered from both primary and alternate sources, including transfers, and in degraded modes for which the system, subsystem or component is expected to remain operational;

(h) proper turbine alignment, including acceptability of displacement and vibration levels,if possible, during both transient and steady state operation;

System operation is considered acceptable when the observed/ measured performance characteristics, from the testing described above, meet the applicable design specifications (while accounting for the testing limitations imposed).

14.2.12.1.71 Main Generator and Auxiliary Systems Preoperational Test

(1) Purpose

Verify that the operation of the main generator and its auxiliariy systems, including the generator hydrogen system and its associated seal oil and cooling systems, those subsystems and/or components that provide cooling to the generator exciter, stator, circuit breakers and isophase bus duct, and the generator protection system, is as specified.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure(s) and has approved the initiation of testing. To the extent practicable, and in conjunction with the turbine preoperational testing, a temporary steam supply shall be available for driving the turbine/generator. The generator instruction manual shall be reviewed in detail in order that precautions relative to generator operation are followed. All required interfacing systems shall be available, as needed, to support the specifiedtesting and the corresponding system configurations.

(3) General Test Methods and Acceptance Criteria

Since preoperational testing in part is performed utilizing a temporary steam supply, the extent to which the turbine, and therefore the generator, can be tested may be limited. Therefore, the testing effort at this stage will concentrate on assuring that the necessary individual generator components and auxiliaries ~~are~~ functioning properly.

Performance shall ~~should~~ be observed and recorded during a series of individual component, subsystem and integrated system tests (to the extent possible) to demonstrate the following, with regrads to both the generator and its auxiliaries:

(a) proper operation of instrumentation and equipment in all combinations of logic and instrument channel trip;

(b) proper functioning of instrumentation and alarms used to monitor system operation and availability;

(c) proper operation of system pumps, valves, fans, and piping or ducting in all design operating modes;

(d) proper system flow paths, flow rates and pressures (particularly with regards to the

generator hydrogen system and its associated seal oil and cooling systems);

(e) proper operation of interlocks and equipment protective devices in the various generator and auxiliary system controls;

(f) proper operation of permissive, prohibit, and bypass functions;

(g) proper operation while powered from primary and any alternate sources, including transfers, and in degraded modes for which the system, subsystem or component is expected to remain operational;

(h) proper generator alignment, including acceptability of clearance and vibration levels, if possible, during both transient and steady state operation;

System operation is considered acceptable when the observed/measured performance characteristics, from the testing described above, meet the applicable design specifications (while accounting for the testing limitations imposed).

14.2.12.1.72 Flammability Control System Preoperational Test

(1) Purpose

To verify the ability of the flammability control system (FCS) to recombine hydrogen and oxygen and therefore maintain the specified inert atmosphere in the primary containment during long term post accident conditions.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. The wetwell and drywell airspace regions of the primary containment should be intact, and all other required interfaces available, as needed, to support the specified testing.

(3) General Test Methods and Acceptance Criteria

Performance ~~should~~ be observed and recorded (Shall) during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of instrumentation and equipment in all combinations of logic;

(b) proper functioning of instrumentation and alarms used to monitor system operation and availability;

(c) proper operation of system valves, including timing, under expected operating conditions;

(d) proper system flow paths and flow rates both into and out of the primary containment;

(e) proper operation of interlocks and equipment protective devices in valve and recombiner skid controls;

(f) proper operation of permissive, prohibit, and bypass functions; and

(g) proper system operation while powered from primary and alternate sources, including transfers, and in degraded modes for which the system is expected to remain operational.

System operation is considered acceptable when the observed/ measured performance characteristics, from the testing described above, meet the applicable design specifications.

14.2.12.1.73 Loose Parts Monitoring System Preoperational Test

(1) Purpose

To verify proper functioning of loose parts monitoring equipment.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. Reactor internals shall be in place with all system sensors connected.

(3) General Test Methods and Acceptance Criteria

Performance should be observed and recorded during a series of system and component test to demonstrate the following:

(a) proper operation of instrumentation and alarms; and

(b) the adequacy of alert level setpoints based on preliminary data.

System operation is considered acceptable when the observed/measured performance characteristics meet the applicable design specifications.

14.2.12.1.74 Seismic Monitoring System Preoperational Test

(1) Purpose

To verify that the seismic monitoring system will operate as designed in response to a seismic event.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and has approved the initiation of testing. The required electrical power should be available and all system recording devices should have sufficient storage medium available.

(3) General Test Methods and Acceptance Criteria

Performance should be observed and recorded during a series of tests, as recommended by the manufacturer, to demonstrate the following:

(a) proper calibration and response of seismic instrumentation including verification of alarm and initiation setpoints;

(b) proper operation of internal calibration or test features;

(c) proper operation of recording and playback devices; and

(d) proper integrated system response to a simulated seismic event.

System operation is considered acceptable when the observed/measured performance characteristics meet the applicable design specifications.

14.2.12.1.75 Liquid and Solid Radwaste Systems Preoperational Tests

(1) Purpose

To verify the proper operation of the various equipment and processes which make up the liquid and solid radwaste systems.

(2) Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure(s) and has approved the initiation of testing. There should be access to appropriate laboratory facilities and an acceptable effluent discharge path, should be established. Additionally, an adequate supply of demineralized water, the necessary electrical power, and other required interfacing systems shall be available, as needed, to support the specified testing.

(3) General Test Methods and Acceptance Criteria

The testing described below consists of that of the equipment and processes for the handling, treating, storing, and preparation for the disposal or discharge of liquid and solid radwaste. Gaseous effluents are treated and released by the offgas system or the standby gas treatment system, the testing of which is specifically described elsewhere.

For the liquid and solid radwaste systems performance should be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

(a) proper operation of equipment controls and logic including prohibit and permissive interlocks;

(b) proper operation of equipment protective features and automatic isolation functions including those for ventilation systems and liquid effluent pathways;

service water systems ~~should~~ shall be operational and other required interfacing systems ~~should~~ shall be available, as needed, to support the specified testing.

(3) General Test Methods and Acceptance Criteria

Performance should be observed and recorded during a series of component and system tests to demonstrate the following:

(a) proper operation of instrumentation and alarms used to monitor system operation and status;

(b) proper operation of active cooling devices, if applicable, such as forced or natural draft towers, spray ponds, etc.; and

(c) the adequacy of intake and discharge structures, including screens or strainers, or other interfaces with the circulating water system, such as freeze protection devices, as applicable.

Operation is acceptable when the observed/measured performance characteristics meet the applicable design specifications.

14.2.12.2 General Discussion of Startup Tests

Those tests proposed and expected to comprise the startup test phase are discussed in this subsection. For each test a general description is provided for test purpose, test prerequisites, test description and test acceptance criteria, where applicable.

Since additions, deletions, and changes to these discussions are expected to occur as the test program is developed and implemented, the descriptions remain general in scope. In describing a test however, an attempt is made to identify those operating and safety-oriented characteristics of the plant which are being explored and evaluated.

Where applicable, the relevant acceptance criteria for the test are discussed. Some of the criteria relate to the value of process variables assigned in the design or analysis of the plant, component systems, and associated equipment. If a criterion of this nature 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 may be repeated to verify that the requirements of the criterion are ultimately satisfied. Other criteria may be associated with expectations relating to the performance of systems. If this type of criterion is not satisfied, operating and testing plans would not necessarily be altered. However, investigations of the measurements and of the analytical techniques used for the predictions would be started. Specific actions for dealing with criteria failures and other testing exceptions or anamolies will be described in the startup administrative manual.

Thus, after it is verified that all CRDs operate properly when installed, tests are performed periodically during heatup to assure that there is no significant binding caused by thermal expansion of the core components and no significant effect on performance due to increased pressure, power or flow. Additionally, software functions such as those associated with the RC&IS are tested to the extent that they could not be checked during preoperational testing. Testing will also be conducted to verify proper operation of the SCRRI logic and function. The particular testing of the SCRRI function might be conducted, at least in part, with the RIP trip test described in 14.2.12.2.30 where the planned trip will automatically result in SCRRI actuation.

(4) Criteria

Each CRD shall have a measured scram time that is less than the technical specifications requirements and consistent with safety analysis assumptions during both individual rod pair and full core scrams, as applicable. Each CRD shall have a measured insert/withdrawal speed consistent with specified design requirements including those associated with group or gang movement. Additionally, the CRDs shall meet friction test requirements and those for demonstrating proper operation of rod deceleration devices. Also, all software functions or features shall perform as specified.

14.2.12.2.6 Neutron Monitoring System Performance

(1) Purpose

To verify response, calibration and operation of startup range neutron monitors (SRNMs), local power range monitors (LPRMs), average power range monitors (APRMs), traversing in-core probes (TIPs), and other hardware and software of the neutron monitoring system during fuel loading, control rod withdrawal, heatup and power ascension.

(2) Prerequisites

The applicable preoperational phase testing is complete and the plant management has reviewed the test procedure(s) and has approved the initiation of testing. For each scheduled test iteration the plant shall be in the appropriate operational configuration with all specified prerequisite testing complete. The applicable instrumentation shall be checked or calibrated as is appropriate.

(3) Description

Testing of the neutron monitoring system will commence prior to fuel load and will continue at intervals up to and including rated power. The SRNMs and operational sources will be tested during fuel loading and during rod withdrawal on the approach to criticality and heatup to rated temperature and pressure. The LPRMs, APRMs and TIPs will be tested as soon as sufficient flux levels exist and at specified intervals during the ascension to rated power. Testing will include response checks, calibrations and verification of system software calculations using actual core flux levels and other live plant inputs.

(4) Criteria

The SRNMs, in conjunction with the installed neutron sources, shall have count rates and signal-to-noise ratios that meet technical specifications and/or design requirements, as applicable. The respective range functions of the SRNMs and APRMs shall provide for overlapping neutron flux indication as required by plant technical specifications and the applicable design specifications. The APRMs shall be calibrated against core thermal power by means of a heat balance. The accuracy of this calibration ~~should~~ be consistent with technical specifications. When technical specifications are not applicable the APRMs ~~should~~ conservatively indicate reactor power. The LPRMs ~~should~~ be calibrated consistent with design calibration and accuracy requirements. Additionally, all system hardware and software shall function properly in response to actual core flux levels.

shall

various plant control systems during actual plant operating conditions.

(2) Prerequisites

The applicable preoperational tests have been completed and plant management has reviewed the testing procedure(s) and has approved the initiation of testing. For each scheduled testing iteration the plant shall be in the appropriate operational configuration with all specified prerequisite testing complete.

(3) Description

During plant heatup and the ascension to rated power the various NSSS and BOP process variables that are monitored by the PCS begin to enter their respective ranges for normal plant operation. During this time it will be verified that the PCS correctly receives, validates, processes, and displays the applicable plant information. Recording and playback features will also be tested. Data manipulation and plant performance calculations using actual plant inputs will be verified for accuracy, using independent calculations for comparison. Also, the ability of the PCS to interface correctly with other plant control systems during operation will be demonstrated.

(4) Criteria

The performance of the PCS shall be as specified by the applicable design requirements. Additionally, plant performance calculations, especially those used to demonstrate compliance with core thermal limits, shall meet the accuracy requirements of the applicable plant safety analysis design assumptions.

14.2.12.2.8 Core Performance

(1) Purpose

To demonstrate that the various core and reactor performance characteristics such as power versus flow, core power distributions, and those parameters used to demonstrate compliance with core thermal limits and plant license conditions are in accordance with design limits and expectations.

(2) Prerequisites

The applicable preoperational tests have been completed and plant management has reviewed the test procedure(s) and has approved the initiation of testing. For each scheduled testing iteration the plant shall be in the appropriate operational configuration with all specified prerequisite testing complete, especially on plant systems to be used for collection or evaluation of pertinent data.

(3) Description

This test will collect data sufficient to demonstrate that reactor and core performance characteristics remain within design limits and expectations for all operational conditions which the plant is normally expected to encounter. Beginning with rod withdrawal and continuing through initial criticality, plant heatup, and the ascension to rated power, pertinent data will be collected at various rod patterns and power and flow conditions sufficient to determine the axial and radial core power distributions, compliance with core thermal limits, and the level of consistency with predicted core reactivity and power versus flow characteristics. Unusual plant conditions such as during control rod sequence exchange or natural circulation will also be investigated, if applicable.

(4) Criteria

Technical specification and license condition requirements involving core thermal limits, maximum power level, total core flow, and any observed reactivity anamolies or core instabilities shall be met when applicable. Other observations should meet predictions and expectations or else ~~should~~ shall be evaluated and explained accordingly.

14.2.12.2.9 Nuclear Boiler Process Monitoring

(1) Purpose

To verify proper operation of various nuclear boiler process instrumention and to collect pertinent data from such instrumenta-

tion at various plant operating conditions in order to validate design assumptions and identify any operational limitations that may exist.

(2) Prerequisites

The applicable preoperational testing has been completed and plant management has reviewed the test procedure(s) and has approved the initiation of testing. For each scheduled testing iteration the plant shall be in the appropriate operational configuration with all specified prerequisite testing complete.

(3) Description

During plant heatup and power ascension pertinent parameters such as reactor coolant temperature, vessel dome pressure, vessel water level, and core flow will be monitored at selected intervals and plant conditions. This data will be used to verify proper instrument response to changing plant conditions and to document the relationships amongst these parameters and with other important parameters such as reactor power, feedwater flow and steam flow. The data will also be used to validate design assumptions such as those used in the calibration of vessel level or core flow indication. Additionally, the data will be used to help identify potential operational condition limitations such as excessive coolant temperature stratification in the vessel bottom head region.

(4) Criteria

The various nuclear boiler process instrumentation shall operate as designed in response to changes in plant conditions. The observed process characteristics shall be conservative relative to applicable safety analysis assumptions and should be consistent with design expectations.

14.2.12.2.10 System Expansion

(1) Purpose

The purpose of the thermal expansion test is to confirm that the pipe suspension system is working as designed and the piping is free of obstructions that could constrain free pipe movement caused by thermal expansion.

(2) Prerequisites

The preoperational tests have been completed and plant management has reviewed the test procedures and has approved the initiation of testing. For each scheduled testing iteration the plant shall be in the appropriate operational configuration with the specified prerequisite testing complete. The applicable instrumentation shall be checked or calibrated as is appropriate.

(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 ~~should~~ Shall be recorded at at least the following test points (following a suitable hold period to assure steady state temperatures):

(a) during reactor pressure vessel heatup at at least one intermediate temperature prior to reaching normal operating temperature, including an inspection of the piping and its suspension for obstructions or inoperable supports;

(b) following reactor pressure vessel heat up to normal operating temperature;

(c) following heatup of other piping systems to normal operating temperature (those systems whose heatup cycles differ from (2) above); and

(d) on subsequent heatup/cooldown cycles, as specified, at the applicable operating and shutdown temperatures, to measure possible shakedown effects.

Thermal expansion shall be conducted on plant systems of the following classifications:

(a) ASME Code Class 1, 2, and 3 systems;

(b) high energy piping systems inside Seismic Category I structures;

(c) high energy portions of systems whose failure could reduce the functioning of any Seismic Category I plant features to an unacceptable level; and

(d) Seismic Category I portions of moderate energy piping systems located outside containment.

(4) Criteria

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 distributions. 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 should 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 by the applicable design or testing specification.

14.2.12.2.11 System Vibration

(1) Purpose

To verify that the vibration of critical plant system components and piping is within acceptable limits during normal steady state power operation and during expected operational transients.

(2) Prerequisites

The applicable preoperational phase testing is complete and plant management has reviewed the test procedure(s) and has approved the initiation of testing. For each scheduled test iteration the plant shall be in the appropriate operational configuration with all specified prerequisite testing complete. The required remote monitoring instrumentation ~~should~~ shall be calibrated and operational.

(3) Description

Vibration testing during the power ascension phase will be limited to those systems that could not be adequately tested during the preoperational phase. Systems within the scope of this testing are therefore the same as mentioned in Subsection 14.2.12.1.51. However, the systems that remain to be tested will primarily be those exposed to and affected by steam flow and high rates of core flow. Due to the potentially high levels of radiation present during power operation, the testing will be performed using remote monitoring instrumentation. Displacement, acceleration, and strain data will be collected at various critical steady state operating conditions and during significant transients such as turbine or generator trip, main steamline isolation, SRV actuation and RIP trip (if not already performed). Steady state and transient vibration affecting the RCIC steamline will also be monitored.

(4) Criteria

Criteria will be calculated for those points monitored for vibration for both steady state and transient cases. Two levels of criteria will be generated, one level for predicted vibration and one level based on acceptable values of displacement and acceleration and the associated stress to assure that there will be no failures from fatigue over the life of the plant. Failures to remain within the predicted levels of vibration should be investigated but do not necessarily preclude the continuation of further testing. However, failure to meet the criteria based on stress limits will require immediate investigation and resolution while the plant or affected system is placed in a safe condition.

14.2.12.2.12 Reactor Internals Vibration

(1) Purpose

To collect information needed to verify the adequacy of the design, manufacture, and assembly of reactor vessel internals with respect to the potential affects of flow induced vibration.

(2) Prerequisite

The applicable preoperational phase testing is complete, including the required inspections, and plant management has reviewed the test procedure and has approved the initiation of testing. For each scheduled testing iteration the plant shall be in the appropriate operational configuration with all specified prerequisite testing complete. The necessary special instrumentation ~~should~~ shall be calibrated and operational.

(3) Description

Reactor internal vibration testing subsequent to fuel loading is merely an extension of the program described during the preoperational phase in Subsection 14.2.12.1.52. The vibration measurement portion of that program ~~should be~~ expanded during the power ascension phase to include intermediate and critical power and flow conditions during steady state operation and anticipated operational transients that are expected to result in limiting or significant levels of reactor internals vibration over and above what was observed during the preoperational phase.

(4) Criteria

Criteria for limits on reactor internals vibration levels are developed during the vibration analysis portion of the assessment program as described in Subsection 14.2.12.1.52.

14.2.12.2.13 Recirculation Flow Control

(1) Purpose

To demonstrate that the stability and response characteristics of the recirculation flow control system are in accordance with design requirements for all applicable modes of control across the span of expected operational conditions.

(2) Prerequisites

The preoperational tests have been completed and plant management has reviewed the test procedure and has approved the initiation of testing. For each scheduled testing iteration the plant shall be in the appropriate operational configuration with all specified prerequisite testing complete. This includes preliminary adjustment and optimization of control system components, as appropriate.

(3) Description

Startup phase testing of the recirculation flow control system is intended to demonstrate that the overall response and stability of the system meets design requirements subsequent to controller optimization. Performance shall be demonstrated at a sufficient number of power and flow points to bound the expected system operational conditions including applicable modes of control (speed, flow and automatic load following) for each such demonstration. Testing will be accomplished by manual manipulation of controllers and/or by direct input of demand changes at various levels of control. Special control features such as those used to maintain a specified margin to the high flux scram setpoint or to avoid regions of potential core instability should also be demonstrated as appropriate.

(4) Criteria

Above all else, system performance shall be stable such that any type of divergent response is avoided. The response should also be sufficiently fast but with any oscillatory modes of response well damped, usually with decay ratios less than .25. The overall response of the system, at all levels of control, should be within design requirements with respect to such standard control system criteria as response time,

rise time, overshoot, and settling time. Also, the overall system performance should be in accordance with expectations for anticipated transients.

14.2.12.2.14 Feedwater Control

(1) Purpose

To demonstrate that the stability and response characteristics of the feedwater control system are in accordance with design requirements for applicable system configurations and operational conditions.

(2) Prerequisites

The preoperational tests are complete and plant management has reviewed the test procedure and has approved the initiation of testing. For each scheduled testing iteration the plant shall be in the appropriate operational configuration with all specified prerequisite testing complete. This includes preliminary adjustments and optimization of control system components, as appropriate.

(3) Description

Startup phase testing of the feedwater control system is intended to demonstrate that the overall response and stability of the system meets design requirements subsequent to controller optimization. Testing will begin during plant heatup for any special configurations designed for very low feedwater or condensate flow rates and will continue up through the normal full power line up. Testing ~~should~~ Shall include all modes of control and should encompass all expected plant power levels and operational conditions. Testing will be accomplished by manual manipulation of controllers and/or by direct input of demand changes at various levels of control. System response ~~should~~ Shall also be evaluated under transient operational conditions such as an unexpected loss of a feedwater pump or a rapid reduction in core flow and/or power level and after plant trips such as turbine trip or main steam line isolation. Proper setup of control system components or features designed to handle the nonlinearities or dissimilarities in system response at various conditions ~~should~~ shall also be demonstrated. The above testing will also serve to demonstrate overall core stability to subcooling changes.

(4) Criteria

Above all else the feedwater control system performance shall be stable such that any type of divergent response is avoided. The response should be sufficiently fast but with any oscillatory modes of response well damped, usually with decay ratios less than 0.25. Additionally, the open loop response of the system should meet design requirements with respect to such standard control system criteria as response time, rise time, overshoot, and settling time. Also, the overall system response should be as expected following major plant transients and trips.

14.2.12.2.15 Pressure Control

(1) Purpose

To demonstrate that the stability and response characteristics of the pressure regulation system are in accordance with the design requirements for all modes of control under expected operating conditions.

(2) Prerequisites

The preoperational tests have been completed and plant management has reviewed the test procedure and has approved the initiation of testing. For each scheduled testing iteration the plant shall be in the appropriate operational configuration with all specified prerequisite testing complete. This includes preliminary adjustment and optimization of control system components, as appropriate.

(3) Description

Startup phase testing of the pressure control system is intended to demonstrate that the overall response and stability of the system meets design requirements, subsequent to control system optimization. Performance

shall be evaluated across the spectrum of anticipated steam flows for both the pressure regulation and load following modes of control, as applicable. Testing ~~should~~ shall demonstrate acceptable response with either the turbine control valves or bypass valves in control and for the transition between the two. Testing will be accomplished by manual manipulation of controllers and/or direct input of demand changes at various levels of control. It ~~should~~ shall also be demonstrated that other affected parameters remain within acceptable limits during such pressure regulator induced transient maneuvers. Overall system response will be evaluated during other plant transients as well. Additionally, proper setup of components or features designed to deal with the nonlinearities or dissimilarities in system response that may exist under various conditions ~~should~~ shall be demonstrated.

(4) Criteria

Above all else, system performance shall be stable such that any type of divergent response is avoided. The response should be sufficiently fast but with any oscillatory modes of response well damped, usually with decay ratios less than .25. The overall response of the system, for each mode and level of control, should be within design requirements for such standard control system criteria as response time, rise time, overshoot and setting time. Also, the overall system performance should be in accordance with expectations for anticipated transients.

14.2.12.2.16 Plant Automation and Control

(1) Purpose

To verify proper plant performance in automatic modes of control such as during automatic plant startup or automatic load following (ALF) under the direction of the power generation control system (PGCS) and the automatic power regulator (APR).

(2) Prerequisites

The applicable preoperational tests have been completed and plant management has reviewed the testing procedure and has approved the initiation of testing. Affected systems and equipment, including lower level control systems such as RC&IS, recirc flow control, feedwater control and turbine control, as well as monitoring and predicting functions of the plant process computer and/or automation computer, shall have been adequately tested under actual operating conditions.

(3) Description

A comprehensive series of tests will be performed in order to demonstrate proper functioning of the various plant automation and control features. This testing shall include or bound all expected plant operating conditions under all permissable modes of control and shall also verify, to the extent possible, avoidance of prohibited or undesirable conditions or control modes. ALF capabilities will be demonstrated under control of the APR for both control rod movements and core flow changes including anticipated transition regions. Such testing will include demonstration(s) that the dynamic response of the plant to design load swings for the facility, including limiting step and ramp changes as appropriate, is in accordance with design. The ability of the PGCS to properly orchestrate automated plant startup, shutdown and power maneuvering will be shown. Also to be tested are system components or interfaces that perform monitoring, prediction, processing, validation, alarm, protection or control functions.

(4) Criteria

The PGCS, APR and other features and functions of plant automation and control shall perform in accordance with the applicable design and testing specifications. Automatic maneuvering characteristics of plant and systems shall meet the appropriate response and stability requirements. Safety and protection features shall perform consistant with safety analysis assumptions and predictions.

dance with design requirements.

(2) Prerequisites

The preoperational testing is complete and plant management has reviewed the test procedure and has approved the initiation of testing. For each scheduled testing iteration the plant shall be in the appropriate operational configuration with all specified prerequisite testing complete. Instrumentation has been checked or calibrated, as is appropriate.

(3) Description

Pertinent recirculation system and related parameters will be monitored at a variety of power and flow conditions in order to demonstrate that system operation is in accordance with design. Parameters to be monitored and evaluated should include RIP speeds, pump deck and core plate differential pressures, pump efficiencies, maximum core flow capability and any number of other variables that may indicate the status of the RIPs and their shafts, motors, or heat exchangers. Data shall also be taken and evaluated during transient conditions such as pump trips and restarts, and during off normal conditions such as one pump out of service operation. Of particular interest might be the onset of reverse flow through idle pumps and the calibration of total core flow indications during both normal and off normal operating conditions.

(4) Criteria

When applicable, measured parameters shall compare conservatively with safety analysis design assumptions. Additionally, test data should demonstrate that system steady state and transient performance meets design requirements.

14.2.12.2.18 Feedwater System Performance

(1) Purpose

To verify that the overall feedwater system operates in accordance with design requirements.

(2) Prerequisites

The preoperational testing is complete and plant management has reviewed the test procedure and has approved the initiation of testing. For each scheduled testing iteration the plant shall be in the appropriate operational configuration with all specified prerequisite testing complete. Applicable instrumentation has been checked or calibrated as is appropriate.

(3) Description

Pertinent parameters will be monitored throughout the feedwater system, and condensate system if appropriate, across the spectrum of system flow and plant operating conditions in order to demonstrate that system operation is in accordance with design. Parameters to be monitored may include temperatures, pressures, flow rates, pressure drops, pump speeds and developed heads, and general equipment status. Of special interest will be data that serves to verify design assumptions used in plant transient performance and safety analysis calculations like maximum feedwater runout capabilities and feedwater temperature versus power level relationships. Steady state and transient testing will be conducted as necessary, to assure that adequate margins exist between system variables and setpoints of instruments monitoring these variables to prevent spurious actuations or loss of system pumps and motor-operated valves.

(4) Criteria

When applicable, measured parameters shall compare conservatively with safety analysis design assumptions. Additionally, test data should demonstrate that system steady state and transient performance meets design requirements.

14.2.12.2.19 Main Steam System Performance

(1) Purpose

To verify that main steam system related performance characteristics are in accordance with design requirements.

testing. For each scheduled testing iteration the plant shall be in the appropriate operational configuration with all prerequisite testing complete. Applicable instrumentation shall be checked or calibrated as is appropriate.

(3) Description

Pertinent system parameters, such as temperatures, pressures, and flows, will be monitored at various steam flow rates in order to demonstrate that system operation is in accordance with design. The steam flow measuring devices that provide input to feedwater control and/or leak detection logic ~~should~~ shall be crosschecked to verify the accuracy of design calibration assumptions. If appropriate, the pressure drop developed across critical components ~~should~~ shall be compared with design values. The quality of the steam leaving the reactor ~~should~~ shall also be determined to be within design requirements (if not previously tested).

(4) Criteria

When applicable, measured parameters shall compare conservatively with safety analysis design assumptions. Additionally, test data should demonstrate that system steady state and transient performance meets design requirements.

14.2.12.2.20 Residual Heat Removal System Performance

(1) Purpose

To verify that residual heat removal system performance is in accordance with design for actual plant operating conditions.

(2) Prerequisites

The preoperational testing is complete and plant management has reviewed the test procedure and has approved the initiation of testing. For each scheduled testing iteration the plant shall be in the appropriate operational configuration with all specified prerequisite testing complete. Instrumentation has been checked or calibrated as appropriate.

(3) Description

Startup phase testing of the RHR system is intended to demonstrate the capabilities of the system beyond what was possible during the preoperational phase due to insufficient temperature and pressure conditions. Pertinent system parameters will be monitored in the suppression pool cooling and shutdown cooling modes to verify that overall system operation and heat removal capabilities are in accordance with design requirements. An attempt ~~should~~ shall be made to obtain results with flow rates and temperatures near process diagram values. However, due to the relatively low core exposures and decay heat loads expected during the startup program, care should be taken such that the limit on vessel cooldown rate is not exceeded.

(4) Criteria

System performance, especially heat removal capability, shall meet safety analysis requirements. Additionally, measured parameters should indicate that overall system performance is consistent with design expectations.

14.2.12.2.21 Reactor Water Cleanup System Performance

(1) Purpose

To verify that reactor water cleanup system performance, in all modes of operation, is in accordance with design requirements at rated reactor temperature and pressure conditions.

(2) Prerequisites

The preoperational testing is complete and plant management has reviewed the test procedure and has approved the initiation of testing. For each scheduled testing iteration the plant shall be in the appropriate operational configuration with the specified prerequisite testing complete. Instrumentation has been checked or calibrated as appropriate.

(3) Description

Startup phase testing of the RWCU system is an extension of the preoperational tests for rated temperature and pressure conditions. System parameters will be monitored in the various modes of operation at critical temperature, pressure and flow conditions.

The performance of system heat exchangers and filter/demineralizer units will be evaluated at hot operating conditions. The ability of the system to reject excess vessel inventory during plant heatup will be verified. Other system features ~~should~~ shall be demonstrated as appropriate.

(4) Criteria

System performance should meet the specified design requirements in all operating modes.

14.2.12.2.22 RCIC System Performance

(1) Purpose

To verify proper operation of the RCIC system over its expected operating pressure and flow ranges, and to demonstrate reliability in automatic starting from cold standby with the reactor at power.

(2) Prerequisites

The preoperational tests are complete and plant management has reviewed the test procedure and has approved the initiation of testing. For each scheduled testing iteration the plant shall be in the appropriate operational configuration with all specified prerequisite testing complete. All applicable instrumentation shall be checked or calibrated as is appropriate.

(3) Description

The RCIC system will be tested in two ways, through a full flow test line leading to the suppression pool and by flow injection directly into the reactor vessel. The first set of tests will consist of manual and automatic mode starts and steady state operation, at 150 psig and near rated reactor pressure conditions, in the full flow test mode. During these tests an attempt will be made to throttle pump discharge pressure in order to simulate reactor pressure and the expected pipeline pressure drop. This testing is done to demonstrate general system operability and to make most controller adjustments. Reactor vessel injection tests will follow to complete the controller adjustments. Proper controller adjustment is verified by introducing small step disturbances in speed and flow demand and then demonstrating satisfactory system response and stability. This will be done at both low RCIC pump flow (but above minimum turbine speed) and near rated RCIC pump flow conditions, and at reactor pressures of 150 psig and rated, in order to span the RCIC operating range.

After all controller and system adjustments have been made a defined set of demonstrations will be performed with the final settings. This will include two consecutive successful reactor vessel injections, by automatic initiation from the cold standby condition, to demonstrate system reliability. Cold is defined as a minimum of 72 hours without any kind of RCIC operation. Following these tests, system data will be collected while operating in the full flow test mode to provide a benchmark for comparison with future surveillance tests. Additionally, a demonstration of extended operation of up to two hours (or until the pump and turbine and their auxiliaries have stabilized) of continuous operation at rated flow conditions will be performed. For all testing proper operation of the system and related auxiliaries will be evaluated.

Additionally, proper functioning of the RCIC steamline isolation valves will be verified at rated temperature and pressure and at higher power levels if appropriate. This verification will include proper valve operation and acceptable closure timing in response to an isolation signal. Also, sufficient operating data will be taken in order to verify proper setting of, or to adjust as necessary, the high RCIC steamline flow trip setting of the leak detection and isolation system trip logic.

¶ Also, any RCIC system testing that was not performed during the preoperational test phase, due to the insufficiency of the temporary steam supply source utilized, will be completed as early in the program as is practicable.

tendencies and should provide quick but stable response.

14.2.12.2.23 Plant Cooling/Service Water System(s) Performance

(1) Purpose

To verify performance of the various plant cooling/service water systems, including the reactor building cooling water system, the reactor service water system, the turbine building cooling water system and the turbine service water system under expected reactor power operation load conditions.

(2) Prerequisites

The preoperational tests are complete and plant management has reviewed the test procedure and has approved the initiation of testing. For each scheduled testing iteration, the plant shall be in the appropriate operational configuration with the specified prerequisite testing complete. All applicable instrumentation shall be checked or calibrated as is appropriate.

(3) Description

Power ascension phase testing of plant cooling water systems is necessary only to the extent that fully loaded conditions could not be approached during the preoperational phase. Pertinent parameters should be monitored in order to provide a final verification of proper system flow balancing and heat exchanger performance under near design or special conditions, as is appropriate. This will include extrapolation of results obtained under normal or test conditions as needed to demonstrate required performance at limiting or accident conditions.

(4) Criteria

System performance should be consistent with design requirements. For systems that are taken credit for in the plant safety analysis, performance shall meet the minimum requirements assumed in such analysis.

14.2.12.2.24 HVAC System Performance

(1) Purpose

To verify various HVAC systems performance for the loads present during reactor power operation.

(2) Prerequisites

The preoperational tests are complete and plant management has reviewed the test procedure(s) and has approved the initiation of testing. For each scheduled testing iteration, the plant shall be in the appropriate operational configuration with the specified prerequisite testing complete. All applicable instrumentation shall be checked or calibrated as is appropriate.

(3) Description

Power ascension phase testing of plant HVAC systems is necessary only to the extent that fully loaded conditions could not be approached during the preoperational phase. Pertinent parameters should be monitored in order to provide a final verification of proper system flow balancing and cooler performance under near design or special situation conditions, as is appropriate. This will include extrapolation of results obtained under normal or test conditions as needed to demonstrate required performance at limiting or accident conditions.

(4) Criteria

System performance should be consistent with design requirements. For systems that are taken credit for in the plant safety analysis, performance shall meet the minimum requirements assumed in such analysis.

14.2.12.2.25 Turbine Valve Performance

(1) Purpose

To demonstrate proper functioning of the main turbine control, stop, and bypass valves during reactor power operation.

steamlines downstream of the SRVs. Tailpipe sensors may include temperature indications, pressure switches or acoustic monitors. Downstream indications of SRV operation could be changes in such parameters as turbine valve positions or generator output. Such changes will also be evaluated for anomalies which may indicate a restriction or blockage in a particular SRV tailpipe by making valve to valve comparisons. Tailpipe backpressures ~~should~~ Shall also be evaluated against any bounding design assumptions. Additionally, during applicable plant transient testing, where SRVs are expected to open, operability, opening setpoints, and reset pressures will be verified.

(4) Criteria

There shall be a positive indication of steam discharge during each manual valve opening. For automatic openings the relief setpoints and reset pressures shall be within technical specification limits. SRV open and close indications, including tailpipe sensors, should function as designed. For manual openings the apparent steam flow through each SRV should not vary significantly from the average for all valves. Tailpipe back pressures should be consistent with design assumptions.

14.2.12.2.28 Loss of Feedwater Heating

(1) Purpose

To demonstrate proper integrated plant response to a loss of feedwater heating event and to verify the adequacy of the modeling and associated assumptions used for this transient in the plant licensing analysis.

(2) Prerequisites

The preoperational tests are complete and plant management has reviewed the test procedure and has approved the initiation of testing. The plant shall be in the appropriate operational configuration with the specified prerequisite testing complete. All applicable instrumentation shall be checked or calibrated as is appropriate.

(3) Description

The credible single failure or operator error that has been indentified as resulting in the largest feedwater temperature reduction will be initiated at a significantly high power level, while considering the event analyzed and the predicted results. Core performance and overall plant response will be observed in order to demonstrate proper integrated response and to compare actual results with those predicted. This comparison will take into account the differences between actual initial conditions and observed results and the assumptions used for the analytical predictions.

(4) Criteria

Resultant MCPR shall remain greater than the fuel thermal safety limit and measured results shall compare conservatively with design assumptions and predictions. The overall plant response should be according to design and testing specifications.

14.2.12.2.29 Feedwater Pump Trip

(1) Purpose

To demonstrate the ability of the plant to respond to and survive the loss of an operating feedwater pump from near rated power conditions.

(2) Prerequisites

The preoperational tests are complete and plant management has reviewed the test procedure and has approved the initiation of testing. The plant shall be in the appropriate operational configuration with the specified prerequisite testing complete. Applicable instrumentation shall be checked or calibrated as is appropriate.

(3) Description

From an initial reactor power level near rated, one of the operating feedwater pumps will be tripped and it will be demonstrated that the overall plant response is such that a reactor trip is avoided. Specifically, it ~~should~~ Shall be verified that the feedwater control system is sufficiently responsive, in

(3) Description

This test ~~should~~ shall be performed from a low

initial power level but from one that is sufficiently high such that a majority of plant systems are in their normal configurations for power operation. This test is as much a test of normal and emergency plant procedures and the ability of plant personnel to carry them out as it is a test of plant systems and equipment. Therefore, the test ~~should~~ shall be performed using the minimum shift crew that would be available during an actual event. Additional qualified personnel will be available in the control room to monitor the progress of the test and to re-establish control of the plant should an unsafe condition develop. These personnel will also perform predefined non-safety related activities to protect plant equipment where such activities would not be required during an actual emergency situation. The test will be initiated by simulating a control room evacuation and then tripping the reactor by means outside of the control room. Achievement and maintenance of the hot standby condition is then demonstrated through control of vessel pressure and water level. The ability to reach cold shutdown is demonstrated by cooling the reactor down to where some form of residual heat removal can be and is initiated by establishing a heat rejection path to the ultimate heat sink, again by means entirely outside of the main control room. The cold shutdown capability does not necessarily have to be demonstrated immediately following the shutdown and hot standby demonstration as long as the total integrated capability is adequately demonstrated. Also, additional personnel, over and above the minimum shift crew, may be utilized for the cold shutdown portion of the test consistent with plant procedure and management's ability to assemble extra help at the plant site in emergency situations.

(4) Criteria

The remote shutdown test ~~should~~ shall, as a minimum, demonstrate the capability of plant personnel, equipment, and procedures to initiate a reactor trip, to achieve and maintain hot standby conditions for at least 30 minutes, and to initiate decay heat removal such that coolant temperature is reduced by at least 50°F, all from outside the main control room. Additionally, system and plant performance should be consistent with design and testing specification requirements.

14.2.12.2.32 Loss of Turbine Generator and Offsite Power

(1) Purpose

To verify proper electrical equipment response and reactor system transient performance during and subsequent to a turbine generator trip with coincident loss of all offsite power sources.

(2) Prerequisites

The preoperational tests are complete and plant management has reviewed the test procedure and has approved the initiation of testing. The plant shall be in the appropriate operational configuration with all specified prerequisite testing complete. Applicable instrumentation shall be checked or calibrated as is appropriate. A sufficient number of qualified personnel shall be available to handle the needs of this test as well as those associated with normal plant operation.

(3) Description

This test ~~should~~ shall be performed at a relatively low power level early in the power ascension phase, but with the generator on line at greater than 10% load. The test will be initiated in a way such that the turbine generator is tripped and the plant is completely disconnected from all offsite power sources. The plant shall then be maintained isolated from offsite power for a minimum of 30 minutes. During this time, appropriate parameters will be monitored in order to verify the proper response of plant systems and equipment, including the proper switching of electrical equipment and the proper starting and sequencing of onsite power sources and their respective loads.

(4) Criteria

All safety-related equipment and systems, and others judged to be important to safety

for this event, shall function as designed in accordance with technical specification and safety analysis requirements. All other systems and equipment should perform consistent with applicable design and testing specifications.

14.2.12.2.33 Turbine Trip and Generator Load Rejection

(1) Purpose

To verify that the dynamic response of the reactor and applicable systems and equipment is in accordance with design for protective trips of the turbine and generator during power operation.

(2) Prerequisites

The preoperational tests are complete and plant management has reviewed the test procedure and has approved the initiation of testing. The plant shall be in the appropriate operational configuration with all specified prerequisite testing complete. All applicable instrumentation shall be checked or calibrated as is appropriate.

(3) Description

From an initial power level near rated, the main generator will be tripped in order to verify the proper reactor and integrated plant response. The method for initiating the trip should be chosen so that the turbine [illegible]d to maximum overspeed potential. Reactor parameters such as vessel dome pressure and simulated fuel surface heat flux will be monitored and compared with predictions so that the adequacy and conservatism of the analytical models and assumptions used to license the plant can be verified. Proper response of systems and equipment such as the turbine stop, control, and bypass valves, main steam relief valves, the reactor protection system, and the feedwater and recirculation systems will also be demonstrated. The core flow coastdown characteristics should be evaluated upon actuation of the recirculation pump trip logic. The ability of the feedwater system to control vessel level after a reactor trip ~~should~~ [Shall] also be verified. Overspeed of the main turbine ~~should~~ [Shall] also be evaluated since the generator is unloaded prior to complete shutoff of steam to the turbine.

For a turbine trip, the generator remains loaded and there is no overspeed. However, the dynamic response of the reactor may be different if the steam shutoff rate is different. If there is expected to be a significant difference, then it may be necessary to perform a separate demonstration and evaluation, similar to that discussed above, but initiated by a direct trip of the main turbine.

A turbine or generator trip should also be performed at an initial power level that is below that where a direct reactor trip is actuated and within the capacity of the bypass valves. Reactor dynamic response is not as important for this transient except for the ability to remain operating as designed. More important is the demonstration of proper integrated plant and system performance.

(4) Criteria

The reactor shall not scram during turbine or generator trips initiated from power levels within the capacity of the bypass valves and below the point at which the direct scram trip on turbine stop valve closure or control valve fast closure is enabled. For high power turbine or generator trips, reactor dynamic response should be consistent with predictions based on expected system characteristics and shall be conservative relative to safety analysis results based on design assumptions. Of particular importance are vessel dome pressure and simulated fuel surface heat flux. Safety-related and essential equipment and systems shall respond, as applicable, consistent with technical specification and safety analysis requirements. Other plant systems and equipment should perform in accordance with the appropriate design and testing specifications.

14.2.12.2.34 Reactor Full Isolation

(1) Purpose

To verify that the dynamic response of the reactor and applicable systems and equipment is in accordance with design for a simultaneous full closure of all MSIVs from near rated reactor power.

(2) Prerequisites

The preoperational tests are complete and plant management has reviewed the test procedure and has approved the initiation of testing. The plant shall be in the appropriate operational configuration with all specified prerequisite testing complete. All applicable instrumentation shall be checked or calibrated as is appropriate.

(3) Description

A simultaneous full closure of all MSIVs will be initiated from near rated power in order to verify proper reactor and integrated plant response. Reactor dynamic response, as determined by such parameters as vessel dome pressure and simulated fuel surface heat flux, will be compared with analytical predictions in order to verify the adequacy and conservatism of the models and assumptions used in the plant safety and licensing analysis. Proper response of systems and equipment such as the MSIVs, SRVs, the reactor protection system, and the feedwater and recirculation systems will also be demonstrated.

(4) Criteria

The reactor dynamic response should be consistent with predictions based on expected system characteristics and shall be conservative relative to safety analysis results based on design assumptions. Safety-related and essential equipment and systems shall respond, as applicable, consistent with technical specification and safety analysis requirements. Other plant systems and equipment should perform in accordance with the appropriate design and testing specifications.

14.2.12.2.35 Offgas System

(1) Purpose

To verify proper operation of the various components of the offgas system over the expected operating range of the system.

(2) Prerequisites

The preoperational tests have been completed and plant management has reviewed the test procedure and has approved the initiation of testing. For each scheduled testing interation, the plant shall be in the appropriate operational configuration with the specified prerequisites testing complete. All applicable instrumentation shall be checked or calibrated as is appropriate.

(3) Description

Proper operation of the offgas system will be demonstrated by monitoring pertinent parameters such as temperature, pressure, flow rate, humidity, hydrogen content, and effluent radioactivity. Data ~~should~~ shall be collected at selected operating points such that each critical component of the system is evaluated over its particular expected operating range. Performance ~~should~~ shall be demonstrated for specific components such as catalytic recombiners, and activated carbon absorbers as well as the various heaters, coolers, dryers and filters. Also to be evaluated are the piping, valving, instrumentation and control that comprise the overall system. Testing of the offgas system is also discussed in 11.3.9.

(4) Criteria

Hydrogen concentration and radioactivity effluents shall not exceed technical specification limits. All applicable system and component parameters should be consistent with design and testing specification requirements.

14.2.12.2.36 Loose Parts Monitoring System Baseline Data

(1) Purpose

To collect baseline data for the loose parts monitoring system under normal plant operational conditions.

(2) Prerequisites

The preoperational tests are complete and plant management has reviewed the test procedure and has approved the initiation of testing. The plant shall be in the appropriate operational configuration for the scheduled testing. Applicable instrumentation shall be checked or calibrated as is appropriate.

(3) Description

Loose parts monitoring system data will be collected at appropriate power and flow conditions to provide a baseline set of data indicative of normal plant operations. The data obtained will be used to help verify the adequacy of, or to facilitate needed changes to, initial alert level settings above normal levels.

(4) Criteria

Sufficient baseline data shall be obtained so as to verify the adequacy of system alert level settings in accordance with design requirements.

14.2.12.2.37 Concrete Penetration Temperature Surveys

(1) Purpose

To demonstrate the acceptability of concrete wall temperatures in the vicinity of selected high temperature penetrations under normal plant operational conditions.

(2) Prerequisites

The preoperational tests are complete and plant management has reviewed the test procedure and has approved the initiation of testing. The plant shall be in the appropriate operational configuration for the scheduled testing. Applicable instrumentation shall be installed and checked or calibrated as is appropriate.

(3) Description

Concrete temperature data will be collected, around selected high temperature penetrations, at various power levels and system configurations in order to verify acceptable performance under expected plant operational conditions. Penetrations and measurement locations selected for monitoring, as well as the test conditions at which data is to be collected, shall be sufficiently comprehensive so as to include the expected limiting thermal loading conditions on critical concrete walls and structures within the plant.

(4) Criteria

The temperature(s) of the concrete at the monitored locations should be consistent with design predictions and shall not exceed design basis requirements or assumptions critical to associated design basis analyses.

14.2.12.2.38 Radioactive Waste Systems Performance

(1) Purpose

To demonstrate acceptable performance of gaseous and liquid radioactive waste processing, storage and release systems under normal plant operational conditions.

(2) Prerequisites

The preoperational tests are complete and plant management has reviewed the test procedure and has approved the initiation of testing. The plant shall be in the appropriate operational configuration for the scheduled testing. The necessary instrumentation shall be checked or calibrated. Appropriate precautions shall be taken relative to activities conducted in the vicinity of radioactive material or potential radiation areas.

(3) Description

Radioactive waste systems operation will be monitored, and appropriate data collected, during the power ascension test phase to demonstrate system operation is an accordance with design requirements. Operation and testing of liquid and gaseous radioactive waste systems is discussed in detail in Sections 11.2 and 11.3, respectively. Testing specific to the main condenser offgas system is also discussed separately in subsection 14.2.12.2.35.

(4) Criteria

Performance characteristics of the liquid and gaseous radioactive waste systems should be in accordance with the appropriate design and testing specifications, and as discussed in Sections 11.2 and 11.3, respectively. Handling and release of radioactive wastes shall be in conformance with all applicable regulations.

14.2.12.2.39 Steam and Power Conversion Systems Performance

(1) Purpose

To demonstrate acceptable performance of the various plant steam driven auxiliaries and power conversion systems under expected operational conditions, particularly that equipment that could not be fully tested during the preoperational phase due to inadequate steam flow conditions.

(2) Prerequisites

The preoperational tests are complete and plant management has reviewed the test procedure and has approved the initiation of testing. The plant shall be in the appropriate operational configuration for the scheduled testing. The necessary instrumentation shall be checked or calibrated.

(3) Description

Operation of steam driven plant auxiliaries and power conversion systems will be monitored, and appropriate data collected, during the power ascension test phase to demonstrate system operation is in accordance with design requirements. Systems to be monitored include the main turbine and generator and their auxiliaries, the feedwater heaters and moisture separator/reheaters, the main condenser and condenser evacuation system, and the main circulating water system. Operation and testing of power conversion systems is discussed in detail in Chapter 10. The main turbine generator and related auxiliaries are discussed in section 10.2 and other power conversion equipment and systems are discussed in section 10.4. Testing specific to turbine valves is described in subsection 14.2.12.2.25 and plant transient testing involving the main turbine generator is described in subsection 14.2.12.2.33.

(4) Criteria

Performance characteristics of the various systems monitored should be in accordance with the appropriate design and testing specifications, and as discussed in Sections 10.2 and 10.4.

14.2.13 Interfaces

The preceding discussion of preoperational and startup tests were limited to those systems and components within, or directly related to, the ABWR Standard Plant. Other testing, with respect to site specific aspects of the plant will be necessary to satisfy certain ABWR in- terface requirements. Testing of such systems and components should be adequate to demonstrate conformance to such requirements as defined throughout the specific chapters of the SSAR. Below are systems that may require such testing:

(1) electrical switchyard and equipment;

(2) the site security plan;

(3) personnel monitors and radiation survey instruments; and

(4) the automatic dispatcher control system (if applicable).

Also to be supplied by the applicant referencing the ABWR design is the startup administration manual described in Section 14.2.4, which will describe, among other things, what specific permissions are required for the approval of test results and the permission to proceed to the next testing plateau.

¶ [INSERT CONTINUATION FROM NEXT PAGE]

14.2.13 Interfaces (continuation)

The applicant referencing the ABWR Standard Plant shall also provide a list of those tests to be performed as part of the power ascension test phase that are proposed to be exempt from operating license conditions requiring NRC prior approval for major test changes. Such tests are those which are not essential to the demonstration of conformance with design requirements for structures, systems, components, and design features which meet any of the following criteria:

a. Those that will be used for safe shutdown and cooldown of the reactor under normal plant conditions and for maintaining the reactor in a safe condition for an extended shutdown period;

b. Those that will be used for safe shutdown and cooldown of the reactor under transient (infrequent or moderately frequent events) conditions and postulated accident conditions and for maintaining the reactor in a safe condition for an extended shutdown period following such conditions;

c. Those that will be used for establishing conformance with safety limits or limiting conditions for operation that will be included in the facility technical specifications;

d. Those that are classified as engineered safety features or will be used to support or ensure the operation of engineered safety features within design limits;

e. Those that are assumed to function or for which credit is taken in the accident analysis for the facility, as described in the FSAR; or

f. Those that will be used to process, store, control, or limit the release of radioactive materials.

Of the tests described in Section 14.2.12.2 for the ABWR Standard Plant the following tests, or designated portions thereof, meet the above criteria:

1) 14.2.12.2.13 Recirculation Flow Control - except for those features intended to limit maximum core flow;

2) 14.2.12.2.21 Reactor Water Cleanup System Performance;

3) 14.2.12.2.23 Plant Cooling/Service Water System Performance - those portions pertaining to the turbine building cooling and service water systems;

4) 14.2.12.2.24 HVAC System Performance - those portions pertaining to the Normal HVAC system and its associated nonessential chilled water system;

5) 14.2.12.2.29 Feedwater Pump Trip; and

6) 14.2.12.2.39 Steam and Power Conversion Systems Performance.

POWER ASCENSION TEST	OV	HU	LP	MP	HP	NOTES
	TESTING PLATEAU					
Chemical and Radiochemical Measurements						
Sampling System Functioning		✓	✓	✓	✓	
Process Rad Monitoring Functioning	✓	✓	✓	✓	✓	
Steady State Performance Measurements	✓	✓	✓	✓	✓	Includes verification of water quality
Steam Separator/Dryer Performance				✓		At low power, high flow corner of power-flow map
Radiation Measurements						
Steady State Measurements	✓	✓	✓	✓	✓	
Shielding Adequacy Assessment				✓	✓	
Fuel Loading						
Core Loading	✓					
Partial Core S/D Margin	✓					
Full Core Verification	✓					
Full Core Shutdown Margin Demonstration	✓					
Rod Control System Performance						
CRD Functional Testing	✓	✓				
Friction Testing	✓	✓				
Rod Pair Scram Testing	✓	✓				
Full Core Scram			✓	✓	✓	With planned scrams
SCRRI Functioning					✓	At low power end of rated rod line prior to planned RIP trips and when actuated following RIP trips
Alternate Rod Run-in Functioning			✓	✓	✓	Post scram verification following planned trips

OV = Open Vessel HU = Nuclear Heatup LP = Low Power MP = Mid Power HP = High Power

POWER ASCENSION TEST	TESTING PLATEAU OV	HU	LP	MP	HP	NOTES
Neutron Monitoring System Performance						
SRNM Calibration/Response	✓	✓				
LPRM Calibration/Response		✓	✓	✓	✓	
APRM Calibration/Response		✓	✓	✓	✓	
TIP System Alignment/Response	✓	✓	✓			Only as needed to complete tests subsequent to HU
Process Computer System Operation						
NSS/BOP Monitoring Programs		✓	✓	✓	✓	
Automation Programs		✓	✓	✓	✓	
RWM/RC&IS Functioning		✓	✓		✓	
Core Performance		✓	✓	✓	✓	
Nuclear Boiler Process Monitoring						
Reactor CoolantTemperature Measurement		✓		✓	✓	At MP & HP during steady state and RIP trip testing
Reactor Water Level Measurement	✓	✓	✓	✓	✓	
Core Flow Calibration/Measurement		✓	✓	✓	✓	
System Expansion						
Support Inspection/Interference Check		✓	✓	✓	✓	Only as needed upon return to cold setting conditions after planned shutdowns subsequent to HU
Displacement Measurements		✓	✓	✓	✓	
System Vibration						
Steady State Measurements		✓	✓	✓	✓	
Transient Response			✓	✓	✓	
Reactor Internals Vibration (If Required)		✓	✓	✓	✓	Cold, zero power, test, if required, will be done with RPV head on during HU

OV = Open Vessel HU = Nuclear Heatup LP = Low Power MP = Mid Power HP = High Power

POWER ASCENSION TEST	TESTING PLATEAU OV	HU	LP	MP	HP	NOTES
Recirculation Flow Control						
Control System Adjustment/Confirmation			✓	✓	✓	
Feedwater Control						
Control System Adjustment/Confirmation		✓	✓	✓	✓	
Pressure Control						
Control System Adjustment/Confirmation		✓	✓	✓	✓	
Plant Automation and Control						
Plant Startup/ Shutdown		✓	✓	✓	✓	
Load Following					✓	
Reactor Recirculation System Performance						
Steady State Performance		✓	✓	✓	✓	
RIPs Out of Service				✓	✓	
Pump Restarts				✓	✓	
Feedwater System Performance						
Steady State Performance		✓	✓	✓	✓	
Maximum Runout Flow Determination					✓	
Main Steam System Performance						
Steady State Performance		✓	✓	✓	✓	
Residual Heat Removal System Performance						
Suppression Pool Cooling		✓			✓	After testing which adds heat to the suppression pool; May not be sufficient heat at lower power levels
Shutdown Cooling		✓			✓	May not be sufficient reactor decay heat at lower power levels to demonstrate Hx heat removal capability

OV = Open Vessel HU = Nuclear Heatup LP = Low Power MP = Mid Power HP = High Power

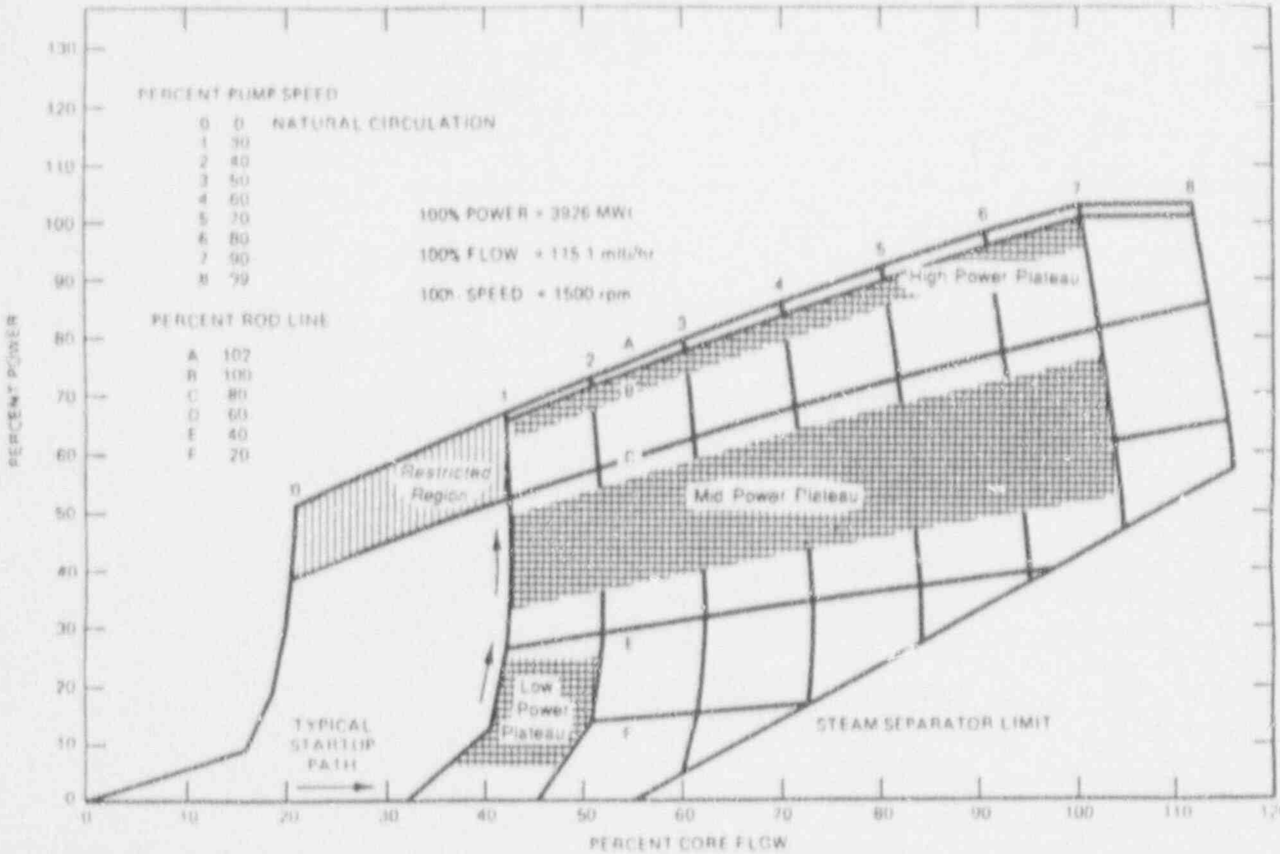
POWER ASCENSION TEST	TESTING PLATEAU OV	HU	LP	MP	HP	NOTES
Reactor Water Cleanup System Performance						
Steady State Performance		✔			✔	
Inventory Rejection Mode		✔				
F/D Performance					✔	May be accomplished during earlier testing plateaus
RCIC System Performance						
Low Reactor Pressure		✔				
High Reactor Pressure		✔				
Hot/Cold Quick Starts		✔	✔			As needed to complete required quick starts subsequent to TCHU
Plant Cooling/Service Water System Performance						
Steady State Power Operations		✔	✔	✔	✔	
Off-Normal Operations		✔	✔		✔	During RHR Hx operation, as practicable
HVAC System Performance						
Steady State Power Operations		✔	✔	✔	✔	
Off-Normal Operations		✔	✔	✔	✔	In individual spaces as conditions allow (i.e. as pertinent equipment is operated)
Turbine Valve Performance		✔	✔	✔	✔	Only bypass valves need be tested at HU
MSIV Performance						
Individual MSIV Closure/ Timing		✔	✔		✔	Fast closure not req'd at High Power
Branch Line Closure/ Timing		✔	✔			
SRV Performance						
Individual Valve Functioning		✔	✔			
Automatic Opening Verification			✔	✔	✔	During planned trips, as applicable

OV = Open Vessel HU = Nuclear Heatup LP = Low Power MP = Mid Power HP = High Power

POWER ASCENSION TEST	TESTING PLATEAU					NOTES
	OV	HU	LP	MP	HP	
Loss of Feedwater Heating					✓	At 80-90% CTP, 100% Flow during HP
Feedwater Pump Trip					✓	
Recirculation Pump Trip						
One RIP Trip				✓	✓	At near rated flow
Two RIP Trip				✓	✓	At near rated flow
Three RIP Trip				✓	✓	At near rated flow
Shutdown from Outside the Control Room			✓			At >10% Generator Load
Loss of Turbine Generator and Offsite Power			✓			At 10-20% rated power
Turbine Trip and Generator Load Rejection						
Load Rejection within Bypass Capacity			✓			
Turbine Trip				✓		
Full Power Load Rejection					✓	
Reactor Full Isolation					✓	
Offgas System Performance		✓	✓	✓	✓	
Power Conversion Equipment Performance		✓	✓	✓	✓	
Loose Parts Monitoring System Baseline Data		✓	✓	✓	✓	
Liquid RadWaste Systems Performance			✓		✓	

OV = Open Vessel HU = Nuclear Heatup LP = Low Power MP = Mid Power HP = High Power

Figure 14.2-1
Power-Flow Operating Map and Testing Plateau Definitions



<u>Testing Plateau</u>	<u>Description</u> (1)
Open Vessel (**OV**)	With the RPV head removed, from initiation of fuel loading to cold conditions with a fully loaded core
Nuclear Heat-Up (**HU**)	During nuclear heat-up, from ambient conditions and 0 psig to rated temperature and pressure within the RPV, with reactor power typically less than 5% of rated
Low Power (**LP**)	Between 5% and 25% rated thermal power, with the reactor internal pumps (RIPs) within 10% of minimum speed
Mid Power (**MP**)	Between approximately the 50% and 75% power rod lines, with the RIPs operating between minimum and rated speeds, with the lower power corner within the capacity of the bypass valves.
High Power (**HP**)	Along and just below (+0,-5%) the 100% power rod line, from minimum RIP speed to rated core flow

(1) Descriptions of testing plateaus are offered for illustrative purposes and general guidance only, as some tests are intended to be conducted outside the general testing plateaus described. Neither the above descriptions, nor the corresponding boundary lines on the power-flow map, are meant to be absolute limits. Any operating limits will be specified in the plant license. Any other testing restrictions will be specified either within the plant administrative procedures covering the power ascension test program or within the individual test procedure for a given test.

RESPONSE 430.31

The plant protection signals that automatically isolate the secondary containment and activate the SGTS are:

(1) [illegible]econdary containment high radiation signal.

([illegible]) Refueling floor high radiation signal.

(3) Drywell pressure high signal.

[illegible] Reactor water level low signal.

[illegible]dary containment HVAC supply/exhaust fans stop.

[illegible] the secondary containment is accomplished by closure of the secondary containment [illegible]ust line ducts which pass through the secondary containment boundary. The HVAC [illegible] consist of two valves in series in each of the supply/exhaust lines. These valves are [illegible] normally-open, fail closed butterfly vales.

Further [illegible]s are provided in Subsection 6.2[illegible], 9.4.5.1 and Section 6.5

QUES[illegible]ION 430.32

Identify and tabulate by size, piping which is not provided with isolation features. Provide an analysis to demonstrate the capability of the Standby Gas Treatment System to maintain the design negative pressure following a design basis accident with all non isolated lines open and the event of the worst single failure of a secondary containment isolation valve to close. (6.2)

RESPONSE 430.32

Response to this question is provided in revised Subsection 6.5.1.3.1 and new Subsection 6.5.5.1.

~~Response to this question will be pro[illegible]ded in a future amendment.~~

QUESTION 430.33

Discuss the design provisions that prevent primary containment leakage from bypassing the secondary containment standby gas treatment system and escaping directly to the environment. Include a tabulation of potential bypass leakage paths, including the types of information indicated in Table 6-18 of Regulatory Guide 1.70, Revision 3. Provide an evaluation of potential bypass leakage paths considering equipment design limitations and test sensitivities. Specify and justify the maximum allowable fraction of primary containment leakage that may bypass the secondary containment structure. The guidelines of BTP 6-3 should be addressed in considering potential bypass leakage paths. (6.2)

RESPONSE 430.33

The secondary containment completely surrounds the primary containment except at the basemat. In addition the lower third of the secondary containment is surrounded by soil, thereby reducing leakage paths. No measurable leakage is expected through its walls except at penetrations. The secondary containment will be maintained at subatmospheric conditions to prevent leakage from bypassing the secondary containment. Only valve leakage through process piping can bypass the secondary containment. This leakage will be monitored via the containment leakage test type C on the outboard containment isolation valves. The secondary containment leak rate calculation is provided in the response to Question 430.52c.

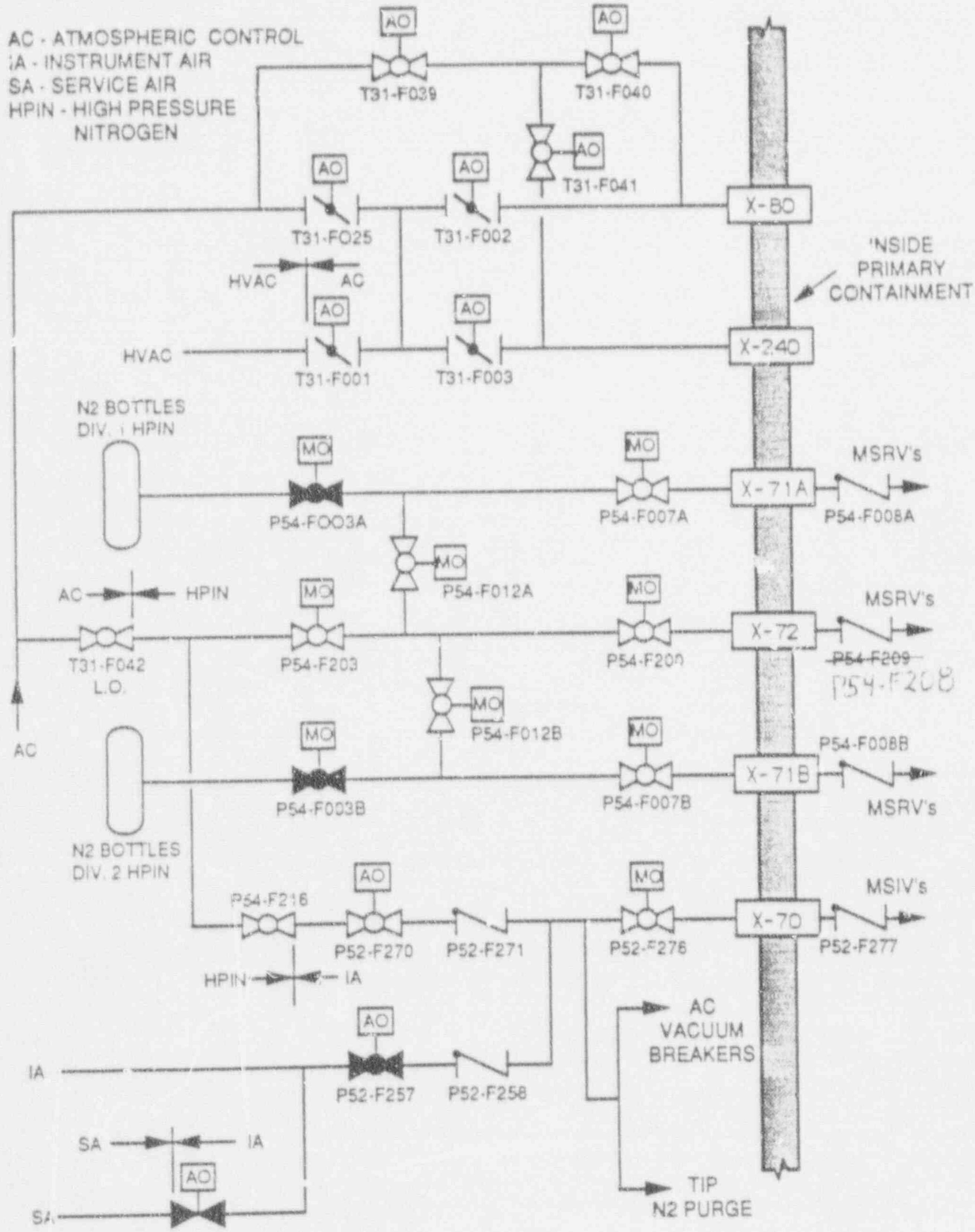


Figure 20.3 - 55 COMPRESSED GAS SYSTEMS INTERCONNECTIONS
(Response to Question 430.217)