52-001

July 29, 1992

NOTE TO: J. Chambers, GE

FROM: Chet Poslusny, NRR, NRC

SUBJECT: PRELIMINARY STAFF FEEDBACK ON ITAAC PHASE 3

Enclosed for your information are two sets of preliminary staff comments on GE's ABWR Phase III Design Certification Material. Enclosure 1, was provided by the Radiation Protection Branch and Enclosure 2 was provided by the Electrical Systems Branch. Please call me on 504-1132 if you have any questions on this information.

Chet Poslusny

cc: R. Pierson
Docket File (Standard Distribution)

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Enclosure 1

COMMENTS ON
ABWR TIER 1 DESIGN DOCUMENTATION
PHASE 3 SUBMITTAL

2.1.1 NUCLEAR STEAM SUPPLY
The design description of the reactor internals should address the elimination of Cobalt bearing materials from the reactor.

2.2.5 NEUTRON MONITORING SYSTEM
Design description of the ATIP system should include a discussion of the electro-mechanical switch that prevents a complete probe withdrawal and the interlocks with local alarm at the lower drywell access to warn personnel of potential radiation hazard. The ITAAC should be revised to include a verification that the ATIP system is built as described.

2.3.2 AREA RADIATION MONITORING SYSTEM
Design description and ITAAC are acceptable to the staff.

2.3.3 DUST RADIATION MONITORING SYSTEM
This is not an ABWR system, therefore, it should not be referenced in the Tier 1 design document. Should be deleted.

2.3.4 CONTAINMENT ATMOSPHERIC MONITORING SYSTEM
The system description and ITAAC are acceptable to the staff.

2.4.1 RESIDUAL HEAT REMOVAL SYSTEM
The system description should include the capability to decontaminate the system heat exchangers and pumps prior to maintenance.

2.6.1 REACTOR WATER CLEANUP SYSTEM
The system description should include the capability to decontaminate the system heat exchangers and pumps prior to maintenance.

2.9.1 RADWASTE SYSTEM
The system description should address ALARA design features such as the use of automated remotely operated equipment and rack mounted pumps to facilitate maintenance.

2.11.18 ZINC INJECTION SYSTEM
This is not an ABWR system as described in the SSAR. Should be deleted from the tier 1 design document.

2.11.19 BREATHING AIR SYSTEM
The system description and ITAAC are acceptable to the staff.

2.11.22 IRON INJECTION SYSTEM
This is not an ABWR system as described in the SSAR. Should be deleted from the tier 1 design document.

2.15.5 HEATING, VENTILATION, AND AIR CONDITIONING
All 7 ventilation systems discussed in this design description should have a cross reference to the Ventilation and Airborne Monitoring DAC in section 3.7.b.

2.15.8 VACUUM SWEEP SYSTEM
This system is not described in the SSAR and should be deleted from the Tier 1 design document.

2.15.9 DECONTAMINATION SYSTEM
This system is not described in the SSAR and should be deleted from the Tier 1 design document.

2.15.10 REACTOR BUILDING
The design description has a appropriate reference to the radiation shielding DAC in section 3.7.a.

2.15.11 TURBINE BUILDING
The design description should address the radiation shielding provided by the structure and reference the DAC in section 3.7.a.

2.15.12 CONTROL BUILDING
The design description should address the radiation shielding provided by the structure and reference the DAC in section 3.7.a.

2.15.13 RADWASTE BUILDING
The design description has a appropriate reference to the radiation shielding DAC in section 3.7.a.

2.15.14 SERVICE BUILDING
The design description has a appropriate reference to the radiation shielding DAC in section 3.7.a.

3.7 RADIATION PROTECTION

The purpose for specifying that 80% of the area of a zone will be less than 25% of the radiation level specified for that zone (Acceptance Criteria 1 in Table 3.7.a) is unclear. The basis for this restriction should be stated in the discussion. Also the reference to Figure 3.7c at the end of this criteria should be changed to 3.7cc.

Acceptance Criteria 3 in table 3.7a should be revised to clarify that the radiation dose specified is an individual, not a cumulative, limit (i.e., "no individual shall receive radiation exposures in excess of 5 rem to the whole body, or its equivalent").

Inspection, Test, Analyses 4 of table 3.7.a, should have the work "radiation" inserted after the word "scattered".

Acceptance Criteria 2.b in table 3.7.b has two typographical errors in the parenthetical phrase. It should read, "(i.e., air sampling monitors in ventilation exhaust streams shall collect an isokinetic sample)."

Figures 3.7.a through 3.7.cc are not consistent with the corresponding figures in Ch. 12 of the SSAR. However, as noted in the FSER, GE intends to revise the SSAR figures in a future amendment. Therefore, acceptance of these figures is pending the review and approval of the revised Ch. 12 figures.

4.8 AIRBORNE PARTICULATE RADIATION MONITORING

This issue is not an interface. As noted in section 12.3.4 of the FSER some aspects of airborne radioactivity monitoring will be addressed by the COL applicant. This discussion should be moved to the SSAR.

Enclosure 2

1.0 Section 2.3.1 Process Radiation Monitoring System

1.1 In a NRC letter to BWR Owner's Group dated May 15, 1991, the staff accepted the elimination of the BWR main steam line isolation valve (MSIV) closure function and reactor scram function of main steam line radiation monitor for operating reactors. The staff's acceptance was based on a safety analysis performed by GE in a licensing topical report, NEDO-31400 dated May 1987 which was submitted to NRC for review by BWR Owner's Group with their transmittal letter dated July 9, 1987. Therefore, GE has the option of eliminating the MSIV closure function and reactor scram function of the main steam line radiation monitor in the ABWR design. Should GE take this option, the corresponding section of the SSAR (Section 11.5.2.1.1) should be revised accordingly.

1.2 Delete Section 2.3.3 in its entirety (heading) since the staff is not sure what it meant by Dust Radiation Monitoring.

1.3 A number of minor editorial and technical comments are noted on the enclosed marked-up pages.

2.3 Radiation Monitoring

PERM

2.3.1 Process and Effluent Radiation Monitoring (PRM) System

Design Description

The primary function of this system is to (a) monitor and record the various gaseous and liquid process streams and effluent releases, (b) initiate alarms in the MCR to warn operating personnel to the high radiation activity, and (c) initiate the appropriate safety actions and controls to prevent further radioactivity releases to the environment.

This system provides both safety and non-safety instrumentation for radiological monitoring, sampling and analysis of identified process and effluents streams throughout the plant. The system monitors the radiation levels during normal, abnormal and accident plant conditions. The stack vent discharge and the standby gas treatment system (SGTS) are both equipped with high range detectors for post accident monitoring of levels up to 10^5 μc/cc.

The process and effluent paths and/or areas as described herein are monitored for potential high radioactivity releases. The monitoring channels of items 1 through 4 below are provided for safety as Class IE instrumentation, while the rest of the process radiation instrumentation is considered non-essential which is provided to monitor plant operations.

(1) Main steam line (MSL) tunnel area - 4 divisional channels

The MSL tunnel area is continuously monitored for high gross gamma radioactivity in the steam flow to the turbine. Reactor scram, MSIV closure, and main condenser vacuum pump shutdown are automatically initiated on any two out of four channel trip.

see comment 1.1.

(2) Reactor Building ventilation exhaust - 4 divisional channels

The air vent exhaust from the secondary containment is continuously monitored for gross gamma radioactivity. On high level, the standby gas treatment system is activated and the containment ventilation ducts are isolated on any two out of four channel trip.

(3) Fuel handling area ventilation exhaust - 4 divisional channels

The air vent exhaust from the fuel handling area is continuously monitored for gross gamma radioactivity. On high level, the standby gas treatment system is activated and the fuel handling area ventilation ducts are isolated on any two out of four channel trip.

(4) Control Building air intake supply - 4 divisional channels

The air intake to the Control Building is continuously monitored for gross gamma radioactivity. On high level, the ventilation ducts are isolated and the ~~emergency air circulation~~ Control Room Habitability HVAC system is activated on any two out of four channel trip.

(5) Turbine Building ventilation exhaust - 4 channel

The vent exhaust from the Turbine Building is continuously monitored for gross gamma radioactivity. The air exhaust from the equipment compartment area and from the ~~clean~~ steam jet air ejector areas in the Turbine Building are each monitored by two redundant channels. Alarms are initiated on high radiation levels.

(6) Charcoal vault ventilation exhaust - 1 channel

The vent exhaust from the charcoal vault is continuously monitored for gross gamma radioactivity ~~that may result from cracks in the activated charcoal beds~~. An alarm is initiated on high radiation.

(7) Pre-treated main condenser off-gases - 1 channel

The pre-treated main condenser off-gases are continuously sampled and monitored for gross gamma radioactivity. Alarms are initiated on high radiation and on abnormal sampling flow. Vial sampling is provided for periodic isotopic analysis.

(8) Post treated main condenser off-gases - 2 channels

The treated off-gases are continuously sampled and monitored for airborne radioactivity by two gas samplers and filters for collecting ~~air~~ airborne particulates and halogens. Each gas sampler consists of a beta/gamma sensitive detector and a source check for periodic testing. On high radiation, the off-gases are routed through the entire charcoal bed for hold-up. On extremely high radiation, the off-gas discharge to the stack is isolated. Alarms are initiated on high radiation levels and on abnormal sampling flow. Vial sampling is provided for periodic isotopic analysis.

(9) Plant vent discharge - 2 channels

The discharge through the stack is continuously sampled through an isokinetic probe and monitored for airborne radioactivity by two redundant channels, each consists of a beta/gamma sensitive detector with a source check, a high-range ion chamber, and filters for collecting air particulates and halogens. Sampling and collecting of tritium is also provided. Alarms are initiated on high radiation levels and on abnormal sampling flow.

(10) Radwaste Building ventilation exhaust - 1 channel

The air vent exhaust from the Radwaste Building is continuously sampled through an isokinetic probe and monitored for airborne radioactivity by a beta/gamma sensitive detector with a source check and filters for collecting air particulates and iodine. A tritium monitor is also provided for sample collection. Alarms are initiated on high radiation and on abnormal sampling flow.

(11) Radwaste liquid discharge - 1 channel

The liquid waste discharge from the plant is continuously sampled and monitored by a liquid sampler, which consists of a scintillation detector, a source check and an ultra sonic cleaner. Alarms are initiated on high radiation levels and on abnormal sampling flow. On high radiation in the discharged waste, the flow to the environment is automatically terminated and alarmed.

(12) Drywell sump liquid discharge - 2 channels, one per sump

The liquid discharge from each of the two drywell sumps is monitored by an in-line ion chamber. On high radiation, the discharge to the Radwaste Building is terminated and alarmed.

(13) Standby gas treatment system (SGTS) discharge - 4 channels

The discharge from the SGTS to the stack is continuously sampled and monitored for airborne radioactivity by two gas chambers that are in series with the flow and by sampling filters for collecting air particulates and halogens. Each gas sampler consists of a scintillation detector and a source check. Also, radioactivity in the discharged gases are continuously monitored for gamma radiation by two in-line high-range ion chambers. Alarms are initiated on high radiation levels.

(14) Turbine gland steam condenser discharge - 1 channel

The discharge from the main turbine gland steam condenser is continuously sampled and monitored for airborne radioactivity by a gas chamber and by sampling filters for collecting air particulates and halogens. The gas sampler consists of a scintillation detector and a source check for periodic testing of the detector. Vial sampling is provided for laboratory analysis. Alarms are initiated on high radiation levels.

(15) Intersystem radiation leakage - 3 channels, one per RCW system loop

Intersystem leakage into each loop of the reactor building closed cooling water system is monitored by an in-line scintillation detector for gross gamma radioactivity. An alarm is initiated on high radiation.

Location of the process radiation monitors is shown in the plant layout drawing of Figure 2.3.1. The radiation detectors are numbered according to the listing provided above.

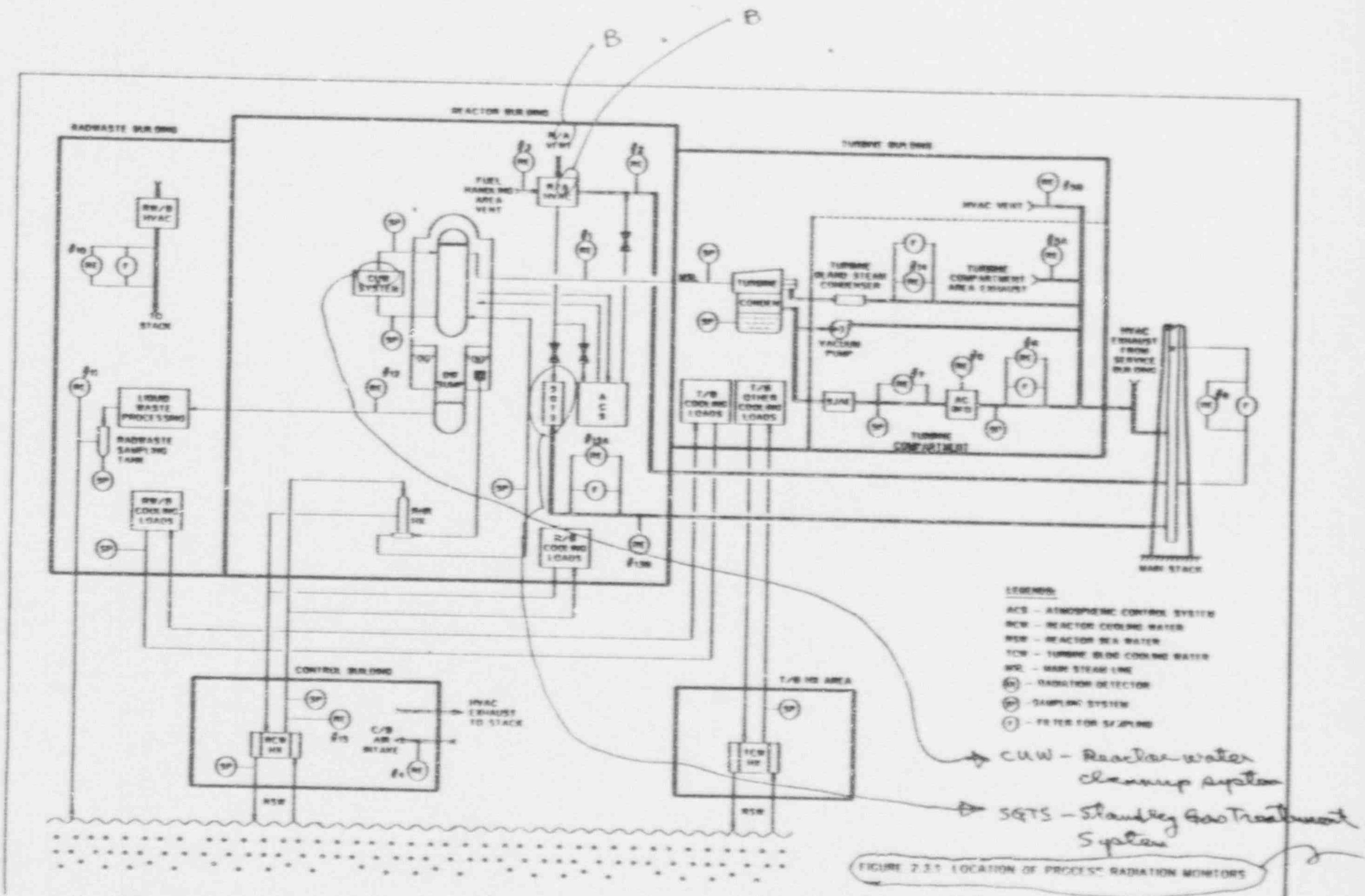
Inspections, Tests, Analyses and Acceptance Criteria

Table 2.3.1 provides a definition of the inspections, tests and/or analyses together with the associated acceptance criteria which will be undertaken for the Process Radiation Monitoring System.

Table 2.3.1: Process and Effluent Radiation Monitoring ~~(PRM)~~ PERM System

Inspections, Tests, Analyses and Acceptance Criteria

Certified Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The ~~PRM~~ PERM is designed to continuously monitor the radiation levels in process and effluent liquid and gaseous streams throughout the plant.	1. Each detector shall be checked for sensitivity and calibration based on certified records and/or response tests using either a portable gamma source or the detector check source as required. Each radiation monitor shall be visually checked for operational readiness.	1. Proper detector calibration and sensitivity are verified based on acceptable records and/or test results. Operational readiness of each radiation monitor is verified by the monitor self test circuitry.
2. The ~~PRM~~ PERM is designed to initiate automatically the controls and safety actions as required to isolate and prevent further releases of radioactivity.	2. The range of each radiation channel shall be checked for the correct response using sufficient simulated inputs. Also, the trip levels that initiate the safety actions and plant controls shall be verified.	2. Verification that the correct monitor response is indicated at the specified inputs for each channel. Also, confirmation that the trips are initiated at the proper setpoints.
3. Each process radiation monitor~~s~~ is designed to initiate alarms on high and low radiation levels and when the monitor indicates gross failure (INOP trip).	3. The alarm setpoints of each radiation channel shall be verified using the adjustable trip output circuits and the INOP trip feature of the monitor.	3. Confirmation that alarm initiation occurs at the proper setpoint and when the monitor indicates gross failure.
4. The ~~PRM~~ PERM is used to monitor radiation levels during normal, abnormal and accident plant conditions.	4. Verify that the high range monitors of the plant vent discharge and the SGTS can detect gaseous effluents of levels up to 10^5 uc/cc.	4. Verification that each high range monitoring channel including the associated radiation monitor is capable of satisfying this requirement.
5. The ~~PRM~~ PERM samples and monitor effluents for noble gases and for collecting air particulates, halogens and vial samples.	5. Verify that the sampling racks and associated equipment are operating within specified limits to assure the extraction of valid and representative samples.	5. Operation of the sample racks is verified when the extracted air flow is normal and is within acceptable limits.
6. For the safety related functions, the ~~PRM~~ PERM provides 4 redundant divisional channels to initiate the required protective action on two out of four channel trip.	6. Each required safety function shall be tested using various simulated signal inputs to verify that the initiation of the protective action occurs only when any two out of four channels indicate trip.	6. Acceptance is based on satisfying the two out of four criteria for initiating the required functions.



and Effluent

Figure 2.3.1 Location of Process Radiation Monitors

2.3.3 Dust Radiation Monitoring System

Not an ABWR system. No entry.

What is this?

2.0 Section 2.9.1 Radwaste System

2.1 This section (and Table 2.9.1) should also include a description of treatment of offgas from incinerator complete with (1) source of heat (and its storage) to be utilized by the incinerator, and (2) the specific fire protection features to prevent any undue fire hazard resulting from the operation of the incinerator.

2.2 Add an additional following certified design commitment in Table 2.9.1 as an ITTAC item.

> "The liquid radwaste system is designed to permit complete recycling of processed liquids during normal plant operation. Discharge of processed liquid radwaste is solely governed by the plant water balance considerations."

2.3 Additional comments are noted in the enclosed marked-up pages.

2.9 Radioactive Waste

2.9.1 Radwaste System

Design Description

The liquid waste system collects, treats, monitors, and either recycles or discharges all radioactive liquid wastes within the plant. The solid waste system collects, sorts, monitors and either recycles or packages all radioactive solid wastes within the plant.

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

Liquid Waste System

The liquid waste system consists of three subsystems: the low conductivity waste system (LCW), the high conductivity waste system (HCW) and the detergent waste system (DW).

The LCW system collects and processes clean radwaste, i. e., water of relatively low conductivity. Equipment drains and backwash transfer water are typical of wastes found in this subsystem. These wastes are collected, treated and monitored. If quality is adequate, the water is sent to the condensate storage tank. If not, it is reprocessed.

The HCW system collects and processes dirty radwaste, i. e., water of relatively high conductivity and solids content. Floor drains are typical of wastes found in this subsystem. These wastes are collected, treated and monitored. If quality is adequate, the water is sent to the condensate storage tank. If not, it is reprocessed. Sometimes, the water is discharged following established procedures to maintain proper plant water balance.

The DW system collects and processes detergent waste from personnel showers and laundry operations. These wastes are collected, filtered and monitored. If quality is adequate, the water is discharged.

The liquid waste system provides one discharge line to the canal for the release of processed liquid waste. This line is provided with flow instrumentation, means of flow control and a radiation monitor. A high radiation signal from this monitor will close the discharge valve. The liquid waste system is provided with sample tanks to collect processed water with provisions to mix the contents and obtain samples for radiochemical analyses prior to discharge. Discharge can be made from only one sample tank at a time through a locked closed valve that is under administrative control.

address treatment of offgas from incinerator including heat source for the incinerator

Solid Waste System

The solid waste system consists of two subsystems: The dry active waste system (DAW) and the wet active waste system (WAW).

The DAW system has an area which is devoted to collecting and storing DAW and sorting it into reusable and nonreusable items. Reusable items are decontaminated as necessary and reused. Nonreusable items are separated for further treatment. Combustible DAW is burned in an incinerator. Incombustible and compressible DAW are reduced in volume using a compactor. The processed DAW is packaged for shipment.

The WAW system has tanks for collecting concentrated liquids, sludges or slurries and spent resins.

The concentrated liquids are dried and solidified.

The slurries and spent resins are either dried or dewatered.

Packaging and transporting of the packaged wastes are in conformance with 10CFR61 and 49CFR 173, Subpart 1. Radiation monitors are provided to survey all waste packages.

Individual components are provided with vents to assure that dust or contaminated air are not released to work spaces.

A Process Control Program shall be prep[illegible]ed and approved by the NRC dem[illegible]ating that the cement-glass [illegible] complies with 10CFR61, Sections 61.56, "Waste Characteristics" and 61.55, "Waste Classification".

Table 2.9.1 provides a definition of the inspections, test and/or analyses together with associated acceptance criteria which will be used for the radwaste system.

Inspections, Tests, Analyses and Acceptance Criteria

Table 2.9.1 provides a definition of the inspections, tests, and/or analyses together with associated acceptance criteria which will be used for the radwaste system.

Table 2.9.1: Radwaste System

Inspections, Tests, Analyses and Acceptance Criteria

Certified Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The liquid ~~waste~~ radwaste system has only one discharge line provided with flow instrumentation, means of flow control and a radiation monitor. A high radiation signal from this monitor will stop the discharge. Discharge can be made from only one sample tank at a time.	1. The as-built discharge line and controls shall be inspected and tested.	1. The as-built discharge line and controls shall operate as designed.
2. The components of the liquid waste system shall be provided which meet the codes and standards in Table 1, Regulatory Guide 1.143.	2. Inspections, tests and analyses shall be performed as required on all as-built system components.	2. All components shall meet the required codes and standards.
3. Means shall be provided to package and transport the solid wastes in conformance with 10CFR61 and 49CFR173, Subpart 1.	3. As-built equipment for packaging and transporting solid wastes shall be inspected, tested, and analyzed.	3. The analysis shall show that the as-built means of packaging and transporting solid wastes can meet the requirements of the regulatory guides.
4. Individual components shall be properly vented to prevent the release of dust or contaminated air to work spaces.	4. The as-built components shall be inspected to show that the release of air-borne radioactivity has been prevented by venting.	4. All as-built components have been properly vented.
5. A Process Control Program has been developed and approved for the cement-glass solidification system.	5. An inspection shall show that an approved PCP is available and the as-built equipment is capable of being operated in conformance with the PCP.	5. A Process Control Program has been approved by the NRC and the as-built equipment is suitable for operation following the PCP.

6. See comment.

3.0 Section 2.10.1. Turbine Main Steam System

3.1 Add the following two certified design commitments in Table 2.10.1 as ITAAC items.

(1) the main steam drain valves are operable from the main control room via essential power supply (class IE).

(2) the main steam piping from MSIV to the condenser inlet including the main steam drain pipe is analyzed to demonstrate appropriate leak-tightness under SSE loading conditions.

3.2 The basis for adding the above ITTAC items are that (1) the staff has provided a credit for airborne radioactive iodine removal in the main steam (and drain) piping and in the main condenser following a postulated LOCA, and (2) the staff accepted the ABWR design without a MSIV leakage control system.

3.3 A marked-up copy of Section 2.10.1 is enclosed.

2.10 Power Cycle

2.10.1 Turbine Main Steam System

Design Description

The Main Steam (MS) System (Figure 2.10.1) supplies steam generated in the reactor to the turbine. This Tier 1 entry addresses that portion of the MS System that ranges between, but does not include, the outermost containment isolation valves and the turbine stop valves.

The MS System is not required to effect or support safe shutdown of the reactor or to perform in the operation of rector safety features; however, the MS System is designed:

(1) To comply with applicable codes and standards in order to accommodate operational stresses such as internal pressure and dynamic loads without risk of failures and consequential releases of radioactivity in excess of the established regulatory limits.

(2) To accommodate normal and abnormal environmental limits.

(3) To assure that failures of non-Seismic Category I equipment or structures, or pipe cracks or breaks in high or moderate piping in the MS will not preclude functioning of safety-related equipment or structures in the plant.

(4) With suitable access to permit in-service testing and inspections.

The MS System main steam piping consists of four lines from the outboard main steamline isolation valves to the main turbine stop valves. The header arrangement upstream of the turbine stop valves allows them to be tested on-line with minimum load reduction and also supplies steam to the power cycle auxiliaries, as required. The main drain valves are operable from the main control room via essential power supply (class 1E).

Inspections, Tests, Analyses and Acceptance Criteria

Table 2.10.1 provides a definition of the inspections, tests, and/or analyses, together with associated acceptance criteria which sill be undertaken for the MS System.

Table 2.10.1:

Inspections, Tests, Analyses and Acceptance Criteria

Certified Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. Failures of non-Seismic Category I equipment or structures, or pipe cracks or breaks in high or moderate piping in the MS System will not preclude functioning of safety-related equipment or structures in the plant.	1. Visual inspection of the MS System will be performed.	1. No safety-related systems or structures are in the vicinity or are protected from failures in the nonseismic portions of the MS System.
2. Access is provided for in-service testing and inspections.	2. Visual inspection of the MS System will be performed.	2 Confirmation that required in-service inspections can be accomplished.
3 The MS train valves are operable from the main control room via essential power supply (Class 1E).		
4 MS piping from MSIV to the condenser inlet including drain pipe is analyzed to demonstrate appropriate leak-tightness under SSE loading conditions		

4.0 Section 2.10.22 Off-Gas System

4.1 Add the following design certification commitments as ITTAC items in Table 2.10.22.

(1) Redundant non-igniting detonation resistant hydrogen analyzers will continuously monitor hydrogen concentration downstream of the recombiners and alarm both locally and in the main control room when hydrogen concentration reaches a pre-set value.

(2) The off-gas system is designed to prevent, monitor, and suppress the potential ignition and combustion propagation of charcoal in the off-gas charcoal adsorber vessels with necessary temperature elements in the charcoal beds and nitrogen purge and blanketing provision.

4.2 On Figure 2.10.3, "Off-Gas System", show (1) redundant hydrogen analyzers, (2) temperature elements in charcoal adsorber vessels, and (3) nitrogen connections for purging and blanketing.

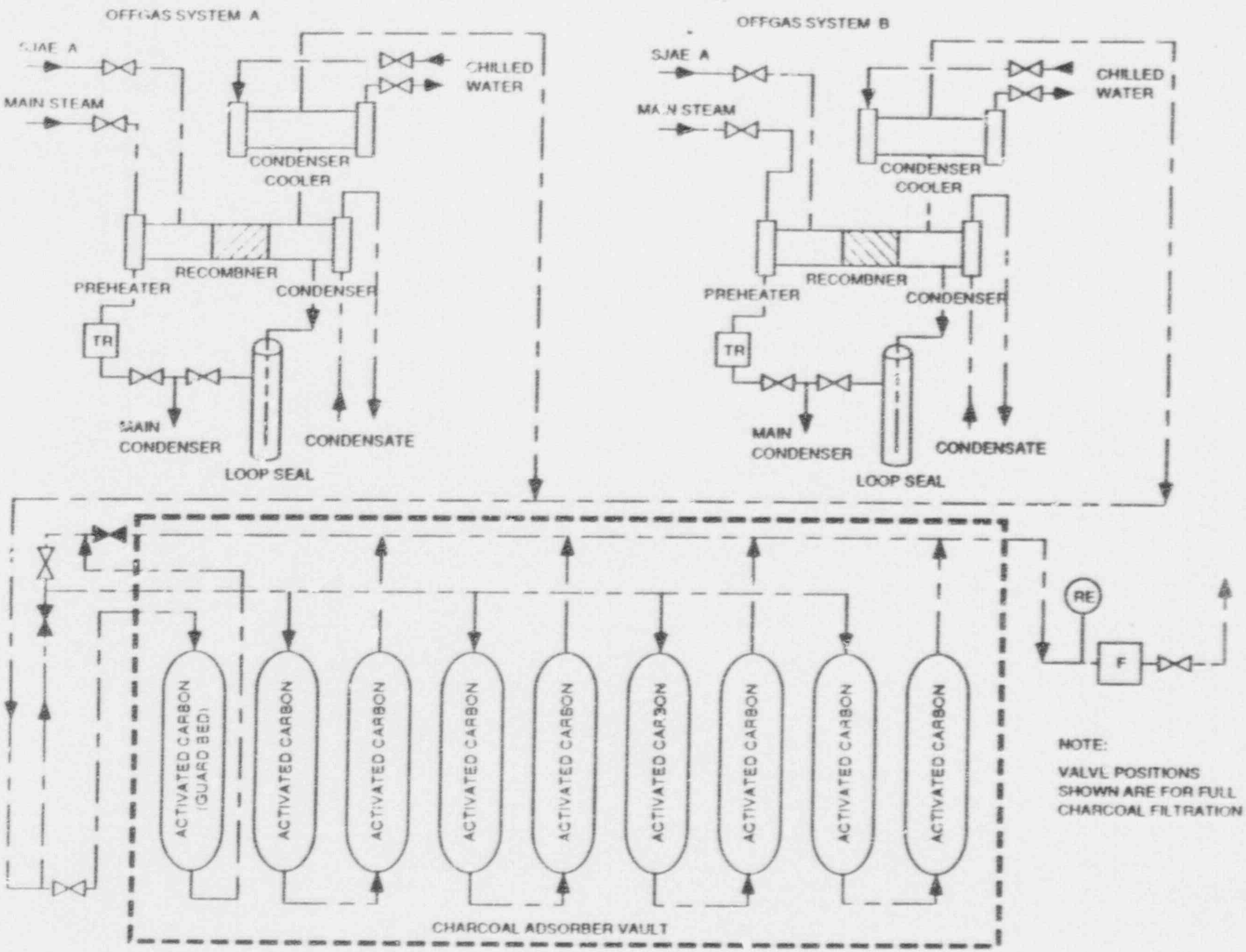


Figure 2.10.22 Off -Gas System

5.0 Section 2.14.1 Primary Containment System

5.1 Add design criteria for bypass leakage between the drywell and the wetwell during and following a LOCA as an ITTAC item in Table 2.14.1 (check with SPLB/NRR).

5.2 Additional comments are noted on the enclosed marked-up pages.

2.14.1 Primary Containment System

Design Description

The primary containment system incorporates the drywell and pressure suppression features of operating BWR plants and consists of a steel lined reinforced concrete containment structure fulfilling its design basis as a fission product barrier even at the increased pressure associated with a main steam pipe rupture or a break in the largest fluid pipe.

Main features include the upper and lower drywell containment surrounding the reactor pressure vessel, a wetwell with a water filled suppression pool serving as a heat sink during normal, and abnormal operations and accidents. Refer to Figure 2.14.1 Primary Containment System.

The primary containment volume is 259,563 cubic feet and is constructed as a right cylinder with an inside radius of 47' 7" and a reinforced concrete wall thickness of 6' 7" set on a reinforced concrete base mat 18' 0" thick and a wall height of 96' 9" measured between the top of the base mat and the underside of the containment top slab. The primary containment top slab is 7' 2" thick except beneath the fuel pool, steam dryer/separator pool, and around the drywell head opening where the slab is 7' 11" thick. The drywell head opening is enclosed with a steel head removable for refueling operations. The drywell design conditions are 45 psig and 340 degrees F. The wetwell design conditions are 45 psig and 219 degrees F.

The drywell is comprised of two volumes: an upper drywell volume of 193,878 cubic feet, surrounding the reactor pressure vessel and housing the steam and feedwater piping, the safety/relief valves, main steam drain piping and upper drywell coolers; and a lower drywell volume of 65,685 cubic feet, below the reactor pressure vessel housing the control rod drives, fine motion control rod drives, recirculation internal pumps, reactor cooling water heat exchangers, neutron monitoring system, equipment platform, lower drywell coolers and two drywell sumps.

The wetwell volume is 338,315 cubic feet, comprised of the suppression pool volume of 127,840 cubic feet at high water level or 126,427 cubic feet at low water level. The suppression chamber air space volume is 210,475 cubic feet at high water level and serves as the LOCA blowdown reservoir for the upper and lower drywell nitrogen and noncondensables which pass through the ten 48 inch diameter drywell to wetwell vertical vents connecting with thirty 2.3 feet diameter, 60 inch long horizontal vents with a total flow area of 125 square feet located at three levels below the suppression pool surface. The vent centerline submergence is 11.48 feet for the top row of horizontal vents, 15.98 feet for the center row of horizontal vents and 20.48 feet for the bottom row of horizontal vents. The suppression pool water serves as the heat sink to condense steam released into the drywell during a LOCA, or steam from safety relief valve activity or exhaust steam from reactor core injection coolant steam turbine operation. The 3' 11" thick drywell diaphragm floor has steel liners on both top and bottom sides to minimize bypass leakage.

Access to the upper drywell is provided through a double sealed personnel lock and an equipment hatch. The lower drywell access is provided through a personnel access tunnel with a double sealed personnel lock at the reactor building end. An equipment transfer tunnel is sealed by an equipment hatch removable only during refueling or maintenance outages. These access tunnels span the suppression chamber. Access to the suppression chamber is provided by a hatch located in the reactor building.

Prior to reactor operation the atmospheric control system in conjunction with the HVAC primary containment purge system and the drywell cooling fans establish an inert gas environment in the primary containment with nitrogen to limit the oxygen concentration to preclude combustion of hydrogen released during a LOCA. The primary containment leak rate must be less than 0.5% per day based on a 39 psig post accident pressure. The primary containment design pressure is 45 psig. Additional nitrogen gas is added to the drywell and the wetwell to maintain a positive pressure and prevent air inleakage. High pressure nitrogen is also used for pneumatic controls inside the primary containment to avoid adding air to the inert atmosphere.

Refer to Section 2.14.2 for data on the Containment Internal Structures and Section 2.14.3 for data on the Reactor Pressure Vessel Pedestal.

Design Bases

The pressure suppression containment structure has the capability to maintain its functional integrity during and following the peak transient pressures and temperatures caused by the worst LOCA pipe break postulated to occur simultaneously with loss of offsite power and a safe shutdown earthquake. The containment structure is designed to accommodate the full range of loading conditions associated with normal and abnormal operations including LOCA related design loads in and above the suppression pool including negative pressure differences between the drywell, wetwell and reactor building.

The containment structure has design features to withstand coincident fluid jet forces associated with outflow from the postulated rupture of any pipe within the primary containment.

The containment structure has design features to accommodate flooding to sufficient depth above active fuel to permit safe removal of fuel assemblies from the reactor core after a postulated design basis accident.

The containment structure is protected from and designed to withstand hypothetical missiles from sources within the primary containment and pipe whip due to the uncontrolled motion of broken pipes.

The containment structure is configured to channel flow from postulated pipe ruptures in the drywell to the pressure suppression pool designed with the required vent submergence and water volume to accommodated the energy of the fluid released.

The containment structure and penetration isolation system with concurrent operation of other accident mitigation systems, are designed to limit fission product leakage during and following a postulated design basis accident to values well below leakage calculated for allowable offsite doses. Leakage tests are described below.

The containment system has features for performing periodic leak rate tests at a reduced test pressure based on a 39 psig peak LOCA pressure initial leak test to establish primary containment leakage limit of 0.5% by weight per day of the primary containment free air volume. Type B tests measure local leakage, such as, individual air locks, hatches, drywell head, piping, electrical and instrument penetrations. Type C tests measure isolation valve leakage, and the Type A test measures the integrated containment leak rate. The individual and integrated preoperational leak rates are recorded in the plant technical specifications for comparison with the periodic leak rate test results. Periodic Type A integrated leak rate tests are conducted (three in a ten year period at nearly equal intervals with the third test at the ten year plant in-service inspection).

ITTAC item

By-pass leakage between the drywell and the wetwell through the drywell diaphragm floor and the wetwell to drywell vacuum breakers is designed 0.05 square feet of area based on A over the square root of K, established by the preoperational test. The recorded value in the technical specifications is 0.005 square foot and is periodically tested and verified to be less than this rate and is conducted at a wetwell air chamber pressure that does not clear the drywell to wetwell vents.

A drywell to reactor vessel refueling bellows and reactor well platform are provided to seal off the drywell during refueling to enable the reactor well to be flooded prior to removal of the reactor steam separator and fuel bundle manipulations. Piping, cooling air ducts and return air vent openings in the reactor well platform must be removed, vents closed and sealed watertight before filling the reactor well with water. The refueling bellows also absorbs the movement of the vessel caused by operating temperature variations and seismic activity.

The primary containment isolation is accomplished with inboard and outboard isolation valves on each piping penetration which are signaled to close on detection of high drywell pressure or reactor low water level. Safety systems performing a post LOCA function are capable of opening their isolation valves as needed.

The drywell bleed system provides the means to reduce containment pressure following heat up of the drywell during reactor startup.

A containment vent system consisting of dual rupture disks in series are provided to relief containment overpressure and isolation valves are provided for reclosure of the containment.

The standby gas treatment system is connectable to the containment purge exhaust system in the event the containment contains airborne radioactivity requiring removal with the nitrogen inert gas atmosphere prior to personnel entry of the drywell and wetwell.

Drywell coolers are provided to remove heat released into the drywell atmosphere during normal reactor operations.

Drywell and wetwell sprays are provided to limit temperature and pressure following an accident within the primary containment.

The Flammability Control System provides redundant hydrogen recombiners to remove any hydrogen released into the primary containment during a LOCA.

Inspections, Tests, Analyses and Acceptance Criteria

Table 2.14.1 provides a definition of the inspection, test, and/or analyses together with the associated acceptance criteria which will be undertaken for the Primary Containment System.

Table 2.14.1: Primary Containment System

Inspections, Tests, Analyses and Acceptance Criteria

Certified Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The configuration of the Primary Containment System is shown in Figure 2.14.1a.	1. Review the as-built Primary Containment System construction records and conduct onsite inspections to confirm the configuration is as shown in the design documents.	1. As-built Primary Containment System installations conform to the configuration for all components shown in Figure 2.14.1a.
2. Drywell free air volumes are: Upper Drywell: 5490 cubic meters. Lower Drywell: 1860 cubic meters. Drywell: 7350 cubic meters.	2. Verify from as-built documents the two independent drywell volumes less internal structures, piping, RPV and equipment (1220 cubic meters in upper drywell and 30 cubic meters in the lower drywell) are equal or less than the design free air volumes. The Upper Drywell is 29 M diameter, 9 M high from diaphragm floor to ceiling. Lower Drywell is 10.6 M diameter, 11.55 M from invert of RPV to top of basemat.	2. As-built documentation and calculations shall confirm the free air volumes of Upper and Lower Drywell are not more than the design values.
3. Wetwell volumes are: Suppression Pool: low water level 3580 cubic meters; high water level: 3620 cubic meters. Suppression Chamber: high water level 5960 cubic meters. Total Wetwell: 9580 cubic meters.	3. Verify from the as-built documents and calculations the Wetwell less internal structures, piping and equipment (50 cubic meters) is equal or more than the design free air volume. The minor diameter is 14 M, the major diameter is 29 M and the height from the basemat to the ceiling (underside of the diaphragm floor) is 7 M.	3. As-built documentation and calculations shall confirm the water volumes of the Suppression Pool and the free air volume of the Suppression Chamber are not less than the design values.
4. Suppression pool water drawdown volume due to holdup in the Lower Drywell is based on the Lower Drywell volume below the five return openings in the lower drywell wall connect into the drywell to wetwell vertical vents.	4. Measure and by visual inspection verify the five 0.3 m diameter return paths from the lower drywell are not installed higher than elevation (-)4550 mm through the wall into the vertical drywell to wetwell vents. Calculate the volume of water that could be contained below the five return paths.	4. Confirm the wetwell drawdown volume that can be contained in the lower drywell below the five return paths in the drywell to wetwell vertical vents is less than 815 cubic meters. Confirm the five vents are a minimum of 0.3 m diameter and connect to the drywall to wetwell vertical vents.

Table 2.14.1: Primary Containment System (Continued)

Inspections, Tests, Analyses and Acceptance Criteria

Certified Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
5. The configuration of the Drywell Head is shown in Figure 2.14.1b	5. Review documentation of the installed drywell head and associated equipment for compliance and (if applicable) the code stamp on the hardware.	5. Confirm the as-built configuration of the Drywell Head and associated equipment is designed, fabricated, installed and tested in compliance with applicable codes and regulatory requirements.
6. Two air lock type personnel access hatches and three equipment hatches are provided through the primary containment wall are shown in Figure 2.14.1b.	6. Review as-built documentation, operational test reports and by visual inspection of the installation and operation of two air lock type personnel access units and three equipment hatches determine compliance and the code stamp on the hardware.	6. Confirm the as-built personnel locks and equipment hatches are located as shown in Figure 2.14.1b and are designed, fabricated, installed and tested in compliance with applicable codes and regulatory requirements.
7. Primary containment leakage is minimized with drywell and wetwell liners anchored to all interior sides of primary containment perimeter walls, ceilings and floors. Wetted portions of suppression pool walls and floors are steel lined with stainless steel cladding. Both surfaces of the upper drywell diaphragm floor are lined, and the lower drywell floor is lined. The pedestal and reactor shield wall are constructed of steel with concrete fill. The drywell head and personnel locks and hatches are steel with double type testable seals.	7. Review as-built documentation, test reports and conduct visual inspection of all primary containment liner welds at joints, penetration sleeves and structural interfaces. Verify tests of seals at the drywell head, personnel locks and hatches.	7. Confirm that liners have been designed, fabricated, installed and leak tested.
8. Primary containment is designed as a Seismic Category I reinforced concrete structure.	8. Review as-built documentation to verify construction materials were tested to required standards, placed and installed as configured for the Seismic Category I requirements.	8. Confirm that primary containment reinforced concrete structure, materials, and appurtenances have been designed, fabricated, installed and tested in compliance with applicable codes and regulatory requirements.

Table 2.14.1: Primary Containment System (Continued)

Inspections, Tests, Analyses and Acceptance Criteria

Certified Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
9. The primary containment integrated leak rate tests are designed to limit the leak rate to 0.5% per day at the primary containment 39 psig peak LOCA pressure.	9. Conduct the as-built Primary Containment System Type A, B and C primary containment leakage tests in conjunction with the preoperational high and reduced pressure leakage test reports to confirm the Type A integrated leak rate test results are within the limits recorded in the Technical Specifications.	9. Confirm the allowable leakage from the primary containment into the secondary containment does not exceed 0.5% per day with the containment peak LOCA pressure of 39 psig.
10. The Type B tests of welds in the primary containment liner, welds in sleeves, electrical and instrument cable penetrations and capped future penetrations are designed to detect excessive leakage and determine when repair is required.	10. Review the as-built Type B test leakage measurements and analyses the preoperational high and reduced pressure tests of the primary containment structural welds, liner welds; piping, electrical and instrument penetrations, sleeve welds; personnel locks, hatches, tunnels and drywell head welds to confirm their leak tight integrity.	10. Confirm the Type B tests have been conducted and the leakage results are within the required leakage limits recorded in the Technical Specifications.
11. The Type C tests for primary containment isolation valves, personnel entry lock seals, hatch seals and drywell head seals are designed to detect excessive leakage and determine when repairs are required.	11. Review the as-built Type C test measurement records and analyses the preoperational high and low pressure test records for isolation valves; personnel lock, hatch and drywell head seals to confirm their leak tight integrity. Verify the leakage limits are recorded in the Technical Specifications.	11. Confirm the Type C tests have been conducted and the leakage results are acceptable with the limits established during preoperational testing and recorded in the Technical Specifications.
12. Penetration sleeves, hatches and personnel locks are designed Safety Class 2, Quality Group B, Seismic Category I. Personnel lock instruments and controls are powered from the essential electric sources serving the Security System.	12. Verify from the as-built records of all penetrations, hatches and personnel locks their safety classification, seismic category and electric power source for this equipment.	12. Confirm all penetrations, the drywell head, personnel locks and equipment hatches are designed, fabricated, installed and tested in compliance with applicable codes and regulatory requirements.

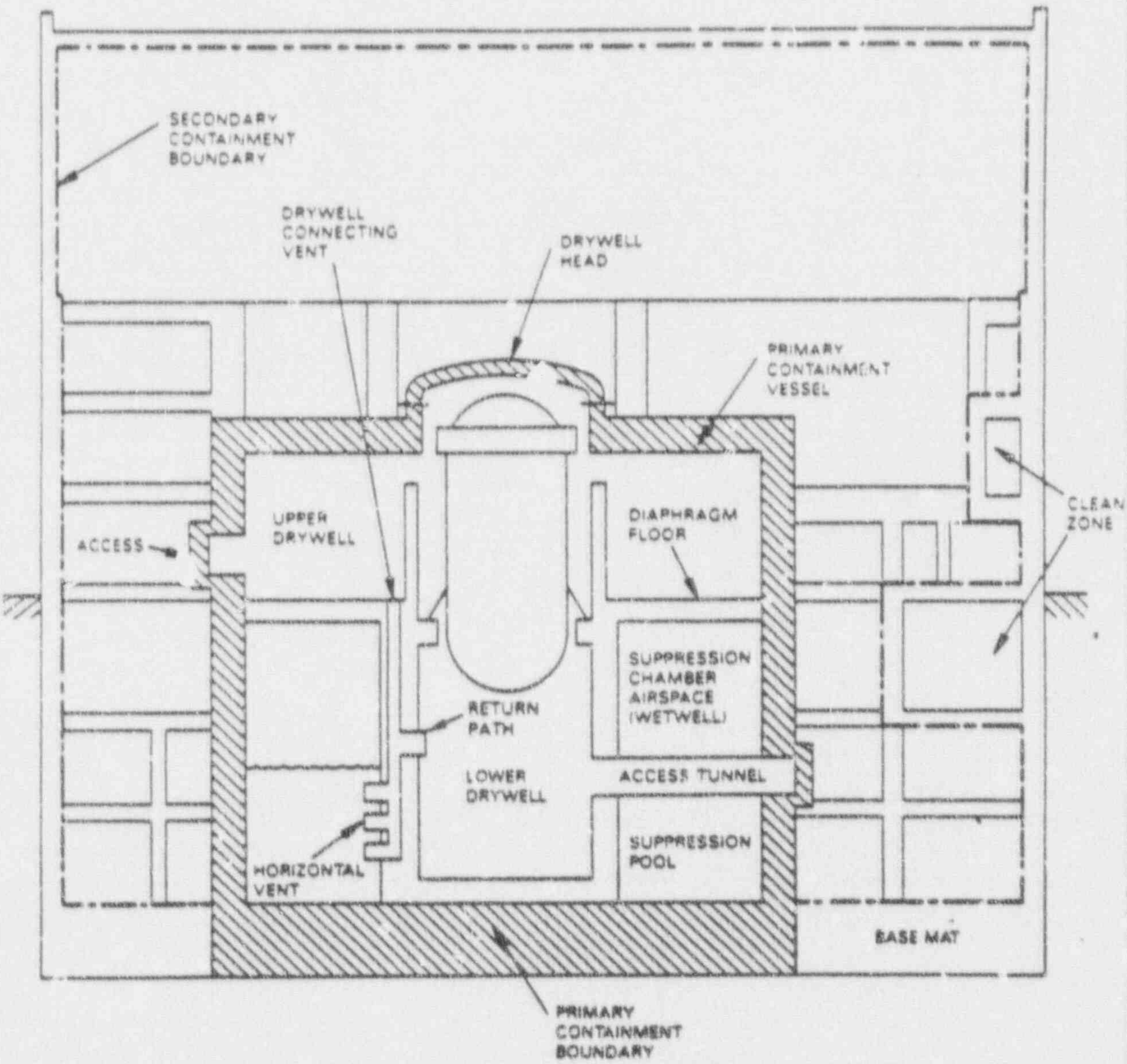


Figure 2.14.1 Primary Containment System

6.0 Section 2.14.4 Standby Gas Treatment System (SGTS)

6.1 Add the following additional ITTAC items to Table 2.14.4.

(1) the SGTS is designed to attain a negative pressure of at least 0.25 inches w.g. within 20 minutes upon the receipt of a containment isolation signal.

(2) the charcoal adsorber in the SGTS filtration unit will be at least 15.24 cm (6 inches) depth with an iodine removal efficiency of greater than 99 percent.

6.2 Clarify the discrepancy on the SGTS charcoal adsorber iodine removal efficiency of 99 percent stated in this section and 97 percent assumed in Section 15.6.5.5 and Table 15.6-8 of the SSAR.

6.3 Additional comments are noted on the enclosed marked-up pages.

2.14.4 Standby Gas Treatment System

The Standby Gas Treatment System (SGTS) has the capability to filter the gaseous effluent from the primary containment or from secondary containment when required to limit the discharge of radioactivity to the environment.

The SGTS is designed to accomplish the following:

(1) Maintain a negative pressure in the secondary containment, relative to the outdoor atmosphere, to control the release of fission products to the environment.

(2) Filter airborne radioactivity (halogen and particulates) ~~in the process stream~~ to reduce off-site doses.

(3) Ensure that failure of any active component, assuming loss of off-site power, cannot impair the ability of the system to perform its safety function.

The SGTS consists of two parallel and redundant trains of active equipment which share a single filter train. Suction is taken from above the refueling ~~flor~~ or from the primary containment via the Atmospheric Control System. The discharge goes to the main plant stack.

The SGTS consists of the following principle components:

(1) Two independent dryer trains consisting of a moisture separator and an electric process heater.

(2) Two independent process fans located upstream of the filter train.

(3) A filter train consisting of a prefilter, a high efficiency particulate air (HEPA) filter, a charcoal adsorber, a second HEPA filter, and space heaters.

Instrumentation strictly required for monitoring the operation of the SGTS to mitigate off-site releases is provided in the main control room (MCR) on panel displays designed for that purpose. Instrumentation used for testing or maintenance is located at the local instrument rack.

There are two basic parameters that are important to assure SGTS function, secondary containment pressure and charcoal adsorber inlet relative humidity. If the secondary containment pressure is less than the ambient pressure, any release from the plant passes through and is treated and monitored by the SGTS. If the inlet relative humidity to the charcoal adsorber is less than or equal to 70%, then credit for a 99% efficiency may be taken. If the operator confirms the secondary containment pressure is negative with respect to ambient on all faces of the building and the relative humidity is less than 70% entering the adsorber, then the system is functioning as intended to mitigate calculated off-site doses.

The ABWR SGTS design provides four divisional differential pressure transmitters with high and low alarms monitoring secondary containment pressure with respect to ambient pressure outside each of the four walls of the Reactor Building. In addition, four divisions of moisture measurement with high alarms are provided in the filter housing upstream of the charcoal adsorber, providing a direct measurement of relative humidity. These basic parameters each have main control room indication and alarm.

Figure 2.14.4 shows the major system components. Key equipment performance requirements are:

(1) Fan capacity (minimum) 4000 scfm

(2) Dryer train outlet relative humidity 70%

(3) Filter train charcoal adsorber ~~weight (nominal)~~ ~~1750 lb~~ 6 inch depth with $\geq$ 99% iodine removal efficiency

A slight negative pressure is normally maintained in the secondary containment by the Reactor Building HVAC system. Upon the receipt of a high primary containment pressure signal or a low reactor water level signal, or when high radioactivity is detected in the secondary containment or refueling floor ventilation exhaust, the SGTS is automatically actuated. Upon SGTS initiation, the secondary containment is automatically isolated from the HVAC system. If SGTS 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. The SGTS has independent, redundant active components. Should any active component fail, SGTS functions can be performed by the redundant component.

The SGTS is on standby during normal plant operation and may be manually initiated before or during primary containment purging (i.e., de-inerting) when required to limit the discharge of contaminants to the environment. If purging through the HVAC could or does result in a trip from the ventilation exhaust radiation monitors, then de-inerting can be [re-]initiated at a reduced rate through the SGTS. Use of SGTS during de-inerting is very infrequent. The SGTS may be manually initiated whenever its use may be needed to avoid exceeding radiation monitor set points.

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 provided for fire protection. Water is supplied from the fire protection system and is connected to the filter train via a removable spool piece.

The SGTS, except for the deluge, is designed and built to meet the requirements for Safety Class 3 equipment. The electrical devices of independent components are powered from separate Class 1E electrical buses. The SGTS is designed to Seismic Category I requirements and is housed in a Category I structure. The construction materials used for the SGTS are compatible with normal and accident environments postulated for the area in which the equipment is located.

Inspections, Tests, Analyses and Acceptance Criteria

Table 2.14.4 provides a definition of the inspections, tests, and/or analyses together with associated acceptance criteria which will be undertaken for the SGTS.

Table 2.14.4: Standby Gas Treatment System

Inspections, Tests, Analyses and Acceptance Criteria

Certified Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The SGTS shall be capable of maintaining a negative pressure of at least 0.25 inches w.g. and the relative humidity of the process stream entering the filter train below 70%. Each SGTS fan capacity shall be at least 4000 scfm measured with secondary containment not isolated.	1. System preoperation tests will be conducted to demonstrate acceptable fan and filter performance. These tests will be conducted at steady state conditions.	1. It must be shown either SGTS fan can maintain the secondary containment at a negative pressure of at least 0.25 inches w.g. with the associated dryer maintaining the outlet relative humidity below 70%. With secondary containment not isolated, fan capacity shall be at least 4000 scfm.
2. A simplified system configuration as shown in Figure 2.14.4.	2. Inspections of installation records together with plant walk-downs will be conducted to confirm that the installed equipment is in compliance with the design configuration defined in Figure 2.14.4.	2. The system configuration is in accordance with Figure 2.14.4.
3. The dryer, fan and associated valves can be powered from the standby AC power supply as described in Section 2.2.4.	3. System tests will be conducted after installation to confirm that the electrical power supply configurations are in compliance with design commitments.	3. The installed equipment can be powered from the standby AC power supply.
4. SGTS components which are required to maintain negative pressure in secondary containment are classified Seismic Category I.	4. Review associated documentation.	4. Components meet Seismic Category I requirements.

7.0 Section 2.15.5. Heating, Ventilating and Air Conditioning (HVAC)

7.1 We find numerous discrepancies in the description of the HVAC major equipment and in the system nomenclature between this document and the SSAR. As we partly noted in the enclosed markup pages, we have attempted to correct the discrepancies unsuccessively. Therefore, we request GE to resubmit this section for NRC review after a thorough review by GE.

7.2 A marked-up pages of Section 2.15.5 is enclosed.

2.15.5 Heating, Ventilating and Air Conditioning

Design Description

Design Descriptions are provided for each of the following HVAC Systems: Control Building, Control Room Habitability Area, Reactor Building, Turbine Building, Electrical Building, Service Building and Radwaste Building. Tables for the Inspections, Tests, Analyses and Acceptance Criteria are included with ten HVAC System Figures.

Control Building HVAC Systems

Control Building safety-related air conditioning systems other than the Control Room Habitability Area, are designed to maintain 85°F, 50% RH at a slight positive pressure to provide efficient work environments for the operators and proper environments for structures and equipment to insure it has the capability to perform every safety function considering the worst case single failure for all normal and abnormal reactor operating conditions and accident conditions.

Air conditioning equipment to accomplish the above is designed to maintain efficient work environments for the operators and proper environments for equipment and structures.

Major equipment consists of redundant supply fans, [redacted], chilled water cooling coils, and recirculation/exhaust fans, backdraft dampers, fire dampers, and air distribution ducts and accessories. [redacted]. Corrosion resistant materials are used in the fabrication of fans, coils, cabinets, plenums, air ducts and accessories (see Figure 2.15.5a for a simplified design configuration).

All safety-related HVAC systems are served from Class 1E power from either normal off-site sources or on-site emergency diesel generators.

Electrical equipment rooms are maintained at a positive pressure, and air movement is designed to flow to the battery rooms maintained at a negative pressure by the exhaust fans.

Rooms housing the motor-generator (MG) sets, which provide power to the reactor internal pumps, are cooled by individual fan coil cooling units. These non-safety related cooling units are powered from the same electrical source as the MG set served. The HVAC Normal Cooling Water System connects to each fan coil unit cooling coil.

Smoke detectors are provided to initiate an alarm to close the return air dampers, open the fire zone damper bypassing the exhaust fans and start the supply fans to pressurize the Control Building compartments and discharge smoke through the exhaust louvers. The supply fans are located in mechanical rooms separate from the remainder of the Control Building compartments. The supply and exhaust fans can be started from the Control Room or the hand-off-automatic switches on the motor control center. These fans are powered from Class 1E Electrical Divisions 1,2 or 3.

Control Room [redacted] HVAC System

The Control Room is maintained at a positive pressure for most events, 76°F, 42% relative humidity (RH) and is continuously habitable during LOCA, chemical release, fire, safe shutdown earthquake, tornado, flood, and other natural phenomena to insure that the operators can safely shut down the reactor and keep it in a safe shutdown condition.

Major equipment consists of redundant supply fans, [redacted], [redacted] heating coils, chilled water cooling coils, and recirculation/exhaust fans, backdraft dampers, fire dampers, and air distribution ducts and accessories. Bird screens, dust and insect filters are provided to protect heating and cooling coil efficiency. Corrosion resistant materials are used in the fabrication of fans, coils, cabinets, plenums, air ducts and accessories. The Control Room [redacted] consists of redundant HEPA and charcoal filtration units designed to meet regulations addressing Control Room habitability during LOCA and other abnormal events. These units treat air from one of two widely separated air intakes with radiation monitors controlled to select the air intake with the non-contaminated air or isolate both in the event contaminants are present at both locations. Provisions are included for the future installation of site dependent toxic chemical monitors with controls capable of actuating the Control Room isolation dampers. The Control Room [redacted] System is Seismic Category I, located in a Seismic Category I structure with air intakes and exhausts designed for protection from the effects of wind, rain, snow, tornados and tornado missiles (see Figure 2.15.5b for a simplified design configuration.

All safety-related HVAC components are served from Class 1E power from either normal off-site sources or on-site emergency diesel generators

Smoke detectors are provided to initiate an alarm to close the return air dampers, open the fire zone damper bypassing the exhaust fans and start the supply fans to pressurize the Control Room Habitability areas and discharge smoke through the exhaust louvers. The supply and exhaust fans are located in mechanical rooms separate from the remainder of the Control Room Habitability Area and can be started from the Control Room or the hand-off-automatic switches on the motor control center. These fans are powered from Class 1E Electrical Divisions II or III.

at each intake. These monitors would permit automatic selection of less-contaminated air at either intake.

insert

habitability area

"The inhabited portions of the control room are physically located underground allowing a sufficient distance from ~~the~~ main steam line so that direct gamma radiation during and following an accident is acceptable.

Reactor Building HVAC Systems

Reactor Building Secondary Containment is served from non-safety related HVAC equipment located in the Turbine Building and is designed to maintain temperatures between 65 to 104°F, 50% RH and hold a negative 0.25-inch water gauge pressure. Air supply and exhaust duct systems are balanced to cause air movement from clean areas to areas with potential airborne radioactive contamination. Redundant Secondary Containment isolation dampers in series are provided in the main air supply and exhaust ducts where they enter the Reactor Building. These isolation dampers close whenever high airborne radiation is detected in the exhaust duct or in the Refueling Floor exhaust air intake, or when the fans fail or are not operating. These isolation dampers are safety related, Seismic Category I with Seismic Category I supports and have normally open, fail closed air operators powered from Class 1E Electrical Divisions I or II.

Secondary Containment ~~air conditioning and heating equipment~~ HVAC System consists of three 50% air supply fans moving 100% outdoor air which is filtered with bag-type filters, heated with hot water coils or cooled with chilled water coils before the air is distributed through air ducts to and within the Secondary Containment. Exhaust air from the Reactor Building Secondary Containment compartments is collected in ducts, monitored for radiation and drawn to three 50% exhaust fans discharging into the plant stack. Seismic Category I duct supports are provided where air ducts could fall on safety-related equipment. The Primary Containment supply fan, filter and purge exhaust fan are not safety-related and serve the Primary Containment Atmospheric Control System (see Figure 2.15.5c for a simplified design configuration).

Essential Equipment HVAC System is safety related and consists of cabinet cooling (HVH) units containing fans and cooling coils connected to the Reactor Cooling Water System. Individual HVH coolers are provided for each compartment housing the following safety-related equipment: (1) Emergency Core Cooling System (ECCS) consisting of three Residual Heat Removal (RHR) pumps and heat exchangers; (2) two High Pressure Core Flooding (HPCF) pumps; (3) one Reactor Core Injection Cooling (RCIC) steam turbine pump; (4) two Flammability Control System (FCS) recombiners; (5) two Standby Gas Treatment System (SGTS) filter/dryer units and the two Containment Atmospheric Monitoring System (CAMS) equipment rooms. Each room cooler is controlled to start when the equipment served starts or when the respective space thermostat calls for cooling.

The main steam tunnel has a non-safety-related cabinet cooler (HVH) containing cooling coils served from the HVAC Normal Cooling Water System. Two fans distribute air to the main steam (MS) and feedwater (FW) isolation valve areas. These units are manually started from the main Control Room and are designed to keep the temperature below 140°F. Other non-safety-related cabinet coolers (HVH) containing fans and cooling coils connected to the HVAC Normal Cooling Water System are provided for the Refueling Machine Control Room, the Inservice Inspection (ISI) Rooms and the Suppression Pool Cleanup System (SPCU) Equipment Room. These cabinet cooling units are controlled to start when the space thermostat calls for cooling.

Radiation monitors are provided in the air environment of the refueling floor and in the main air exhaust duct in the Reactor Building to cause closure of the main air supply and exhaust duct automatic isolation dampers whenever high airborne radiation occurs. This high radiation signal will also activate the Standby Gas Treatment System to maintain the negative 0.25-inch water gauge pressure within the Secondary Containment.

Smoke removal from any compartment of the Secondary Containment is accomplished by operating all three air supply fans and all three air exhaust fans with their filter bypass dampers opened. Air exhaust flow limiting dampers are actuated within the fire zones not experiencing the fire to pressurize these fire zones to limit smoke intrusion.

The remaining areas of the Reactor Building outside of Secondary Containment are served by individual HVAC supply and exhaust systems designed to keep the temperatures below 104°F.

Electrical Equipment HVAC consists of three safety-related systems, Seismic Category I, Safety Class 3, Quality Group C and are powered from their respective Class 1E Electrical Divisions 1, 2 or 3. Outdoor air and return air is mixed, filtered, cooled, and distributed to maintain a slightly positive pressure in the electrical equipment rooms and a slightly negative pressure in the Diesel Generator and Day Tank Rooms except when the diesel generators are running and their two emergency cooling fans operate to keep the temperature below 110°F. Smoke removal is accomplished by stopping the exhaust fans, closing the return air damper and opening the exhaust fan by-pass damper. Continuing to operate the supply fans pressurizes the areas served and releases the smoke through the exhaust bypass duct to the outdoors (see Figure 2.15.5d for a simplified design configuration).

Reactor Internal Pump (RIP) Rooms are supplied recirculated air cooled by HVAC normal cooling water coils and distributed by fans and air ducts. The return air is drawn into the RIP power supplies and control panels before being recooled. This RIP HVAC System is non-safety related and non-seismic except the air duct supports where safety related equipment is located (see Figure 2.15.5e for a simplified design configuration).

Fine Motion Control Rod Drive (FMCRD) Auto Exchanger Control Panel Rooms are served by three fan coil units (FCU) with cooling water supplied by the HVAC Normal Cooling Water System. These FCU's are not safety related.

Turbine Building HVAC Systems

Turbine Building is served from non-safety-related HVAC equipment located within the building to maintain less than 104°F, 50% RH and a slightly negative pressure except in electric switchgear rooms. Air supply and exhaust duct systems shall be balanced to cause air movement from clean areas to areas with potential airborne radioactive contamination.

Turbine Building air conditioning and heating equipment consists of three 50% ventilation system air supply fans moving 100% outdoor air which is filtered with bag type filters, cooled with chilled water coils or heated with hot water coils before the air is distributed through air ducts to and within the Turbine Building. General exhaust air from the Turbine Building is collected in ducts connected to three 50% ventilation system exhaust fans with bag filters discharging into the plant vent stack. Heat from the Turbine Operating Floor is removed by roof exhaust ventilating fans (see Figures 2.15.5f and 2.15.5g for the simplified design configurations).

Separate Lube Oil Area exhaust fans and ducts are provided to serve the LO storage and pump rooms to remove lubricating oil (LO) fumes and discharge them from the plant vent stack.

Compartments with potential radioactive contamination are collected in separate exhaust ducts and moved by the compartment exhaust fans with bag filters and radiation monitors to the plant vent stack.

Compartments housing heat releasing equipment are provided with multiple fan recirculation fan coil unit coolers with cooling coils and filters to keep temperatures below 104°F.

Smoke removal is accomplished with operation of the Turbine Building roof power exhaust ventilators, supply fans with the return air damper closed, exhaust fans with their exhaust filter bypass dampers opened and fire zone smoke dampers positioned to create a positive pressure in the areas adjacent to the zone experiencing the fire. The Turbine Building supply and exhaust fans can be started from the Control Room or the on-off-automatic switches on the motor control center in the Electrical Building.

Electrical Building HVAC Systems

Redundant air supply units with filters, cooling coils and fans are provided to maintain a positive pressure in the non-safety related Electrical Switchgear

Rooms. Return/exhaust fans and air ducts provide the ventilation. Recirculating fan coil unit coolers help maintain the temperature below 104°F in the Electrical Switchgear Rooms and the Air Compressor Room. A negative pressure in the Auxiliary Boiler Rooms and Combustion Gas Turbine Generator Room is accomplished with roof exhausters (see Figure 2.15.5h for a simplified design configuration).

Smoke removal is accomplished by closing the return air dampers and circulating all outdoor air within the Electrical Building. The Heating Boiler Room and Combustion Turbine Generator Room are maintained at a negative pressure relative to the Electrical Switchgear Rooms, Chiller Room, Air Compressor Room and the stair towers which are maintained at a positive pressure. Equipment rooms position their fire zone smoke dampers to increase pressurization when the fire is in an adjacent area. Supply and exhaust fans can be started and dampers aligned from the Control Room or the hand-off-automatic switches on the motor control center.

Service Building HVAC Systems

The Service Building is served from non-safety-related HVAC equipment located within the building to maintain 72°F, 50% RH and a slightly negative pressure except in corridors and electrical equipment rooms (see Figure 2.15.5i Service Building HVAC Systems for a simplified design configuration).

Service Building air supply to the nonradioactive area is provided with a mixture of outdoor and return air which is filtered, cooled, dehumidified or humidified and distributed by redundant fans through air ducts and diffusers to three reheat zones controlled by zone thermostats. Cooling is provided by the HVAC Normal Cooling Water System and reheat by the Hot Water Heating System. Air supply and exhaust duct systems are balanced to cause air movement from clean areas to areas with potential airborne radioactive contamination.

Service Building air supply to the potentially radioactive area is provided with 100% outdoor air which is filtered, cooled and distributed by redundant fans and air ducts to a single reheat zone controlled by a thermostat. The potentially radioactive area is maintained at a negative pressure by redundant exhaust fans which draw the exhaust air through filters before discharge to the vent stack. The exhaust air flow is controlled by a variable air operated damper with signals from a flow meter and radiation monitor.

Room cooling is supplemented by fan coil units with filters and cooling coils provided with HVAC normal cooling water. The Chemical Counting Room, Computer Room and Technical Support Center are provided with cooling units having redundant fans. The space temperature is controlled by thermostats modulating the HVAC normal cooling water valves.

Smoke removal can be accomplished by closing the non-radioactive controlled area return air damper to pressurize this area and positioning the fire zone smoke damper in the exhaust duct to by-pass the exhaust fans and remove the smoke through the exhaust louvers. The radioactive controlled area supply and exhaust fans circulate all outdoor air and normally maintain this area at a negative pressure compared to the non-radioactive controlled area. The radioactive controlled area exhaust fans can remove smoke from both the non-radioactive controlled area and the radioactive controlled area. Supply and exhaust fans and return air and fire zone dampers can be controlled from the Control Room or from the hand-off-automatic switches on the motor control center.

Radwaste Building HVAC Systems

The Radwaste Building is served from non-safety-related HVAC equipment located within the building to maintain 65 to 104°F, 50% RH and a slightly negative pressure except in the Radwaste Control Room. Air supply and exhaust duct systems are balanced to cause air movement from clean areas to areas with potential airborne radioactive contamination (see Figure 2.15.5j for a simplified design configuration).

Radwaste Building air supply to potentially radioactive areas is provided with 100% outdoor air which is filtered, cooled, and distributed by redundant fans and air ducts to several reheat zones each controlled by a thermostat. The potentially radioactive area is maintained at a negative pressure by redundant exhaust fans which draw the exhaust air through filters before discharge to the vent stack. The exhaust air flow is controlled by a variable air operated damper with signals from a flow meter and radiation monitor.

Radwaste Building process tanks are connected to a tank vent transfer system that equalizes air outflow from tanks being filled with air inflow needed for tanks being emptied. Any excess air is exhausted through a filter, radiation monitor and redundant exhaust fans to the plant vent stack.

The Radwaste Control Room is maintained at a positive pressure by varying the air flow to the redundant exhaust fans by a variable position damper.

Smoke removal is accomplished by opening the exhaust fan by-pass damper to enable the dual Radwaste Building air supply fans to be started to pressurize all areas. Smoke is discharged to the stack. The supply and exhaust fans can be controlled from the Radwaste Building Control Room or the hand-off-automatic switches on the motor control center.

Inspections, Tests, Analyses and Acceptance Criteria

The following tables provide the Inspections, Tests, Analyses and associated Acceptance Criteria which are to be accomplished for the plant HVAC systems.

Table	System
2.15.5a	Control Building HVAC Systems
2.15.5b	Control Room Habitability Area HVAC System
2.15.5c	Reactor Building HVAC Systems
2.15.5d	Turbine Building HVAC Systems
2.15.5e	Electrical Building HVAC Systems
2.15.5f	Service Building HVAC Systems
2.15.5g	Radwaste Building HVAC Systems

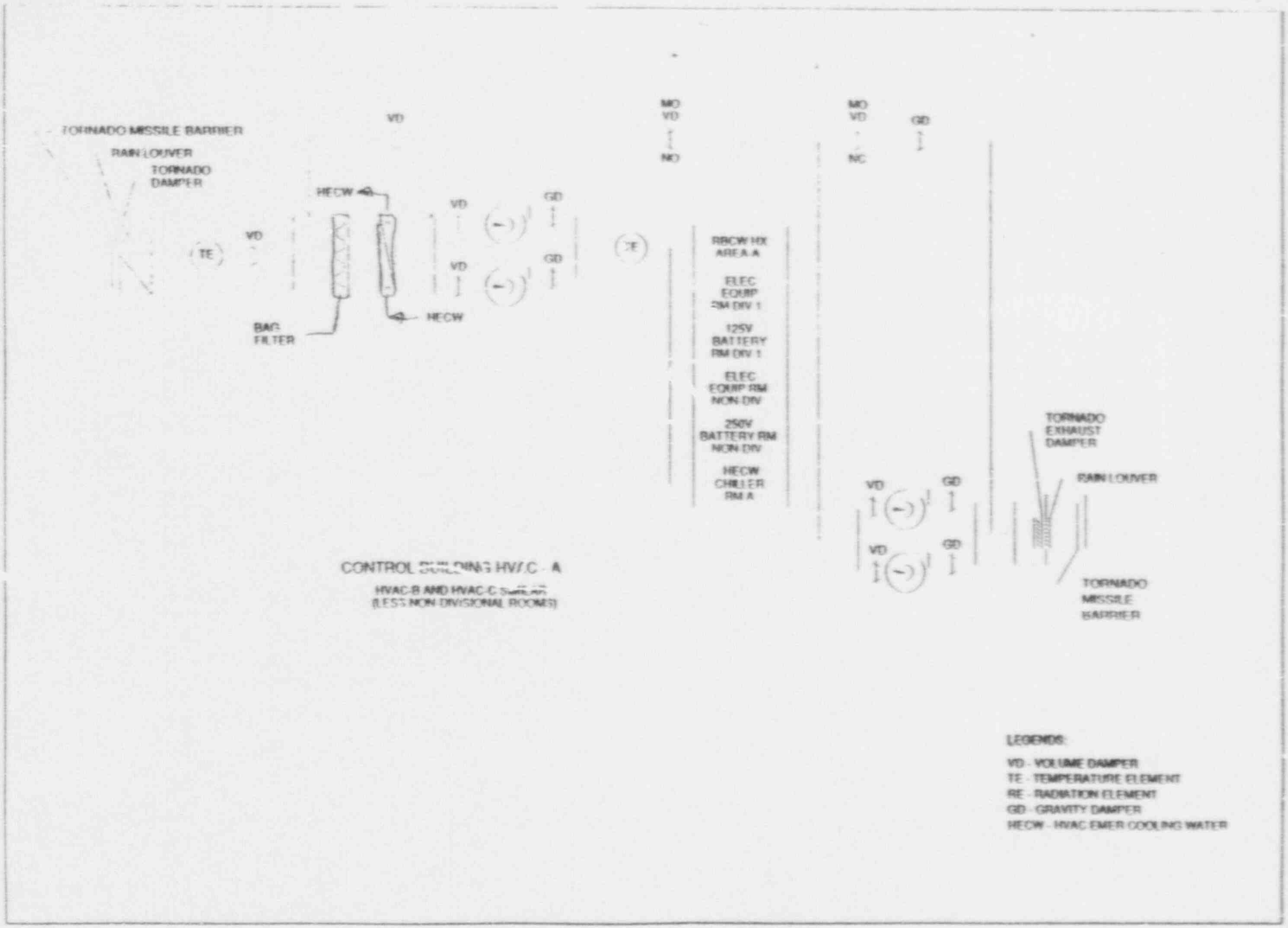


Figure 2.15.5a Control Building HVAC System

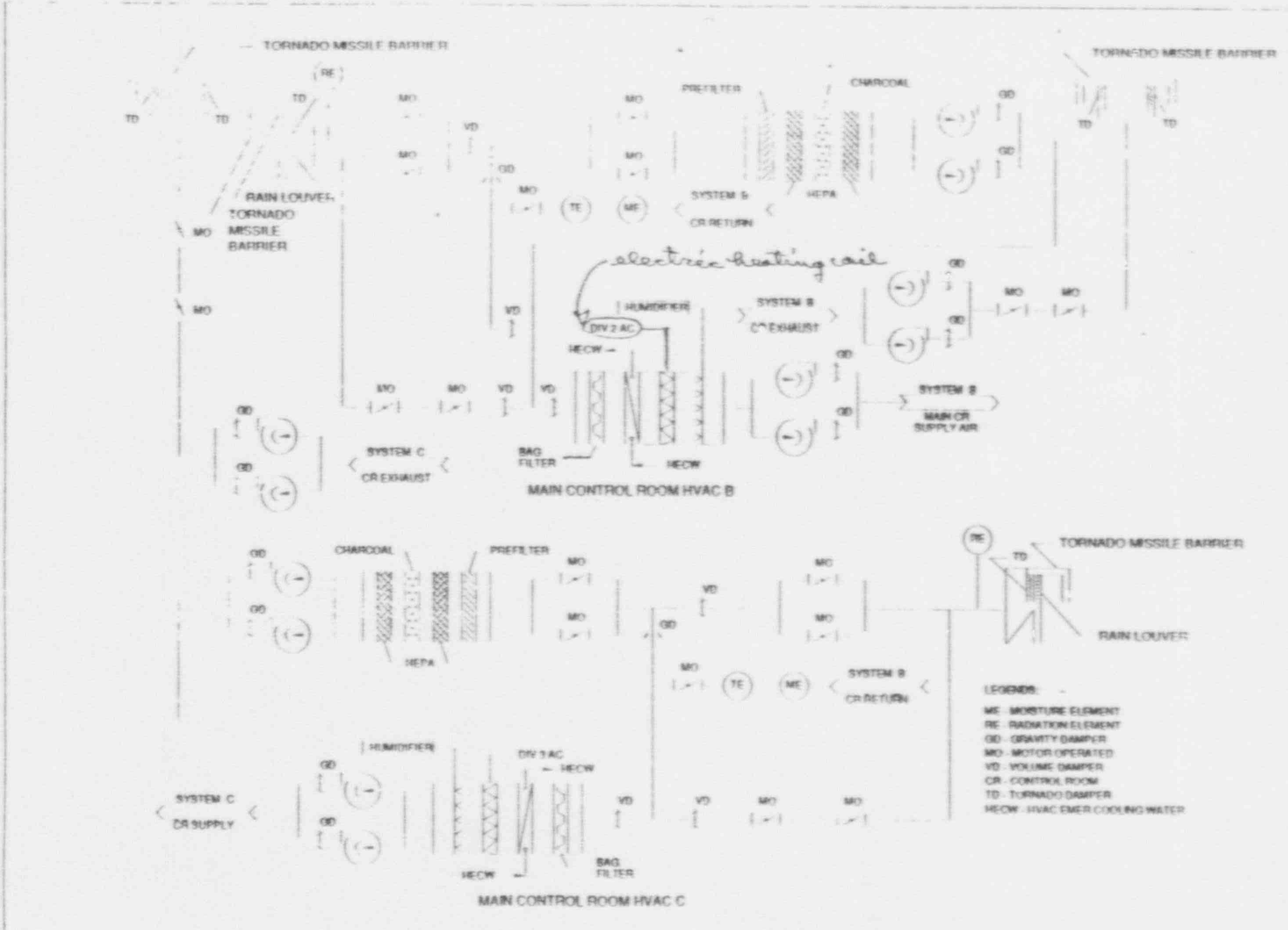


Figure 2.15.5b Control Roor 1 Habitability Area HVAC System

ITAAC FOR NON-SEISMIC/SEISMIC INTERACTION

Position C.2 in RG 1.29, "Seismic Design Classification", states that those portions of structures, systems, or components whose continued function is not required (non-Seismic Category I), but whose failure could reduce the functioning of any Seismic Category I item to an unacceptable safety level or could result in incapacitating injury to occupants of the control room should be designed and constructed so that the SSE would not cause such failure. In addition, Position C.3 of RG 1.29 states that Seismic Category I design requirements should extend to the first seismic restraint beyond the non-seismic/seismic interface. Note f in Table 3.2-1 and Subsections 3.2.8 and 3.7.3.13 in the ABWR SSAR collectively state that equipment, structures, and piping in the ABWR that are non-seismic Category I, but whose failure could damage Seismic Category I items, are designed and analyzed to assure that their structural integrity is maintained under loadings from the SSE. In addition, Subsection 3.7.3.13 states that at the interface between Seismic and non-Seismic Category I piping systems, the Seismic Category I dynamic analysis will be extended to either the first anchor point in the non-seismic system or to sufficient distance in the non-seismic system so as not to degrade the validity of the Seismic Category I analysis.

As briefly discussed in Section 3.2.1 of the ABWR FSER, the staff has concluded that these commitments are in conformance with RG 1.29 and are therefore, acceptable. However, to verify that these commitments have been implemented, Section 3.2.1.1 in the ABWR FSER provides the staff's position that GE should develop an ITAAC for non-seismic/seismic interaction. This ITAAC should be submitted as a part of Section 3.0, "Non-System Based Tier 1 Material" in the ABWR Design Document, "Tier 1 Design Certification Material for the GE ABWR Design." Part of this ITAAC should consist of plant-specific walkdowns to be conducted prior to commercial operation to assess the safety-related consequences of potential failures of non-seismically designed systems, structures, and components that are overhead, adjacent to, or attached to Seismic Category I items. The acceptance criteria in the ITAAC should be sufficient to satisfy Positions C.2 and C.3 in RG 1.29.

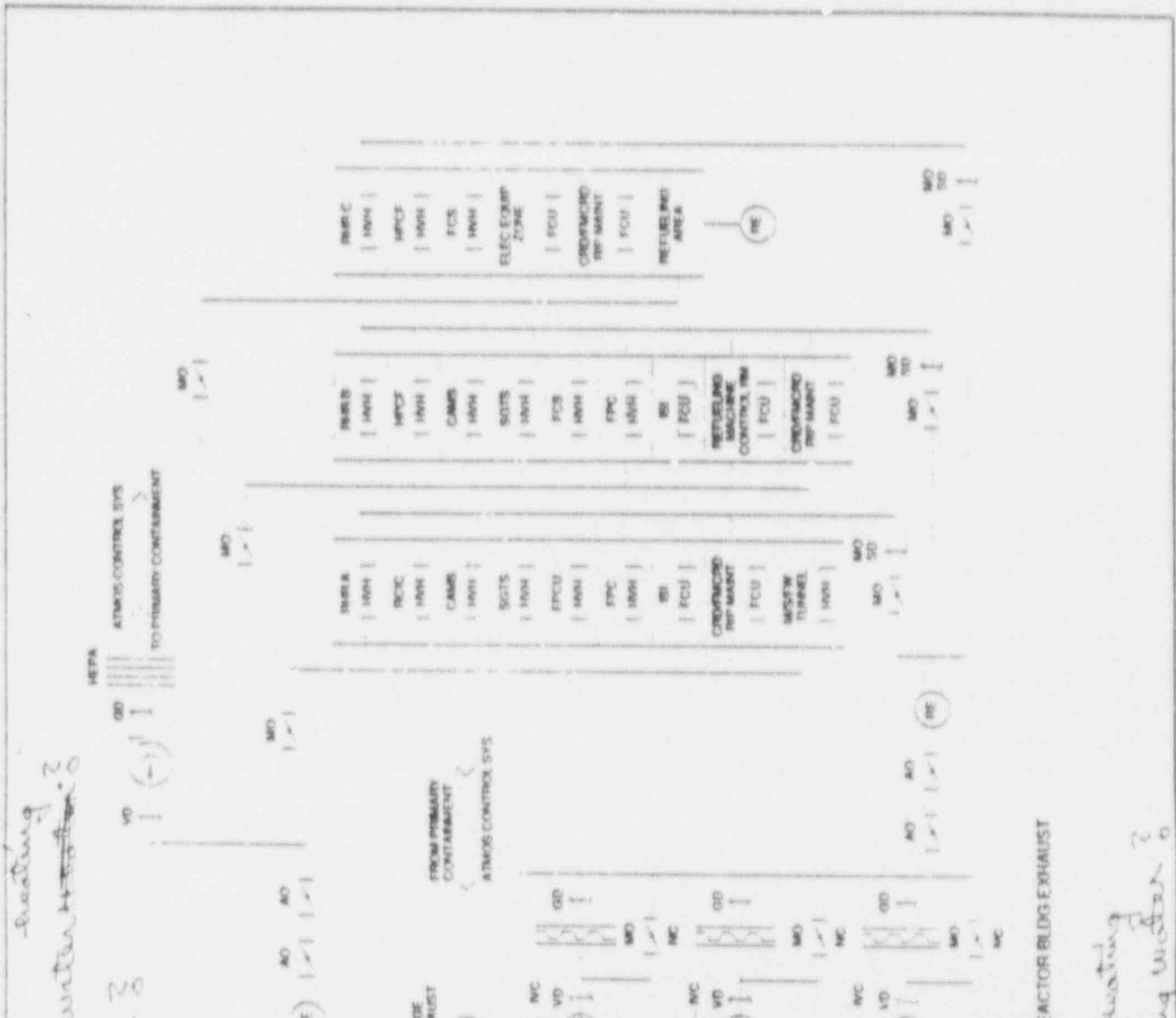


Figure 2.15.5c Reactor Building Secondary Containment HVAC System

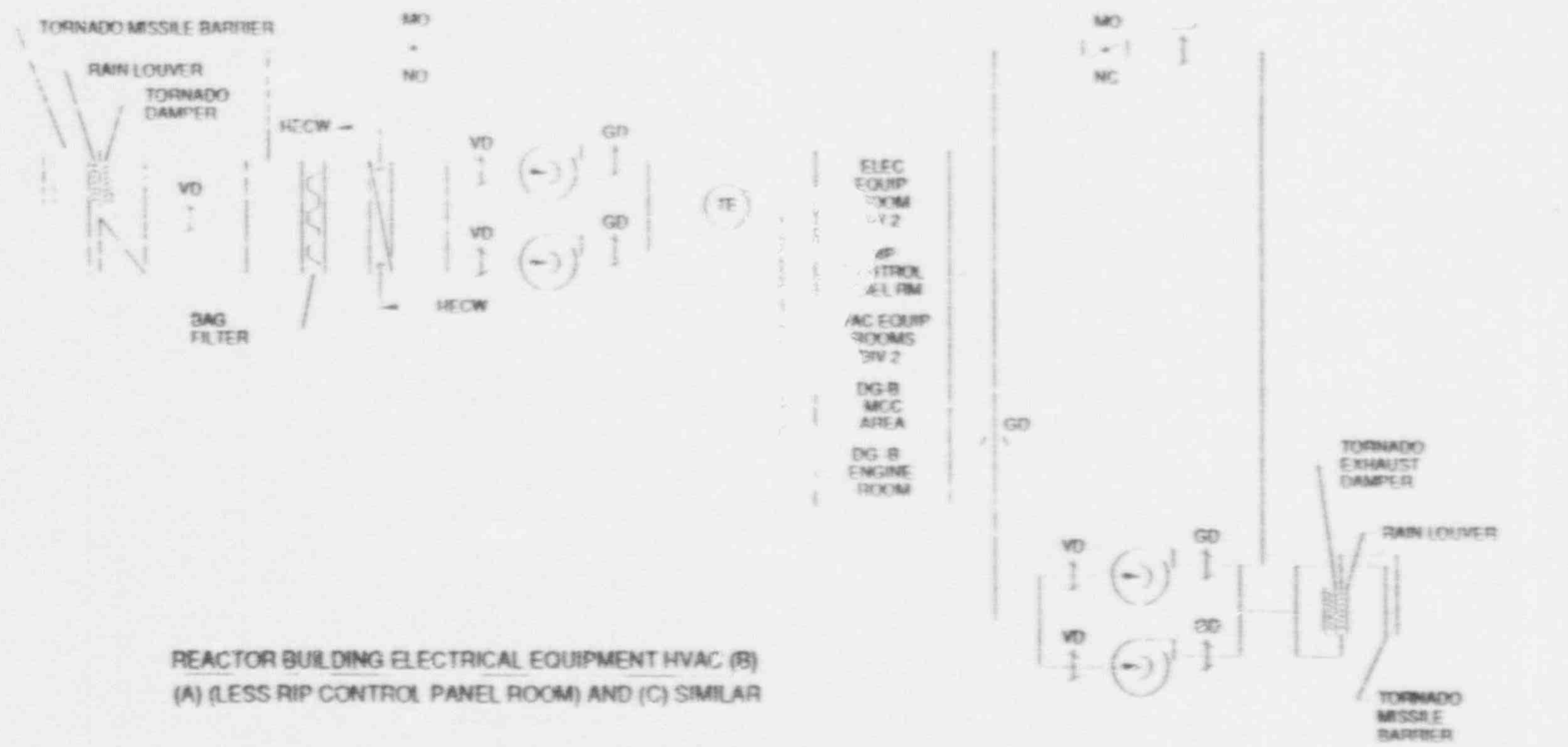


Figure 2.15.5d Reactor Buildir ˜lectrical Equipment HVAC System

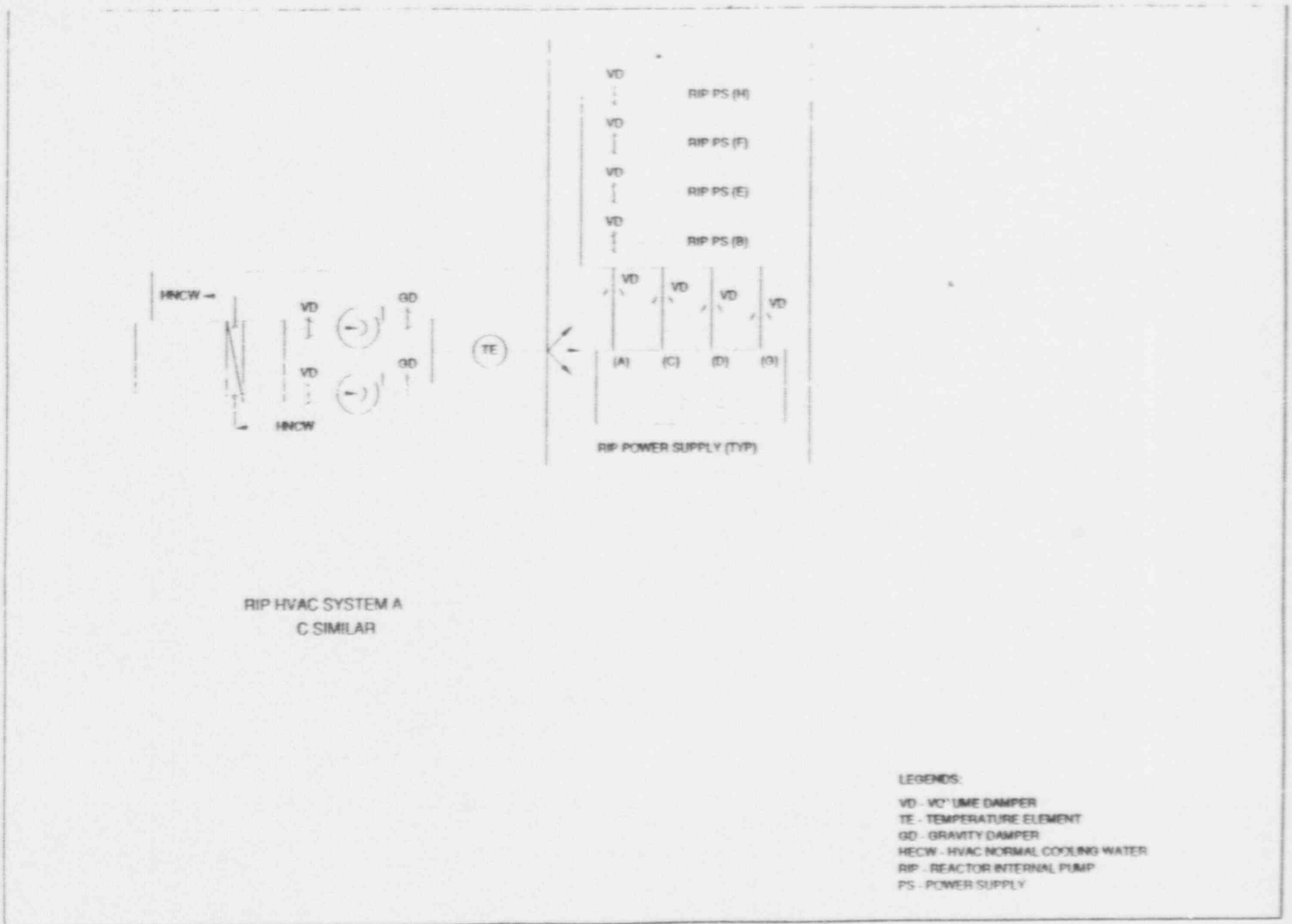


Figure 2.15.5e Reactor Building RIP HVAC System

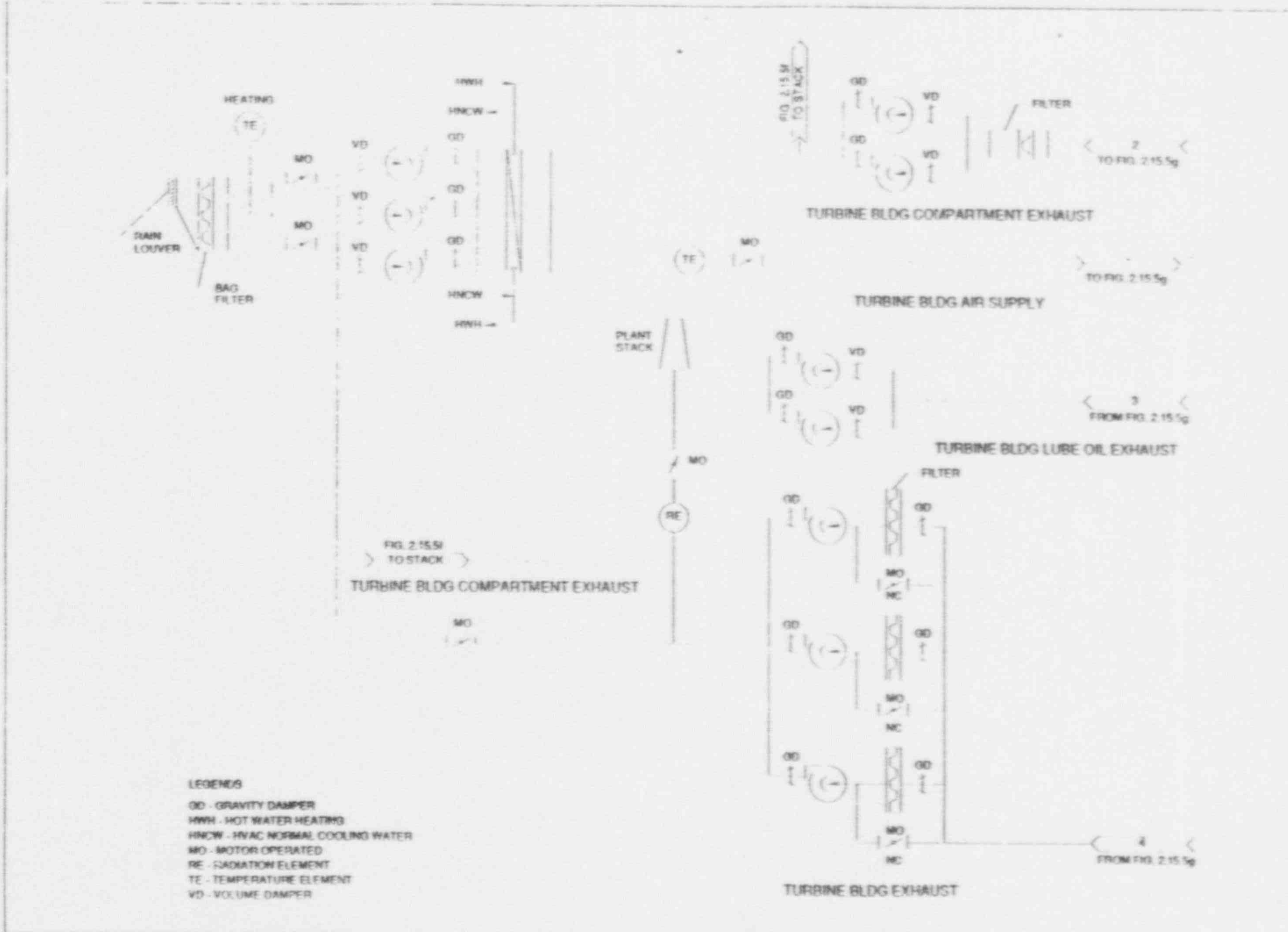


Figure 2.15.5f Turb Building HVAC System

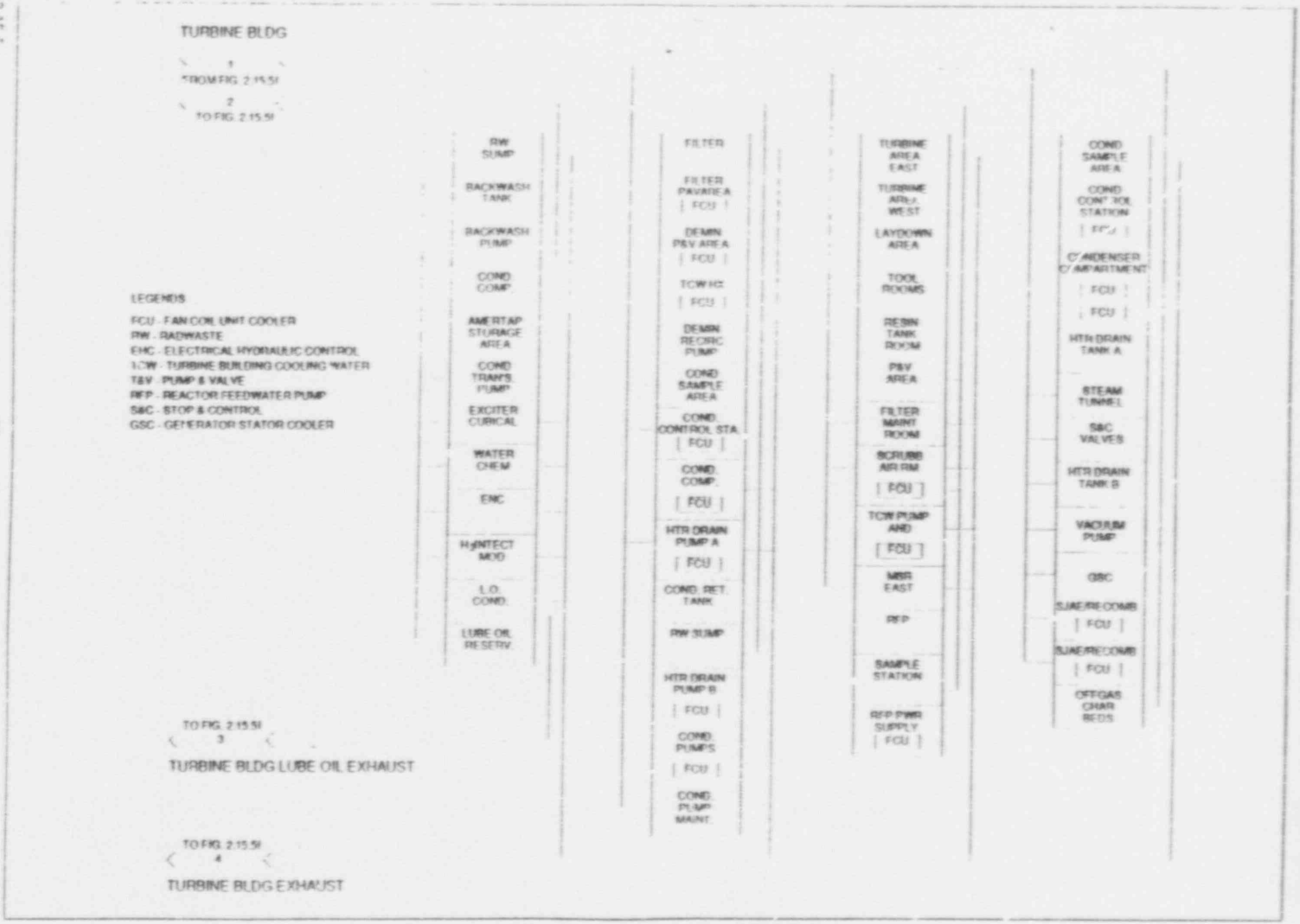


Figure 2.15.5g Turbine Building HVAC System

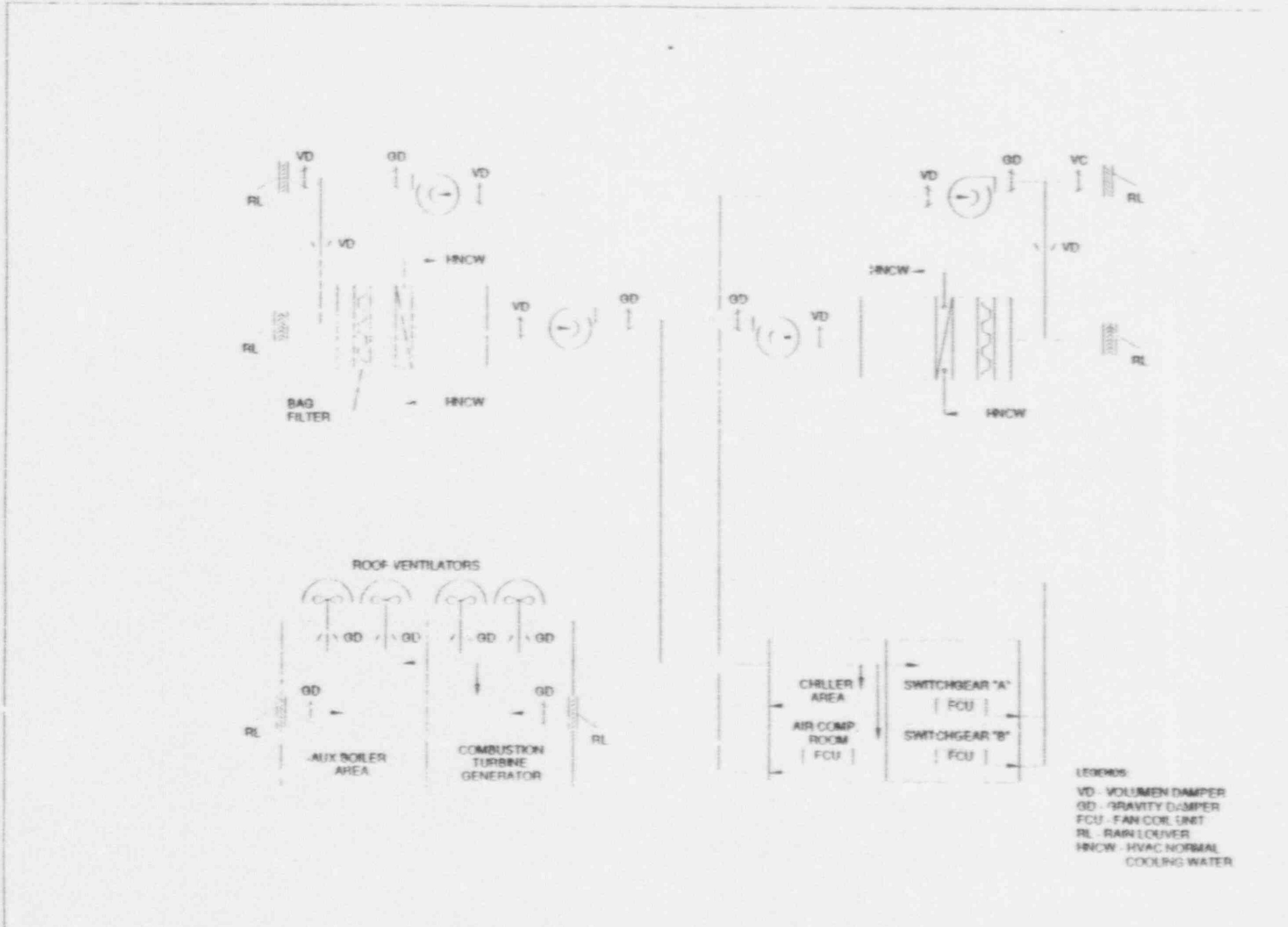


Figure 2.15.5h Turbine/" 'rical Building HVAC System

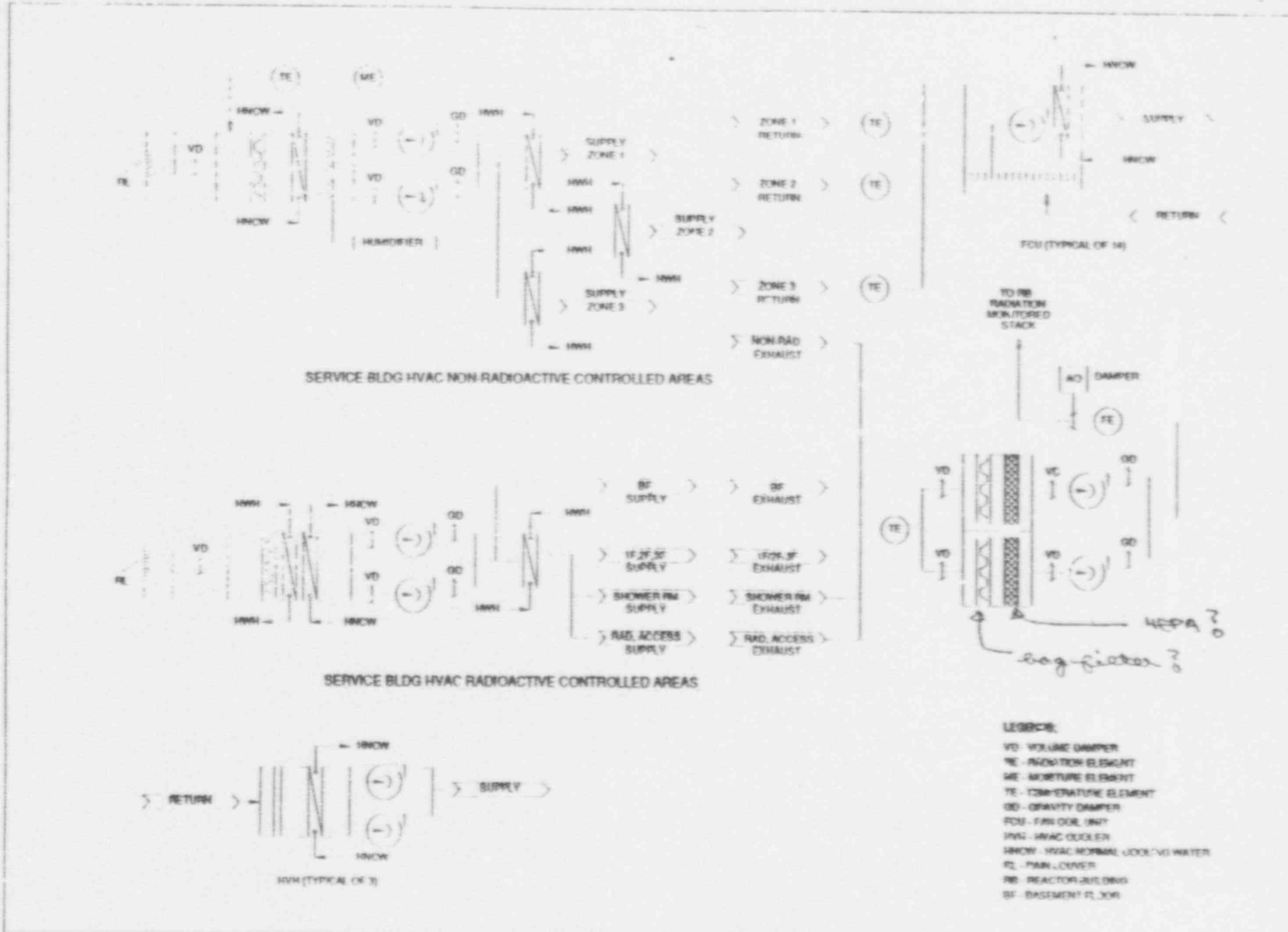


Figure 2.15.5i Service Building HVAC System

Table 2.15.5a: Control Building HVAC System

Inspections, Tests, Analyses and Acceptance Criteria

Certified Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The configuration of the Control Building HVAC Systems are shown in Figure 2.15.5a.	1. Inspections of the as-built HVAC System construction records shall be performed. Visual inspection of the configuration shall be accomplished.	1. As-built Control Building HVAC System installations conform to the configuration for all components shown in Figure 2.15.5a.
2. Three Control Building HVAC trains are mechanically and electrically independent.	2. Tests and visual inspection of the three independent trains will be conducted which will include independent and coincident operation of the three trains to demonstrate complete divisional separation.	2. As-built operational tests and visual inspection shall confirm independence of the three electrical divisions.
3. Exhaust fan bypass dampers are designed to enhance smoke removal from the Control Building in the event of a fire inside or outside the Control Building. Refer to Table 3.[illegible], Ventilation and Airborne Monitoring.	3. Demonstrate and visually inspect the capability of each exhaust fan bypass damper to open, return air damper to close and the exhaust fans to be stopped from the Control Room or aligned and positioned from outside the Control Room with their hand-off-automatic (H-O-A) switches in the motor control center (MCC) to remove smoke from the Control Building.	3. Confirm that the Control Building exhaust fan bypass dampers are capable of being aligned and operated from inside or outside the Control Room and able to remove smoke from the Control Building.
4. Control Building HVAC equipment is designed to Safety Class 3, Quality Group C, Seismic Category I requirements and is powered from Class 1E Electrical Divisions 1, 2 or 3.	4. Review documentation of the installed equipment, instruments, ducts, piping and supports for compliance, and (if applicable) the Code Stamp on the hardware.	4. Confirm the system equipment is designed, fabricated, installed and tested in compliance with applicable codes and regulatory requirements. Visually inspect the electrical installation to confirm Class 1E Electrical Divisions 1, 2 and 3.

Table 2.15.5b: Control Room Habitability Area HVAC System

Inspections, Tests, Analyses and Acceptance Criteria

Certified Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The configuration of the Control Room HVAC and Habitability System is shown in Figure 2.15.5b.	1. Inspections of the as-built HVAC and Habitability System construction records shall be performed. Visual inspection of the configuration shall be accomplished.	1. As-built configuration of the HVAC and Habitability System installation conforms with those components shown in Figure 2.15.5b.
2. Two Control Room HVAC and Habitability trains are both mechanically and electrically independent.	2. Tests and visual inspection of the two independent trains will be conducted which will include independent and coincident operation of the two trains to demonstrate complete divisional separation.	2. As-built operational tests and visual inspection shall confirm independence of the two electrical divisions
3. During abnormal and accident conditions the Control Room HVAC and Habitability trains are capable of responding to high radiation levels at one or both of the two air intakes.	3. Tests and visual inspection of each train operating in the abnormal or accident mode and using a simulated high radiation signal at one of the outdoor air intakes, confirm the logic will open the alternate air intake dampers and close the dampers at any intake detecting high airborne radiation.	3. As-built operational tests and visual inspections shall confirm that a simulated high radiation signal at one of the two outdoor air intakes will open the outdoor air damper at the alternate air intake. Also confirm that dampers at both air intakes close with simulated high airborne radiation signals at both outdoor air intakes.
4. Isolation valves are designed to isolate the Control Room during onsite or offsite chemical releases.	4. Demonstrate with a simulated signal from the chemical release sensor that the Control Room HVAC and Habitability isolation valves close to isolate the Control Room.	4. Confirm the isolation valves are in their design locations and are capable of completely isolating the Control Room and Habitability Areas from the outside environment upon receipt of an isolation signal.

Table 2.15.5b: Control Room [illegible]tability Area HVAC System (Continued)

Inspections, Tests, Analyses and Acceptance Criteria

Certified Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
5. Exhaust fan bypass dampers are designed to enhance smoke removal from the Control Room in the event of a fire inside or outside the Control Building.	5. Demonstrate and visually inspect the capability of each exhaust fan bypass damper to be opened, each return air damper to be closed and the exhaust fans to be stopped by their remote manual switches (RMS) in the Control Room or the hand- off-automatic switches in the motor control center (MCC) outside the Control Room. All outdoor air pressurization of the Control Room removes the smoke through the exhaust louvers.	5. Confirm the Control Room smoke removal equipment is capable of being aligned and operated outside the Control Room and able to remove smoke from the Control Room.
6. Habitability air treatment equipment is designed to meet the requirements of applicable regulations and standards. Refer to Table 3.2b Ventilation and Airborne Monitoring.	6. Test and visually inspect the air treatment equipment to demonstrate that all of the components are ready to perform their function in accordance with applicable standards.	6. Confirm treatment equipment is in compliance with acceptance criteria of applicable standards relating its functional performance.
7. Control Room Habitability Area HVAC equipment is designed to Safety Class 3, Quality Group C, Seismic Category I requirements and are powered from Class 1E Electrical Divisions 2 or 3.	7. Review documentation of the installed equipment, instruments, ducts, piping and supports for compliance, and (if applicable) the Code Stamp on the hardware.	7. Confirm the system equipment is designed, fabricated, installed and tested in compliance with applicable codes and regulatory requirements. Visually inspect the electrical installation to confirm the Class 1E Electrical Divisions 2 and 3.
8 Control Room is physically located underground with a sufficient distance from main steam lines to provide an acceptable direct gamma radiation to the control room operator during and following an accident	8	8

3/30/92

9. In the event that significant concentration of airborne radioactivity is detected at the normal control room ventilation system air intake, it would be automatically isolated. Automatic control room pressurization would immediately occur with filtered air taken in by either of two separate air intakes.	9	9
10 Each control room habitability HVAC train will consist a two-inch thick charcoal adsorber with 95% iodine removal efficiency.	10	10
11 Two Control Room emergency air intakes are widely separated with radiation monitors at each intake	11	11
12 Radiation monitors at air intakes would permit automatic selection of less-contaminated air at either intake.	12	12
13 Control Room habitability HVAC system is designed to meet single-failure criterion	13	13

Table 2.15.5c: Reactor Building Heating, Ventilating And Air Conditioning (HVAC) System

Inspections, Tests, Analyses and Acceptance Criteria

Certified Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The configuration of the Reactor Building Secondary Containment HVAC System is shown in Figure 2.15.5c.	1. Inspections of the as-built HVAC System construction records shall be performed. Visual inspection of the configuration components shall be accomplished.	1. As-built Reactor Building Secondary Containment HVAC installation conforms to the configuration shown in Figure 2.15.5c.
2. Secondary Containment dual isolation dampers of the main air supply and exhaust ducts are designed to Safety Class 2, Quality Group B, Seismic Category I and are powered from Class 1E Electrical Divisions 1 or 2.	2. Review the documentation of the as-installed isolation dampers to verify compliance with the required standards and (if applicable) visually inspect the Code Stamp on the hardware.	2. Confirm by visual inspection the isolation dampers are designed, fabricated, installed and tested in compliance with codes and regulatory requirements.
3. Secondary Containment dual isolation dampers close in less than 30 seconds due to a LOCA signal or detection of high airborne radioactivity upstream of these isolation dampers or at the exhaust air intake duct in the Refueling Area or failure of system fans. Refer to Table 3.2b Ventilation and Airborne Monitoring.	3. Test the closure of the Secondary Containment HVAC main dual supply and exhaust isolation dampers with simulated isolation signals. Verify that closure of each isolation valves occurs in less than 30 seconds. Also test the fail close actuation of each damper on loss of power or instrument air supply.	3. Confirm by visual inspection that each Secondary Containment HVAC main supply and exhaust isolation damper closes in less than 30 seconds after receipt of each isolation signal.
4. Leakage through each Secondary Containment isolation damper is designed to be compatible with the Secondary Containment leakage requirements established for the Standby Gas Treatment System.	4. Inspect the damper position switch capability and verify each secondary containment isolation damper reaches the fully closed position when automatic closure actuation occurs.	4. Confirm by visual inspection the Secondary Containment isolation dampers and their position switches comply with regulation requirements calling for an acceptable secondary containment barrier when fully closed.
5. Secondary Containment HVAC System exhaust fans are designed to be started before the supply fans start and be stopped in the event the supply fans fail.	5. Inspect the configuration of the controls and test the interlock of the supply fans with the exhaust fans to verify the supply fans cannot be started before the exhaust fans are operating and upon failure of the exhaust fans, the supply fans stop automatically.	5. Confirm by visual inspection that the supply fans do not start before the exhaust fans are operating and the supply fans stop when the exhaust fans are not operating.

Table 2.15.5c: Reactor Building Heating, Ventilating And Air Conditioning (HVAC) System (Continued)

Inspections, Tests, Analyses and Acceptance Criteria

Certified Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
6. Secondary Containment Essential Equipment HVAC system configuration is shown on Figure 2.15.5c and consists of safety related room coolers in each of the following rooms: Residual Heat Removal (RHR) System's three pump and heat exchanger rooms, High Pressure Core Flooding(HPCF) System's two pump rooms, Reactor Core Injection Cooling (RCIC) System turbine driven pump room, Standby Gas Treatment System (SGTS) two fan rooms, Flammability Control System (FCS) two recombiner rooms, Fuel Pool Cooling (FPC) System's two pump rooms, and Containment Atmospheric Monitoring System (CAMS) two equipment rooms.	6. Inspect the configuration of the room coolers and verify their cooling coils are connected to the HVAC Emergency Cooling Water (HECW) System.	6. As-built Secondary Containment HVAC installation conforms to the design documentation and the configuration of the components as shown in Figure 2.15.5c. Confirm by visual inspection that each cooling unit starts when the equipment to be cooled starts or the space thermostat calls for cooling.
7. Reactor Building HVAC equipment is designed to Safety Class 3, Quality Group C, Seismic Category I requirements.	7. Review documentation of the installed equipment, instruments, ducts, piping and supports for compliance, and (if applicable) the Code Stamp on the hardware	7. Confirm the system equipment is designed, fabricated, installed and tested in compliance with applicable codes and regulatory requirements.
8. Reactor Building HVAC safety related equipment room cooling units are powered from Class 1E Electrical Divisions 1, 2 or 3 and each unit is connected to the same electrical division as equipment served. Equipment Room cooling units are designed to start when the equipment served starts or the room thermostat calls for cooling.	8. Test each cooling unit fan to verify they are powered from the same Class 1E Electrical Division that serves the equipment being cooled. Visually inspect each cooling unit to verify the cooler starts when the equipment served starts or the space thermostat is calling for cooling.	8. Based on visual inspection of actual operational tests confirm independence of the three electrical divisions and verify equipment room cooling unit starts when equipment served starts. Confirm the room cooling unit will also start when the room thermostat calls for cooling.

Table 2.15.5c: Reactor Building Heating, Ventilating And Air Conditioning (HVAC) System (Continued)

Inspections, Tests, Analyses and Acceptance Criteria

Certified Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
9. Exhaust fans are designed to remove smoke from the Reactor Building Secondary Containment Rooms in the event of a fire. Fire zone dampers are designed to close to pressurize all areas adjacent to the zone with the fire and enable the exhaust filter bypass dampers to be opened and the exhaust fans establish and maintain a negative pressure in the zone and remove the smoke.	9. Demonstrate and visually inspect the capability of each fire zone damper to be positioned, each Reactor Building air exhaust filter to be bypassed and the exhaust fans started from the Control Room or from the hand-off- automatic (H-O-A) switches at the motor control center (MCC) outside the Reactor Building and remove the smoke.	9. Confirm the Reactor Building HVAC fire zone dampers partially close, exhaust bypass dampers open and each exhaust fan is capable of being started from outside the Reactor Building and able to remove smoke from the Reactor Building compartments.
10. The configuration of the Reactor Building Electrical Equipment HVAC System is shown in Figure 2.15.5d.	10. Inspections of the as-built HVAC System construction records shall be performed. Visual inspection of the configuration components shall be accomplished.	10. As-built Reactor Building Electrical Equipment HVAC installation conforms to the configuration shown in Figure 2.15.5d.
11. Three Reactor Building Electrical Equipment HVAC trains are mechanically and electrically independent.	11. Tests and visual inspection of the three independent trains will be conducted which will include independent and coincident operation of the three trains to demonstrate complete divisional separation.	11. As-built operational tests and visual inspection shall confirm independence of the three Class 1E Electrical Divisions 1,2 or 3.
12. Exhaust fan bypass dampers are designed to enhance smoke removal from the Reactor Building Electrical Equipment Rooms in the event of a fire inside these Reactor Building rooms. The exhaust fans are designed to remove smoke from the Diesel Day Tank Rooms and the Diesel Generator Rooms.	12. Demonstrate and visually inspect the capability of each exhaust fan bypass damper to open, return air damper to close and the exhaust fans to be stopped from the Control Room or aligned and positioned from outside the Reactor Building Electrical Equipment Rooms with their hand-off-automatic (H-O-A) switches on the motor control center to remove smoke from these Reactor Building Rooms. Demonstrate the capability of the exhaust fans to remove smoke from the Diesel Day Tank Rooms and the Diesel Generator Rooms.	12. Confirm by visual inspection the Reactor Building Electrical Equipment Rooms' exhaust fan bypass dampers are capable of being opened, return air dampers closed and the exhaust fans stopped from the Control Room or aligned and operated from outside the Reactor Building Electrical Equipment Rooms to remove smoke from the Electrical Equipment Rooms. Also confirm by inspection that the exhaust fans are also capable of removing smoke from the Diesel Day Tank Rooms and the Diesel Engine Rooms.

Table 2.15.5c: Reactor Building Heating, Ventilating And Air Conditioning (HVAC) System (Continued)

Inspections, Tests, Analyses and Acceptance Criteria

Certified Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
13. DG Emergency Supply Fans are safety related and are designed to provide additional diesel generator room cooling when the diesel is operating and also remove smoke from the Diesel Generator Room in the event of fire.	13. Inspections of the as-built HVAC System shall determine that one DG Emergency Supply Fan is controlled to start when the diesel engine starts, and the second fan starts when the room thermostat calls for additional cooling. High and low temperature alarms in the Control Room when the temperature is high. Both fans can be manually controlled, locally or from the Control Room. In the event of a fire these fans can also remove smoke from the Diesel Generator Room	13. As-built Reactor Building DG Emergency Supply Fan installation conforms to the design documentation and visual inspection shall confirm the controls will start one of the two fans when the diesel engine is started or start the second fan when the room thermostat calls for additional cooling. Also confirm these fans can remove smoke from the Diesel Generator Room.
14. Reactor Building non-safety related RIP Panel and Power Supply Rooms are designed to be cooled by the RIP HVAC dual fan recirculating air system with cooling coils served from the HVAC normal cooling water (HNCW) system as configured on Figure 2-15-5e. This is in addition to the supply and return/exhaust air cooling and smoke removal provided by the Electrical Equipment HVAC System configured on Figure 2.15.5d.	14. Inspections of the as-built RIP HVAC System construction records shall be performed. Visual inspection of the configuration components shall be accomplished.	14. As-built Reactor Building RIP Panel and Power Supply Rooms RIP HVAC installation conforms to the configuration shown in Figure 2.15.5e.

Table 2.15.5d: Turbine Building Heating, Ventilating and Air Conditioning (HVAC) System

Inspections, Tests, Analyses and Acceptance Criteria

Certified Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The configuration of the Turbine Building HVAC System is shown in Figures 2.15.5f and 2.15.5g.	1. Inspections of the as-built HVAC System construction records shall be performed. Visual inspection of the configuration components shall be accomplished.	1. As-built Turbine Building HVAC installation conforms to the configuration shown in Figures 2.15.5f and 2.15.5g.
2. Exhaust fans and roof power ventilators are designed to remove smoke from the Turbine Building rooms in the event of a fire. Fire zone dampers are designed to pressurize all areas adjacent to the zone with the fire and enable the exhaust filter bypass dampers to be opened and the exhaust fans and roof power ventilators started to establish and maintain a negative pressure in the zone and remove the smoke.	2. Demonstrate and visually inspect the capability of each fire zone damper to partially close and each Turbine Building air exhaust filter to be bypassed and the exhaust fans started from the Control Room or from the hand-off- automatic (H-O-A) switches in the motor control center (MCC) outside the Turbine Building fire zone and remove the smoke.	2. Confirm the Turbine Building HVAC fire zone dampers partially close and pressurize the areas adjacent to the zone with the fire, the exhaust filter bypass dampers open and each exhaust fan is capable of being started from outside the Turbine Building fire zone and able to remove smoke.
3. The Turbine Building Compartment Exhaust System is designed to establish and maintain a negative pressure in rooms with potential airborne radioactivity. Adjacent areas are pressurized to move air from clean areas to potentially contaminated areas. Refer to Table 3.2b Ventilation and Airborne Monitoring.	3. Demonstrate and visually inspect the performance of the Turbine Building Compartment Exhaust System to create a negative pressure in the rooms having the potential for radioactive contamination and observe the movement of air from the pressurized clean areas to the potentially contaminated rooms.	3. Confirm that the Turbine Building Compartment Exhaust System has the capability to maintain a negative pressure in the rooms having the potential for airborne radioactive contamination. Verify by visual inspection the movement of air from clean areas to potentially contaminated rooms.
4. The Turbine Building Lube Oil Exhaust System is designed to remove oil vapors from lube oil reservoir, condenser and pump rooms.	4. Visually inspect the lube oil exhaust system to demonstrate it maintains a negative pressure in the lube oil condenser and pump room and the room housing the lube oil reservoir.	4. Confirm that the Turbine Building Lube Oil Exhaust System actually maintains a negative pressure in the lube oil condenser and pump room and the room housing the lube oil reservoir.
5. Various Turbine Building spaces are provided with supplemental fan coil cooling units with coils connected to the HVAC Normal Cooling Water System. Space thermostats control the cooling water flow valves.	5. Visually inspect the supplemental fan coil units to verify their operation and control.	5. Confirm that the Turbine Building supplemental cooling units are capable of removing operating equipment heat releases to the spaces and are controlled by space thermostats.

Table 2.15.5e: Electrical Building Heating, Ventilating and Air Conditioning (HVAC) System

Inspections, Tests, Analyses and Acceptance Criteria

Certified Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The configuration of the Electrical Building HVAC System is shown in Figure 2.15.5h. The equipment in this building is not safety related.	1. Inspections of the as-built HVAC System construction records shall be performed. Visual inspection of the configuration components shall be accomplished.	1. As-built Electrical Building HVAC installation conforms to the configuration shown in Figure 2.15.5h.
2. Fan coil cooling units supplement the equipment room cooling with coils connected to the HVAC Normal Cooling Water System. Room thermostats control the cooling water flow control valves.	2. Visually inspect the supplemental fan coil units to verify their operation and control.	2. Confirm that the Electrical Building supplemental cooling units are capable of removing operating equipment heat releases to the spaces and are controlled by space thermostats.
3. Smoke removal is accomplished by closing the return air damper and circulating all outdoor air within the Electrical Building spaces. The Heating Boiler Room and the Combustion Turbine Generator Room are normally maintained at a negative pressure relative to the remaining equipment rooms maintained at a positive pressure. Equipment rooms are designed with zone fire dampers in their exhaust ducts to increase the pressurization when the fire is in an adjacent area.	3. Visually inspect the damper alignment to utilize all outdoor air and adjacent room pressurization to accomplish smoke removal. Demonstrate the capability to start each exhaust fan and align the dampers for smoke removal locally or from the hand-off-automatic (H-O-A) switches at each of the motor control centers.	3. Confirm by visual inspection that all supply and exhaust fans can be started from local or remote panels. Also confirm the return air dampers can be closed and the fire zone dampers positioned to accomplish pressurization in the areas adjacent to a fire. Verify that the Heating Boiler Room and the Combustion Turbine Generator Room is maintained at a negative pressure relative to the adjacent equipment rooms which are maintained at a positive pressure.

Table 2.15.5f: Service Building Heating, Ventilating and Air Conditioning (HVAC) System

Inspections, Tests, Analyses and Acceptance Criteria

Certified Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The configuration of the Service building HVAC System is shown in Figure 2.15.5i. The HVAC equipment in this building is not safety related.	1. Inspections of the as-built HVAC System construction records shall be performed. Visual inspection of the configuration components shall be accomplished.	1. As-built Service Building HVAC installation conforms to the configuration shown in Figure 2.15.5i.
2. The Service Building HVAC System consists of two trains, one serving the non-radioactive controlled areas and the other serving the radioactive controlled areas. The non-radioactive controlled areas are pressurized by redundant supply fans. The radioactive controlled areas are maintained at a negative pressure by redundant supply and exhaust fans to insure that air moves from the clean areas to the potentially contaminated areas. Refer to Table 3.2b Ventilation and Airborne Monitoring.	2. Visually inspect the equipment serving each area and demonstrate that air moves from the clean areas to the potentially contaminated areas. Demonstrate that the flow controls and low flow alarm are functioning to maintain the radioactive controlled area at a negative pressure as the pressure drop across the exhaust filters increase with time.	2. Visually confirm that air moves from the clean areas toward the potentially contaminated areas. Confirm that the HVAC equipment and flow control serving the radioactive controlled areas establishes and maintains a negative pressure relative to the environment. Confirm that the non-radioactive controlled areas are pressurized.
3. Smoke removal is accomplished by closing the non-radioactive controlled area return air damper and positioning the fire zone damper in the exhaust duct to pressurize the area. The radioactive controlled area exhaust fans remove smoke from both the clean areas and the potentially contaminated areas.	3. Inspect and visually demonstrate the return air damper can be closed and the radioactive controlled area fire zone damper can be positioned to pressurize the non-radioactive controlled areas. The exhaust fans of the radioactive controlled areas can be started locally or from their hand-off-automatic (H-O-A) switches on the motor control center to remove smoke from all areas of the Service Building.	3. Visually confirm that for smoke removal the return air damper closes, the fire zone damper is positioned to pressurize the non-radioactive controlled areas and the radioactive controlled area redundant exhaust fans start from the local panel or the H-O-A switches on the motor control center. Verify that smoke is removed from all areas of the Service Building.

Table 2.15.5g: Radwaste Building Heating, Ventilating and Air Conditioning (HVAC) System

Inspections, Tests, Analyses and Acceptance Criteria

Certified Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The configuration of the Radwaste building HVAC System is shown in Figure 2.15.5j. The HVAC equipment in this building is not safety related.	1. Inspections of the as-built HVAC System construction records shall be performed. Visual inspection of the configuration components shall be accomplished.	1. As-built Radwaste Building HVAC installation conforms to the configuration shown in Figure 2.15.5j.
2. The Radwaste Building HVAC System consists of a dual fan supply unit with bag filters and cooling coil connected to the HVAC Normal Cooling Water System. The radioactive controlled areas are maintained at a negative pressure by redundant exhaust fans to insure that air moves from the clean areas to the potentially contaminated areas. The Radwaste Control Room is maintained at a positive pressure with volume control on the room's redundant exhaust fans. Refer to Table 3.2b Ventilation and Airborne Monitoring.	2. Visually inspect the equipment serving each area and demonstrate that air moves from the clean areas to the potentially contaminated areas. Demonstrate that the flow controls function to maintain the Radwaste Control Room at a positive pressure.	2. Visually confirm that air moves from the clean areas toward the potentially contaminated areas. Confirm that the Radwaste Control Room flow control establishes and maintains a positive pressure relative to the environment and confirm that the potentially radioactive areas are maintained at a negative pressure.
3. Smoke removal is accomplished by opening the exhaust fan bypass damper to enable the dual supply fans to be started to pressurize all areas and remove smoke from the Radwaste Building. The supply and exhaust fans can be controlled from the Radwaste Control Room panel or the hand-off- automatic switches in the motor control center.	3. Inspect and visually demonstrate the exhaust fan bypass damper can be opened, the exhaust fans stopped and both supply fans started from the Radwaste Control Room panel or from the hand-off-automatic (H_O_A) switches in the motor control center. Both exhaust fans of the Radwaste Control room can be started locally or from their hand-off-automatic (H-O-A) switches on the motor control center to remove smoke from all areas of the Radwaste Building.	3. Visually confirm that for smoke removal tha exhaust fan bypass damper opens, the exhaust fans stop and both supply fans start when their controls are actuated from the Radwaste Control Room panel or the H-O-A switches on the motor control center to remove smoke from the Radwaste Building. Similarly confirm that the Radwaste Control Room exhaust fans can both be started to remove smoke from the Radwaste Building

Table 2.15.5g: Radwaste Building Heating, Ventilating and Air Conditioning (HVAC) System (Continued)

Inspections, Tests, Analyses and Acceptance Criteria

Certified Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
4. Radwaste Building Tank Exhaust System is designed to control air released from tanks being filled and permit this air to be drawn into tanks being simultaneously pumped out or being drained. Excess air is passed through a bag filter before the tank exhaust fan discharges it along with Radwaste Building exhaust to the stack.	4. Inspect and visually determine that the Radwaste Building Tank Exhaust System limits the release of tank air to the Radwaste Building Exhaust System and the stack.	4. Confirm that the Radwaste Building Tank Exhaust System controls the release of tank air and filters it before the tank exhaust is discharged to the stack.Verify the exhaust air is monitored for radioactivity before it is discharged to the stack.
5. Radwaste Building Incinerator Exhaust is designed to be treated by cooling the gas and passing it through a HEPA filter and fan before release to the stack.	5. Inspect and visually determine the Radwaste Building Incinerator System functions to cool the exhaust gas before passing it through a HEPA filter and fan to the stack.	5. Confirm the Incinerator exhaust gas is cooled and passes through a HEPA filter and fan before the gas is discharged to the stack.

8.0 <u>Table 5.0, ABWR Site Parameters</u>

8.1 The tornado design basis parameters in Table 5.0 should be revised to the parameters accepted by the staff and agreed by GE. The revised parameters are noted on the enclosed marked-up pages.

8.2 A map of the contiguous United States showing the tornado design regions (I, II, and III) is enclosed.

Table 5.0: ABWR Site Parameters

Maximum Ground Water Level:
2 feet below grade

Maximum Flood (or Tsunami Level)[(3)]:
1 foot below grade

Precipitation (for Roof Design):
- Maximum rainfall rate: 19.4 in/hr[(5)]
- Maximum snow load: 50 lb/sq. ft.

Design Temperatures:
- Ambient
  1% Exceedance Values
  Maximum: 100°F dry bulb/77°F coincident wet bulb
  Minimum: -10°F
  0% Exceedance Values (Historical Limit)
  Maximum: 115°F dry bulb/82°F coincident wet bulb
  Minimum: -40°F
- Emergency Cooling Water Inlet: 95°F
- Condenser Cooling Water Inlet: ≤100°F

Extreme Wind: Basic Wind Speed:
110 mph[(1)]/130 mph[(2)]

Tornado[(4)]
- Maximum ... wind speed: 260 mph
- Translational velocity: 57 mph
- Radius: 455 ft
- Maximum atm ΔP: 1.46 psid
- Missile Spectra: Per ANSI/ANS-2.3

Soil Properties:
- Minimum Bearing Capacity (demand): 15ksf
- Minimum Shear Wave Velocity: 1000fps[(6)]
  None at plant site resulting from OBE and SSE.

Seismology:
- OBE Peak Ground Acceleration (PGA): 0.10g[(7)(8)]
- SSE PGA: 0.30g[(9)]
- SSE Response Spectra: per applicable regulations
- SSE Time History: Envelope SSE Response Spectra

(1) 50-year recurrence interval; value to be utilized for design of non-safety-related structures only.

(2) 100-year recurrence interval; value to be utilized for design of safety-related structures only

(3) Probable maximum flood level (PMF), as defined in ANSI/ANS-2.8, "Determining Design Basis Flooding at Power Reactor Sites."

(4) 1,000,000-year tornado recurrence interval, with associated parameters based on ANSI/ANS-2.3.

(5) Maximum value for 1 hour of 0.15g is employed to evaluate structural and component responses of the certified design.

(6) This is the minimum shear wave velocity at low storms after the soil property uncertainties have been applied.

(7) Free-field, at plat grade elevation.

(8) For conservatism, a value of 0.15g is employed to evaluate structural and component responses in Chapter 3.

(9) Free-field, at plat grade elevation.

Region	Maximum wind speed (mph)	Rotational speed (mph)	Translational speed (mph)	Radius of maximum rotational speed (feet)	Pressure drop (psi)	Rate of pressure drop (psi/sec)
I	300	240	60	150	2.0	1.2
II	220	170	50	150	1.0	0.5
III	200	160	40	150	0.9	0.3

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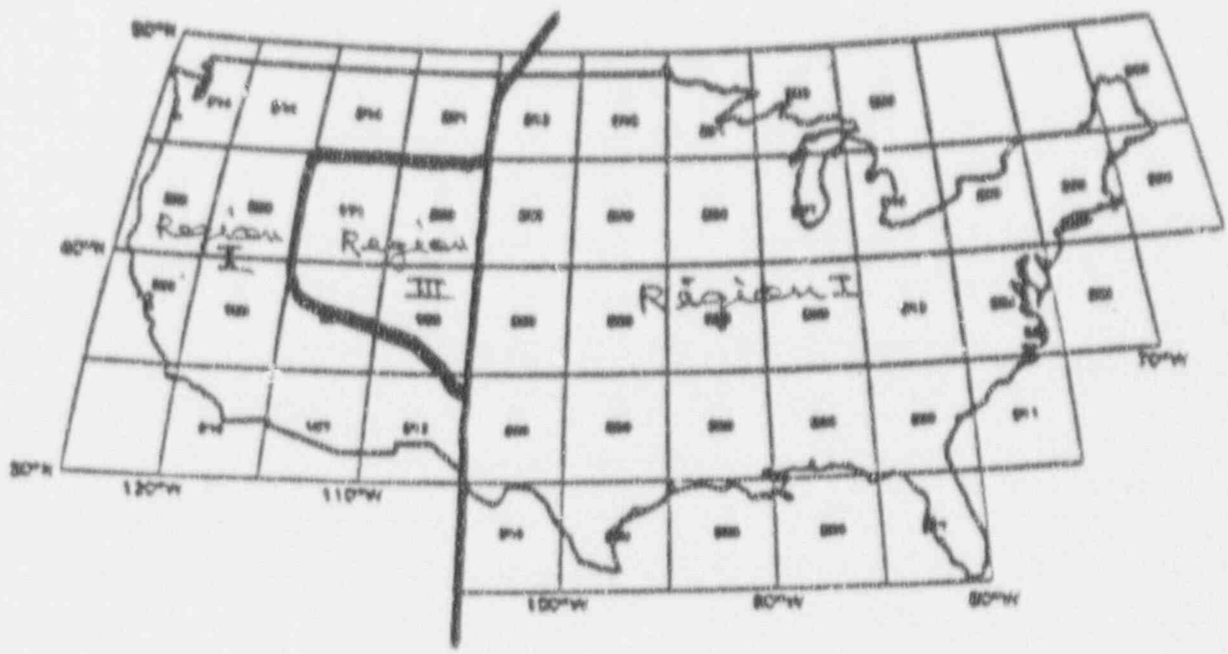

Region II
Region III
Region I
120°W
110°W
100°W
90°W
80°W
70°W

Enclosure 2

Comments on ABWR ITAAC from the Electrical Systems Branch

1.Electrical ITAACs for plant "fluid" type systems with Class 1E power needs

"Fluid" type sytems include emergency core cooling systems, cooling water systems and heating, ventilating, and air conditioning systems. We believe that each fluid type system could treat electric power identically and the following aspects should be included:

1.DESIGN DESCRIPTION(CERTIFIED DESIGN COMMITMENTS)-should outline the Class 1E power requirements (both ac and dc) for the pumps, fans, valves, heaters, controls, etc. of the system. This should include the voltage levels as well as the Divisional assignments for the components.

2.INSPECTIONS, TESTS, AND ANALYSES-should state that the electrical aspects shall be verified by tests (for the electrical capability and independence) and inspections (for the physical separation).

3.ACCEPTANCE CRITERIA-should be a detailed listing of the design commitments. For example:

a.Pump A and the discharge valve are powered by Division 1 480 vac.
Pump B and its discharge valve are powered by Division 2 480vac.
b.Heater bank A is powered ...... etc.
c.etc.

(Alternatively the acceptance criteria could state the design is in accordance with the Certified Design Description/Certified Design Commitments if these include the detailed information.)

The Standby Liquid Control System(SLCS) basically conforms to this approach however the following comments should be resolved:

--the description should be revised to state that the components are fed by Class 1E 480 vac and not specify that they receive power from offsite and/or standby power.

--the description of powering the heaters can be interpreted to mean that these loads are non-Class 1E. It is our understanding that these heaters are Class 1E and are manually loaded to the EDGs

--the description should specify 480 vac vs 48

--In ITAAC #5 why is the Acceptance criteria different from the Design Description?

--How is the SLCS verified to be "physically and electrically separated" from the control rod drive system (It is our understanding that the Fine Motion Drives are powered from Division 1. SLCS also receives Division power.

2.Electrical ITAACs for Instrumentation and Control(I&C) Systems

I&C systems include systems like Reactor Protection System, Engineered Safety Features Actuation System, Radiation Monitoring System, etc. We believe that these systems could be treated the same as the fluid sytems. That is the power requirements would be specified for the various instrument channels, logic cabinets, control/actuation panels, etc. The Acceptance criteria would be the design commitments. For example:

a.RPS channel A is powered by Division 1 Constant Voltage Constant Frequency (CVCF) power supply.
b.etc

3.The staff's review of the SSAR raised the following items as candidates for treatment in ITAAC. Either (1) include each of the following listed items as acceptance criteria with appropriate inspection, test, and/or analysis(Note:In some cases it may be covered by a submitted draft ITAAC. In those cases identify where it is already to be covered.) or (2) provide justification for not including it.

-- The reserve auxiliary transformer will be separated from the unit auxiliary transformers by a minimum distance of 15.24 meters (50 feet).

-- The main, unit auxiliary, and reserve auxiliary transformers will each be provided with an oil collection pit and drain to a safe deposal area.

-- The reserve auxiliary transformer and its input feeders will be separated from the main power transformer and its input feeders and from the unit auxiliary transformers by a minimum of 15.24 meters (50 feet).

-- The main, unit auxiliary, and reserve auxiliary transformers will each have automatic deluge water spray systems.

-- Separation of the normal preferred and alternate preferred power feeds will be accomplished by floors and walls over their routes through the turbine, control, and reactor buildings except within the switchgear rooms where they must be routed to the same switchgear lineups.

-- In the switchgear rooms, normal and alternate preferred offsite circuits will be separated to the maximum extent feasible (i.e., the circuits will be routed on opposite sides of the room and will be connected to the switchgear lineup on opposite ends).

- The isolated phase bus duct and/or cables located outside the turbine, control, and reactor buildings and associated with the normal preferred power circuit will be separated by a minimum of 15.24 meters (50 feet) from the reserve auxiliary transformer.

-- The isolated phase bus duct and/or cables located outside the turbine, control, and reactor buildings and associated with the alternate preferred offsite circuit will be separated by a minimum of 15.24 meters (50 feet) from the unit auxiliary and main transformers.

-- The cables associated with the instrumentation and control circuits for the normal preferred offsite circuit will be routed in solid metal enclosed raceways corresponding to the load group of their power source.

-- The cables associated with the instrumentation and control circuits for the alternate preferred offsite circuit will be routed in dedicated raceways.

-- The alternate preferred offsite instrumentation and control circuit cables will not share raceways with any other cables.

-- The separation between the normal and alternate preferred offsite instrumentation and control cables will be the same as the separation between the normal and alternate preferred offsite power circuits (i.e., floors, walls, or 15.24 meters (50 feet) of physical separation)

-- There will be no electrical interconnections between the normal and alternate preferred power, instrumentation, and control circuits except where the power circuits connect to common Class 1E and non Class 1E switchgear lineups.

-- At the common switchgear lineups between normal and alternate preferred power, the electrical independence will be maintained by one open and one closed circuit breaker.

-- The circuit breakers that supply the normal and alternate preferred power to switchgear lineups will be interlocked so that the closed breaker must be open before the open breaker can be closed.

-- Transfer between normal and alternate (or alternate to normal) preferred power circuits will be manual.

-- Instrumentation and control circuits including their power supply associated with the normal preferred offsite circuit will be electrically independent (i.e., no electrical interconnection) from the instrumentation and control circuits including their power supply associated with the alternate preferred power supply

-- All systems, equipment, and components associated with the offsite system's normal and alternate preferred power circuits within the GE scope of supply except generator breakers will have the capability of being periodically tested during normal plant operation.

-- The design will permit the verification of the generator breaker's capability to open on demand when the unit is shutdown.

-- The design will permit the verification of the functional capability and calibration of the instrumentation, control, and protection systems, equipment, and components associated with the offsite system's normal and preferred circuits.

-- The design will permit the verification of the functional capability and calibration of the instrumentation and control systems, equipment, and components associated with the generator breaker's system used to prevent incorrect synchronization.

-- The design will permit verification that all required Class 1E and Non Class 1E loads can be powered from their designated preferred power supply within the capacity and capability margins specified in the SSAR for the offsite system circuits.

-- The design will permit verification that the loss of the offsite preferred power supply can be detected.

-- The design will permit verification that transfer between preferred power sup. [illegible] can be accomplished.

-- The design will permit verification that the batteries and chargers associated with the preferred power system can meet the requirements of their design loads.

-- High and medium voltage bus ducts and cables will be designed to provide ready access for regularly inspecting, cleaning, and tightening terminals, and for inspecting and cleaning insulators.

-- The bus duct design will include provisions for excluding debris and fluids, and for draining condensate.

-- A reliability of 0.9967 for the generator breaker to open on command will be maintained.

-- During all modes of plant operation (i.e., shutdown, refueling, startup, and run), the normal preferred power supply will be connected to two of the three safety buses and the alternate preferred power supply will be connected to one of the three safety buses.

-- If the normal preferred supply is lost due to failure of the generator breaker to open, offsite power will still be available immediately through the alternate preferred power supply to one of the three safety buses and on a delayed basis (within minutes by manual action from the control room) to the two other safety buses through the alternate preferred power supply.

-- Each circuit of the preferred power supply will be designed to provide sufficient capacity and capability to power equipment required to ensure that (a) specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded as a result of anticipated operational occurrences, and (2) the core is cooled and containment integrity and other vital functions are maintained in the event of plant design basis accidents.

-- Each preferred power supply when used for normal operation will be sized to supply the maximum expected coincident Class 1E and Non-Class 1E loads.

-- The secondary winding of the reserve auxiliary transformer which supplies the Class 1E load groups will have an oil/air rating which is greater than or equal to the combined load of the three Class 1E load groups.

-- The offsite normal and alternate preferred power circuits will be designed with sufficient capacity and capability to limit variations of the operating voltage of the onsite power distribution systems to a range appropriate to ensure (a) normal and safe steady state operation of all plant loads, (b) starting and acceleration of the limiting drive system with the remainder of the loads in service, and (c) reliable operation of the control and protection systems under conditions of degraded voltage.

Specifically, when measured at the load terminals, the voltage variations at all voltage levels will not exceed (a) plus or minus 10 percent of the load rated voltage during all modes of steady state operation and (b) minus 20 percent of the motor rated voltage during motor starting.

-- Voltage levels at the low voltage terminals of the auxiliary and reserve transformers will be analyzed for the maximum and minimum load conditions that are expected throughout the anticipated range of voltage variations of the offsite transmission system and of the main generator. Separate analyses will be performed for each possible circuit configuration of the offsite power supply system.

-- The normal and alternate preferred power circuits which are subject to environmental conditions (e.g., Wind, Ice, Snow, Lightning, Temperature variations, Flood, etc.) during their operation will be designed in accordance with industry recommended practice to minimize their likelihood of failure while operating under environmental conditions to which they are subject.

-- The normal and alternate preferred power circuits which are subject to transmission systems, steady-state, and transient conditions (e.g., Switching and lightning surges, voltage ranges--maximum and minimum for heavy and light load conditions, Frequency variation, Stability limits, etc.) during their operation will be designed such that these conditions will not subject the onsite Class 1E systems, equipment, and components (including all loads and systems which use the services of the preferred power supply during start up, normal operation, safe shutdown, accident, and post-accident operation) to conditions that are beyond the limits to which they are designed and qualified.

-- Performance and operating characteristics for the normal and alternate preferred power circuits will be required to meet operability and design basis requirements such as short-circuit withstand capability, equipment capacity, voltage and frequency transient response, voltage regulation limits, step load capability, coordination of protective relaying, grounding, etc.

-- The generator circuit breaker will be designed to withstand the maximum RMS and crest momentary currents and interrupt the maximum asymmetrical and symmetrical currents determined to be produced by a bolted three phase fault at the location which results in the maximum fault currents.

-- The main step-up transformers and the unit auxiliary and reserve transformers will be designed and constructed to withstand the mechanical and thermal stresses produced by external short circuits, and will meet the corresponding requirements of the latest revisions of ANSI Standard C57.12.00, General Requirements for Liquid-Immersed Distribution, Power and Regulating transformers.

-- Circuit breakers and disconnecting switches will be sized and designed in accordance with the latest revision of ANSI Standard C37.06, Preferred ratings and Related Capabilities for ac High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.

-- A station grounding grid, consisting of bare copper cables, will be provided that will limit step and touch potentials to safe values under all fault conditions.

-- Bare copper risers will be furnished for all electrical underground ducts and equipment, and for connections to the grounding systems within buildings.

-- The design and analysis of the grounding system will follow the procedures and recommendations of the latest revision of IEEE Standard 665, Guide for Generation Station Grounding.

-- Grounding systems connected to the station grounding grid will be provided in each building. As a minimum, every other steel column of the building perimeter will be connected directly to the grounding grid.

-- The plant main generator will be grounded with a neutral grounding device having an impedance which will limit the maximum phase current under short circuit conditions to a value not greater than that for a three-phase fault at its terminals.

-- Provisions will be included to ensure proper grounding of the isophase buses when the generator is disconnected.

-- The onsite medium voltage ac distribution system will be resistance grounded at the neutral point of the low voltage windings of the unit auxiliary and reserve transformers.

-- Grounding of the neutral point of the generator windings of the onsite standby power supply units, safety and non-safety, will be through distribution type transformers and loading resistors, sized for continuous operation in the event of a ground fault.

-- The neutral point of the low voltage ac distribution systems will be either solidly or impedance grounded as necessary to provide properly coordinated ground fault protection.

-- The dc systems will be left ungrounded.

-- Each major piece of equipment, metal structure, or metallic tank will be provided with two ground connections diagonally opposite each other.

-- The ground bus of all switchgear assemblies, motor control centers, and control cabinets will be connected to the station ground grid through at least two parallel paths.

-- One bare copper cable will be installed with each underground electrical duct run, and all metallic hardware in each manhole will be connected to this cable.

-- Plant instrumentation will be grounded through separate radial grounding systems, consisting of isolated instrumentation ground buses and insulated cables. The instrumentation grounding systems will be connected to the station grounding grid at one point only and will be insulated from all other grounding circuits.

-- Separate instrumentation grounding systems shall be provided for plant analog and digital instrumentation systems.

-- A lightning protection system will be provided for all major plant structures, including the containment enclosure building. The design and installation of the system will be in accordance with the National Fire Protection Association's Lightning Protection Code, NFPA-78, and the Nuclear Energy Property Insurance Association's (NEPIA) Basic Fire Protection for Nuclear Power Plants.

-- Lightning arresters will be provided in each phase of all tie lines connecting the plant electrical systems to the switching station(s) and offsite transmission system. These arresters will be connected to the high voltage terminals of the main step up and reserve transformers.

-- Plant instrumentation and monitoring equipment located outdoors or connected to cabling running outdoors will be provided with built in surge suppression devices to protect the equipment from lightning induced surges.

-- The offsite system circuits will derive their control, protection, and instrumentation power from a Non-Class 1E dc system that is independent of the onsite Class 1E dc system.

-- The onsite Class 1E systems will be normally energized from the offsite normal and alternate preferred power system.

-- Should the voltage on the Class 1E bus decay to below 70 percent of its nominal rated value for a predetermined time, a bus transfer will be initiated (i.e., the onsite Class 1E buses that will be normally energized from the offsite normal and alternate preferred power system will be transferred so that they are powered from the onsite standby diesel generators).

-- On initiation of bus transfer, a signal will be generated which opens the offsite supply breaker to the Class 1E bus.

-- If there is a LOCA signal present when there is a LOPP, the time delay for initiation of bus transfer will change from 3 to 0.4 seconds.

-- The design will include a time delay relay to establish the predetermined time before initiation of bus transfer.

-- The time delay relay will be initiated by the LOPP signal (i.e., the voltage on the Class 1E bus has decayed to below 70 percent of its nominal rated value). After the time delay relay has timed out, a bus transfer will be initiated (i.e., a signal will be generated which opens the offsite supply breaker to the Class 1E bus).

-- When there is only a LOPP signal present, the time delay relay will be set for 3 seconds.

-- When there is both a LOPP and LOCA signal present, the time delay relay will be set for 0.4 seconds.

-- When the bus voltage degrades to 90 percent or below of its rated value and after a time delay, undervoltage will be annunciated in the control room. Simultaneously, a 5-minute timer will be started, to allow the operator to take corrective action. After 5 minutes, the respective feeder breaker with the undervoltage, will be tripped. Should a LOCA occur during the 5 minute time delay, the feeder breaker with the undervoltage will be tripped instantly.

-- The design for degraded offsite voltage will meet the guidelines of BTP PSB 1, Adequacy of Station Electric Distribution System Voltages.

-- Systems, equipment, and components that are included in the design for both the first and second level of voltage protection will meet all requirements of IEEE Std 603-1980.

-- Safety system equipment (i.e., reactor trip system, engineered safety features, auxiliary supporting features, and other auxiliary features equipment) that require ac electric power from the offsite system to perform their safety function (1) will be designed to perform their required safety function before, during and after the following defined design basis operating conditions and (2) will be qualified by type test, previous operating experience, or analysis, or any combination of

these three methods to substantiate that the safety system equipment will be capable of performing their required safety function before, during, and after the following defined design basis operating conditions:
(a) Continuous operation with voltages at the load at either +10% or -10% of nominal voltage rating
(b) Operation for 5 minutes with voltages at the load at 70% of nominal voltage rating
(c) Operation for 3 seconds with voltage at the load below 70% (3 seconds at 35%) of nominal voltage rating

-- If a LOCA occurs when the diesel generator is paralleled with the offsite system, the diesel generator will automatically be disconnected from the 6.9 KV emergency bus regardless of whether the test is being conducted from the local control panel or the main control room.

-- Interlocks to the LOCA and LOPP sensing circuits will be included in the ABWR design to terminate parallel operation and cause the diesel generator to automatically revert and reset to its standby mode if either LOCA or LOPP signal appears during a test and the interlock design will have the capability of being periodically tested.

-- Interlocks to the LOPP sensing circuits will be included in the ABWR design to terminate parallel operation test and cause the diesel generator to automatically revert and reset to its standby mode if LOPP signal appears during a test and the interlock design will have the capability of being periodically tested.

-- Diesel generator protective relaying (i.e., generator differential, engine overspeed, low jacket water pressure, loss of excitation, antimotoring (reverse power) overcurrent voltage restraint, high jacket water temperature, and low lube oil pressure) will be used to protect the machine when operating in parallel with the normal power system during periodic tests.

-- Each diesel generator will be high resistance grounded.

-- Systems, equipment, and components that are included in the design for the diesel generator protective relaying when operating in parallel with the normal power system during periodic tests will meet all requirements of IEEE Std 603-1980.

-- The ABWR design will include synchronizing interlocks to prevent incorrect synchronization whenever a standby power source is required to operate in parallel with the preferred power supply and the synchronizing interlocks will have the capability of being periodically tested.

-- Any given single failure of a non-safety load or load group will affect only one of the three Class 1E load groups.

-- Each non safety system load group will be associated with only one of the three safety system load groups by being powered from the same offsite power system transformer winding.

-- The ABWR design will include provisions to limit harmonic effect on the power supply to safety system load groups to less than 5 percent for operation and/or failure of reactor internal pumps and other non safety load groups powered from the same source as the safety system load groups.

-- The offsite circuits will be physically separated from any Class 1E systems, equipment, components, cables, or loads by floors or walls up to the point where the offsite circuits enter the reactor building. From the point where the alternate preferred circuit enters the Division 2 side of the reactor building to the Class 1E switchgear rooms and from the point where the normal preferred circuit enters the Division 1 and 3 side of the reactor building to the Class 1E switchgear rooms, the offsite circuits will be physically separated from circuits of the Class 1E systems by a minimum physical separation distance of 0.91 meters (three foot) horizontal by 1.524 meters (five foot) vertical.

-- Safety systems whose failure could potentially affect the operation of an offsite circuit will not be located in the same rooms with the normal or alternate offsite circuits, or barriers will be installed to preclude possible interaction between offsite and onsite systems.

-- The Class 1E ac power system will consist of three independent and redundant Class 1E power systems each with it's associated Class 1E diesel generator power supply and Class 1E ac distribution system.

-- Each of the three Class 1E diesel generator power supplies will consist of all components from the stored energy (fuel) to the connection to the distribution system's supply circuit breaker.

-- Each Class 1E ac distribution system will consist of a 6.9 KV medium voltage, a 480 volt low voltage, a 120/240 volt low voltage, and a 120 volt instrumentation and control Class 1E ac distribution system and load their group.

-- Each of the three Class 1E 6.9 KV ac distribution systems will consist of all equipment in the distribution circuit from the power side of the offsite and onsite power supply breakers to the 6.9 KV loads.

-- Equipment in each of the three Class 1E 6.9 KV ac distribution circuits will include one 6.9 KV Class 1E ac switchgear, connections to one or more 6.9 KV safety system loads, connections to two Class 1E 480 volt ac distribution systems, and connections through the Class 1E 480 volt ac distribution system to (a) one Class 1E 120 volt ac I&C distribution system, (b) one or more Class 1E 120/240 ac distribution systems, (c) the Class 1E dc power system, and (d) one or two Class 1E vital 120 volt ac I&C power systems.

-- Each of the six (i.e., two per division) Class 1E 480 volt ac distribution systems will consist of all equipment in the distribution circuit from the 6.9 KV side of the 6.9 KV/480 volt transformer to the 480 volt loads.

-- Equipment in each of the six Class 1E 480 volt ac distribution circuits will include one Class 1E 6.9 KV/480 volt transformer, one Class 1E 480 volt load center, connections to one or more 480 volt safety system loads, and connections to one or more Class 1E 480 volt ac motor control centers and their associated 480 volt safety system loads.

-- Each of the three 120 volt Class 1E ac I&C distribution systems will consist of all equipment in the distribution circuit from the 480 volt side of the 480/120 volt transformer to the 120 volt instrumentation and control loads.

-- Equipment in each of the three Class 1E ac I&C distribution circuits will include one Class 1E 480/120 volt transformer, one or more Class 1E 120 volt ac distribution panels, and connection to 120 volt safety system instrumentation and control loads.

-- Each of the Class 1E 120/240 volt ac distribution systems will consist of all equipment in the distribution circuit from the 480 volt side of the Class 1E 480/120/240 volt transformer to safety system loads.

-- Equipment in each of the Class 1E 120/240 distribution circuits will include one Class 1E 480/120/240 volt transformer, one or more Class 1E 120/240 volt ac distribution panels, connection to 120 and 240 volt safety system loads, and connection to Class 1E 120 volt ac receptacles.

-- The Class 1E dc power system will consist of four independent and redundant 125 volt Class 1E dc power systems (Division I, II, III, and IV) each with it's associated Class 1E battery and battery charger power supply, a 125 volt dc Class 1E distribution system, and their load group.

-- Each of the four Class 1E battery power supplies will consist of storage cells, connectors, and its connections to the distribution system supply circuit interrupting device.

-- Each of the four Class 1E battery charger power supplies will consist of all equipment from its connection to the 480 volt ac distribution system to its distribution system's supply breaker.

-- Each of the four Class 1E 125 volt dc distribution systems will consist of all equipment in the distribution circuit from the power side of the battery interrupting device and the battery charger supply breaker to the 125 volt dc safety system loads.

-- Equipment in each of the four distribution circuits will include one or more Class 1E distribution panels and connections to 125 volt dc safety system loads.

-- Division II and III battery charger power supplies will be fed from division II and III respectively of the 480 volt ac distribution system and division I and IV battery charger power supplies will be fed from division I of the 480 volt ac distribution system.

-- The Class 1E vital 120 volt ac I&C power supply will consist of four independent and redundant vital 120 volt Class 1E ac I&C power systems (Division I, II, III, and IV) each with it's associated Class 1E Constant Voltage Constant Frequency (CVCF) power supply, 120 volt Class 1E ac distribution system, and their load group.

-- Each of the four CVCF power supplies will consist of the power source (i.e., static inverter, ac and dc static transfer switches, and a regulating step down transformer as an alternate ac power supply) and its connection to the distribution supply circuit interrupting device.

-- Each of the four Class 1E vital 120 volt ac I&C distribution systems will consists of all equipment in the distribution circuit from the power side of the constant voltage constant frequency power supply breaker to safety system instrumentation and control loads.

-- Equipment in each of the four Class 1E vital 120 volt ac distribution circuits will include one or more 120 volt ac distribution panels and connections to vital 120 volt safety system instrumentation and control loads.

-- Each divisional CVCF power supply will be fed from its associated divisional dc power system (e.g., Division I CVCF power supply will be fed from Division I 125 volt dc distribution system).

-- Division II and III CVCF power supplies will be fed from division II and III respectively of the 480 volt ac distribution system and division I and IV CVCF power supplies will be fed from division I of the 480 volt ac distribution system.

-- Electrical equipment and wiring for the Class 1E systems which are segregated into separate divisions will be separated so that no design basis event is capable of disabling more than one division of any engineered safety features (ESF) total function.

-- Redundant parts of the electrical system will be physically separated and independent to the extent that in any design basis event with any resulting loss of equipment, the plant can still be shut down with either of the remaining two divisions.

-- Class 1E electric equipment and wiring will be segregated into separate divisions so that no single credible event will be capable of disabling enough equipment to hinder reactor shutdown and removal of decay heat by either of two unaffected divisional load groups or prevent isolation of the containment in the event of an accident.

-- Equipment arrangement and/or protective barriers will be provided such that no locally generated force or missile can destroy any redundant reactor protection system (RPS), nuclear steam supply system (NSSS), emergency core cooling system (ECCS), or ESF functions.

-- Arrangement and/or separation barriers will be provided to ensure that such disturbances do not affect both high pressure core flooder (HPCF) and reactor core isolation cooling (RCIC) systems.

-- Containment penetrations will be so arranged that no design basis event can disable cabling in more than one division.

-- The protection system and ESF control logic, and instrument panels/racks will be located in a safety class structure in which there are no potential sources of missiles or pipe breaks that could jeopardize Class 1E cabinets and raceways.

-- The standby ac power system will be capable of providing the required power to safely shutdown the reactor after loss of preferred power (LOPP) and/or loss of coolant accident (LOCA) or to maintain the safe shutdown condition and operate the Class 1E auxiliaries necessary for plant safety during and after shutdown with any one of the three power load groups.

-- There will be a limited number of design basis events (e.g., design basis event fire) that have been approved by the NRC for which protection will be afforded Class 1E systems, equipment, and components by there being the capability of maintaining safe plant shutdown with any one of the three load groups.

-- The scram solenoid circuits, from the actuation devices to the solenoids of the scram pilot valves of the CRD hydraulic control units, will be run in grounded steel conduits, with no other wiring contained within the conduits.

-- Separated grounded steel conduits will be provided for the scram solenoid wiring for each of four scram groups.

-- Separate grounded steel conduits will also be provided for both the A solenoid wiring circuits and for the B solenoid wiring circuits of the same scram group.

-- Scram group conduits will have unique identification and will be separately routed as Division II and III conduits for the A and B solenoids of the scram pilot valves, respectively.

-- The A solenoids of the scram pilot valves will have a division II power source.

-- The B solenoids of the scram pilot valves will have a division III power source.

-- The conduits containing the circuits for the A solenoids of the scram pilot valves will be separated by a minimum separation distance of 2.54 centimeters (1 inch) from the conduits containing the circuits for the B solenoids of the scram pilot valves in accordance with divisional separation requirements.

-- The conduits containing the scram solenoid group wiring of any one scram group will also be physically separated by a minimum separation distance of 2.54 centimeters (1 inch) from the conduit of any other scram group and from conduit or metal enclosed raceways associated with any of the four safety related electrical divisions or associated with any non-safety-related (non-divisional) circuits.

-- The scram group conduits will not be routed within the confines of any other tray or raceway system.

-- The conduits containing the scram solenoid group wiring of any one scram group will also be physically separated from non-enclosed raceways associated with any of the four safety related electrical divisions or associated with any non-safety-related (non-divisional) circuits in accordance with IEEE Std 384 and Regulatory Guide 1.75.

-- Conduits containing scram solenoid group circuit wiring will be separated from any non enclosed raceway (containing either safety or non safety related circuits) by a vertical separation distance of 1.52 or more meters (five or more feet) and by a horizontal separation distance of 0.91 or more meters (three or more feet).

-- Neutron monitoring cables will be routed in their own dedicated raceways from termination to termination.

-- The raceways dedicated for the neutron monitoring cables will be separated from raceways containing all other Class 1E or non Class 1E power, instrumentation, and control cables by the same separation provide between scram and other cables.

-- The dc emergency lighting cables will be routed in their own dedicated raceways from termination to termination.

-- The raceways dedicated for the dc emergency lighting cables will be separated from raceways containing all other Class 1E or non Class 1E power, instrumentation, and control cables by the same separation provide between scram and other cables.

-- Electrical penetration assemblies of different Class 1E divisions will be separated by three hour fire rated barriers (i.e., separate rooms and/or locations on separate floor levels) and that separation by distance (without barriers) will be allowed only within the inerted containment.

-- Penetrations containing non-Class 1E circuits will be separated from penetrations containing Class 1E or associated Class 1E circuits by a vertical separation distance of 1.52 or more meters (five or more feet) and by a horizontal separation distance of 0.91 or more meters (three or more feet).

-- Separation between penetrations containing Class 1E circuits and other divisional cables (e.g., division II, III and IV cables and the penetration containing division I cables) will be by separate rooms and/or different floor levels outside containment and by a minimum of 0.91 meters (three feet) horizontal and 1.52 meters (five feet) vertical distance inside the inerted containment.

-- Separation between penetrations containing Class 1E circuits and non-divisional cables will be by a minimum of 0.91 meters (three feet) horizontal and 1.52 meters (five feet) vertical both inside and outside of containment.

-- All power, control, and instrumentation cables including fiber optic cables located outside cabinets/panels throughout the plant will be supported in raceways in accordance with IEEE recommended practice for support of cable systems.

-- When separation distance between Class 1E (or Class 1E associated) cables of different safety divisions or between Class 1E (or Class 1E associated) cables and non-Class 1E cables is less than 1.52 meters (five feet) vertical or 0.91 meters (three feet) horizontal, the cables will be supported in enclosed solid metal raceways (i.e., rigid or flexible metal conduits, totally enclosed cable trays, etc.).

-- Separation distance will be at least 2.54 centimeters (one inch) between solid metal raceways containing Class 1E (or Class 1E associated) cables of different safety divisions or between solid metal raceways containing Class 1E (or Class 1E associated) cables and non-Class 1E cables.

-- Single panels or instrument racks will not contain circuits or devices of the redundant protection or ESF systems except:
(a) Certain operator interface control panels may have operational considerations which dictate that redundant protection system or ESF system circuits or devices be located in a single panel. These circuits and devices will be separated horizontally and vertically by a minimum distance of 15.24 centimeters (6 inches) or by steel barriers or enclosures.
(b) The input and output circuits of isolation devices will be separated horizontally and vertically by a minimum distance of 15.24 centimeters (6 inches) or by steel barriers or enclosures.

-- Class 1E circuits and devices will also be separated from the non-Class 1E circuits and devices which are present inside a panel. These circuits and devices will be separated from each other horizontally and vertically by a minimum distance of 15.24 centimeters (6 inches) or by steel barriers or enclosures.

-- If two panels containing circuits of different separation divisions are less than 0.91 meters (3 feet) apart, there will be a steel barrier between the two panels. Panel ends closed by steel end plates will be considered to be acceptable barriers provided that terminal boards and wireways are spaced a minimum of 2.54 centimeters (1 inch) from the end plate.

-- Penetration of separation barriers within a subdivided panel will be permitted, provided that such penetrations are sealed or otherwise treated so that fire generated by an electrical fault could not reasonably propagate from one section to the other and disable a protective function.

-- Class 1E or non-Class 1E power circuits located inside panels/cabinets (1) will be limited to those required to operate systems, equipment, or components located inside the panels/cabinets (i.e., Power cables will not be permitted to traverse through from one side of a panel/cabinet to the other without being terminate inside the panel) and (2) will be routed inside rigid or flexible conduits that will be physically separated horizontally and vertically by a minimum distance of 15.24 centimeters (6 inches) or by steel barriers or additional enclosures from instrumentation and control cables.

-- Instrumentation and control and optical cables (i.e., metallic and fiber-optic cables) will be treated the same with respect to separation and protection throughout the plant.

-- Each division of Class 1E power, instrumentation, and control cables will be routed to the control room complex through a cable chase or other means such that redundant division areas are separated by a 3 hour fire rated barrier.

-- Each cable chase will be ventilated.

-- Separation between Class 1E and non Class 1E cables within the cable chase will be the same as separation of cables located outside cabinets/panels.

-- Class 1E, Class 1E associated, or non-Class 1E power circuits routed in a cable chase or the control room area will be limited to those required to operate systems, equipment, or components located in the control room area (i.e., Power cables will not be permitted to traverse through from one side of the control room area to the other without being terminated in the control room area).

-- Class 1E, Class 1E associated, or non-Class 1E power circuits routed in a cable chase or the control room area will be routed inside rigid or flexible conduits that will be physically separated horizontally and vertically by a minimum distance of 15.24 centimeters (6 inches) or by steel barriers or additional enclosures from any instrumentation and control cables.

-- Power cables may be routed in flexible metallic conduit under the raised floor of the control room.

-- Separation between redundant Class 1E and between Class 1E and non Class 1E power, instrumentation, and control cables within the control room area will be the same as separation of cables located outside cabinets/panels.

-- Redundant Class 1E power, instrumentation, and control cables will enter cabinets/panels through separate apertures.

-- Class 1E and non Class 1E power, instrumentation, and control cables will enter cabinets/panels through separate apertures.

-- Cable chases and the control room area will be a non hazard area as defined in section 6.1.3 of IEEE Std 384-1981.

-- Cable chases and the control room area will not contain potential hazards such as high energy equipment (e.g., switchgear, power distribution panels, transformers, rotating equipment, etc.), potential sources of missiles, pipe failure hazards, or fire hazards.

-- All redundant Class 1E electrical power supply and distribution systems, equipment, and components from and including the power supply to the power distribution panels will be separated by a three hour rated fire and/or missile barrier such that any failure of or within one division of the Class 1E power system or its associated load group will not caused loss of function of another division of the Class 1E power system.

-- The background of the nameplate for the equipment of a division will be the same color as the cable jacket markers and the raceway markers associated with that division.

-- All Class 1E and associated circuit raceways that are exposed will be marked with the division color at 4.57 meter (15 foot) intervals on straight sections, at turning points, at points of entry and exit from enclosed areas, at discontinuities, at pull boxes, at points of entrance and exit of rooms, and at origin and destination of equipment.

-- Class 1E and associated circuit cable raceways will be marked prior to the installation of their cables.

-- All cables for Class 1E systems and associated circuits will be marked with the division color at intervals of approximately 1.54 meter (5 foot) prior to or during installation.

-- Cables for Class 1E systems and associated circuits that are routed in conduits (which may not be marked at 1.54 meter (5 foot) intervals inside conduits) will be marked with the division color during installation at points of entrance to and exit from conduits at pull boxes, equipment, or enclosures where cables will or can be exposed.

-- All equipment and cable/raceway markings will be marked in a manner of sufficient durability to be legible throughout the life of the plant and to facilitate initial verification that the installation is in conformance with the separation criteria.

-- All cables will be tagged with a permanent marker at each end with a unique identifying number (cable number) in accordance with the design drawings or cable schedule.

-- The method used for identification will readily distinguish between redundant Class 1E systems, between Class 1E and non-Class 1E systems, and between associated cables of different redundant Class 1E systems.

-- Associated cables will be uniquely identified as such by a longitudinal stripe or other color coded method

-- The color of the cable marker for associated cables will be the same as the related Class 1E cable.

-- Individual conductors (located inside panels/cabinets) exposed by stripping the jacket will be color coded or color tagged (at intervals not to exceed 30.48 centimeters (1 foot) such that their division will still be discernable. Exceptions are permitted for individual conductors within cabinets or panels where all wiring is unique to a single division. Any non-divisional cable within such cabinets will be appropriately marked to distinguish it from the divisional cables.

-- Class 1E wire bundles or cables will be identified in a distinct permanent manner at a sufficient number of points to readily distinguish between redundant Class 1E wiring and between Class 1E and non-Class 1E wiring.

-- For a cabinet or compartment containing only Class 1E wiring of a single division, no distinctive identification will be required.

-- Neutron monitoring cables will be marked with a VN designations.

-- Scram solenoid cables will be marked with a VS designation.

-- The thermal capability of all electrical conductors within containment penetrations will be preserved and protected by two independent devices which meet requirements of IEEE Std 603-1980.

-- The two independent devices used to protect containment penetrations will be located in separate panels or will be separated by barriers.

-- The two devices used to protect containment penetrations will be independent such that failure of one will not adversely affect the other.

-- The two independent devices used to protect containment penetrations will not be dependent on the same power supply to accomplish their safety function of protecting the containment penetration.

-- Analysis will demonstrate that with failure of either one of two devices used to protect the containment penetrations (i.e., short or open between input and output of a current limiting device or protective device fails open or closed) the maximum available fault current will be less than the maximum continuous current capacity of the conductor within the penetration and the maximum continuous current capacity rating of the penetration.

-- Fault current clearing-time curves of the electrical penetrations' primary and secondary current interrupting devices plotted against the thermal capability (I^2t) curve of the penetration will show proper coordination of these curves.

-- A simplified one-line diagram will be available showing the location of the protective or current limiting devices in the penetration circuit, the maximum available fault current of the circuit, and specific identification and location of power supplies used to provide external control power for tripping primary and backup electrical penetration breakers (if utilized).

-- The devices used to protect the containment penetrations will be capable of being functionally tested and calibrated.

-- Each type of Class 1E equipment (including all structures, systems, equipment, components, pipes, loads, etc. that are not Class 1E and whose failure could possibly prevent Class 1E systems, equipment, components, and circuits including connected loads from performing their required safety function) will be qualified by analysis, successful use under similar conditions, or by actual test to demonstrate its ability to perform its function under normal and design basis event environmental and operational conditions.

-- Each type of Class 1E equipment will be designed and qualified to survive the combined effects of temperature, humidity, radiation, etc. associated with a LOCA environment or other design basis event environments at the end of their qualified and/or design life.

-- Each type of Class 1E equipment will be qualified to IEEE 344-1987, "Recommended Practices for Seismic Qualifications of Class 1E Equipment for Nuclear Power Generating Stations," (i.e., electric equipment will be demonstrated to meet its performance requirements during and following the design basis seismic event by test and/or analysis).

-- Each type of Class 1E equipment will be located in Seismic Category I structures.

-- Each type of Class 1E equipment will be seismically supported.

-- Each type of Class 1E equipment will be designed and qualified without exception to operate in a normal, accident, and post accident environments for any design basis event.

-- All structures, systems, equipment, components, pipes, loads, etc. that are not Class 1E and whose failure could possibly prevent Class 1E systems, equipment, components, and circuits including connected loads from performing their required safety function will be appropriately designed and qualified to not fail in the normal and design basis event environment for which the structures, systems, equipment, components, pipes, loads, etc. will be expected to function.

-- Each type of Class 1E equipment will be designed and qualified to operate within allowable design basis limits (e.g., equipment will be designed and qualified to operate for 5 minutes when subject to voltage below 90 percent, to operate for a predetermined time when voltage is below 70 percent, to operate continuously when subjected to voltage variations of $\pm$ 10% of nominal, etc.).

-- Variations of voltage and frequency and waveform in the Class 1E power systems during any mode of plant operation will not degrade the performance of any safety system load below an acceptable level.

-- The dc system equipment and loads will be designed and qualified to be capable of performing their required safety function while operating with voltages between 100 to 140 volts at the dc system's 125 volt distribution panels.

-- Light fixtures will be seismically qualified.

-- The light bulb may fail during and/or following a seismic event such that there will be no light. However, the light bulb (1) will not fail in such a manner to possibly cause failure to other safety systems, (2) will be replaceable, and (3) will not become a hazard to personnel or safety equipment during or following a seismic event.

-- All Class 1E equipment subject to submergence due to being located in the suppression pool level swell zone (1) will be designed and qualified to be able to perform their required safety function and to not fail while submerged or (2) will be appropriately protected from submergence and will be appropriately designed and qualified to be able to perform their required safety function and to not fail in the normal and design basis event environment for which the equipment will be expected to operate.

-- Associated cables will remain with or be physically separated the same as those Class 1E circuits with which they are associated; or associated cables will remain with or be physically separated the same as those Class 1E circuits with which they are associated from the Class 1E equipment to and including an isolation device.

-- Associated circuits, including their isolation devices or their connected loads without the isolation devices, will be subjected to all requirements placed on Class 1E circuits.

-- Power circuits that are defined as associated will be limited to power circuits related to the fine motion control rod drive motors.

-- Non Class 1E circuits that are powered from a Class 1E power supply division and are considered to be isolated through devices described in IEEE Standard 384 as isolation devices (such as fuses, breakers, power packs, etc.) will be physically and electrically independent of non Class 1E circuits that are powered in a similar manner (i.e., through a 384 isolation device) from a different Class 1E power supply division.

-- The design of the diesel generator protective relay bypass circuitry will meet all the requirements of IEEE 603-1980.

-- Abnormal values of all diesel generator bypassed parameters will be alarmed in the control room so that the control room operator can react appropriately to the abnormal diesel generator unit condition.

-- The diesel generator trip bypass function will be capable of being reset manually.

-- The diesel generator protective relaying and its bypass circuitry will have the capability to be periodically tested.

-- Thermal overload protection for Class 1E motor operated valves will be in effect during normal plant operation but the overloads will be bypassed under accident conditions per Position 1.(b) of Regulatory Guide 1.106 (revision 1).

-- The bypass initiation system circuitry will meet all of the requirements of IEEE Std 603-1980.

-- The thermal overload and its bypass circuitry will have the capability to be periodically tested.

-- Protective device trip set point, the margin between the trip set point and operating current point of loads, set point drift, and the margin between the trip set point and overload rating of loads will be clearly defined.

-- The Protective device trip set point will have the capability of being periodically verified and calibrated.

-- Protective relaying as well as all other components, equipment, and systems within the Class 1E power system (that have no direct safety function and are only provided to increase the availability or reliability of the Class 1E power systems) including the diesel generator protective relaying and thermal overload protective devices which are bypassed during accident conditions, will meet those requirements of IEEE Std 603-1980 that assure that the consequences of any operation or failure is acceptable to the Class 1E power system.

-- An analysis will be performed that demonstrates that the consequences of any operation or failure of protective relaying or other components, equipment, and systems (which have no direct safety function) is acceptable to the Class 1E power system.

-- The interrupting capacity of switchgear, load centers, motor control centers, and distribution panels will be equal to or greater than the maximum available fault current to which it is exposed under all modes of operation.

-- One EPA will be installed in each of the distribution circuits between the constant voltage constant frequency power supply and RPS scram and MSIV solenoid valves (i.e., fail-safe-type equipment).

-- The CVCF alarm on any abnormality in voltage and frequency (which can cause failure of fail-safe-type equipment) will be a Class 1E circuit.

-- The design of the CVCF alarm system will have the capability of being periodically tested.

-- The design of the EPA's will have the capability of being periodically tested.

-- Interlocks for the bus grounding device include: Under voltage relays must be actuated; Related breakers must be in the disconnect position; and Voltage for bus instrumentation must be available.

-- Annunciation will be provided to alarm in the control room whenever the breakers used for bus grounding are racked in for service.

-- Class 1E power system power supplies and distribution equipment (i.e., diesel generators, batteries, battery chargers, constant voltage constant frequency power supplies, 6.9 KV switchgear, 480 volt load centers, and 480 volt motor control centers) will be located in areas with access doors that can be administratively controlled.

-- The ac and dc distribution panels will be located in the same or similar areas as Class 1E power supplies and distribution equipment or the distribution panels will be designed to be locked so that access to circuit breakers located inside the panel can be administratively controlled.

-- The plant physical design will permit the administrative control of access to Class 1E power equipment areas.

-- The protective actions (i.e., operation of equipment for the purpose of accomplishing a safety function) of each load group will be independent of the protective actions provided by redundant load groups.

-- There will be no provision for automatically transferring loads from one Class 1E ac power supply (i.e., diesel generator) to a redundant supply.

-- Each onsite Class 1E power supply (i.e., diesel generator) will have provisions for automatic connection to one Class 1E load group, but will have no automatic connection to any other redundant load group. If nonautomatic interconnecting means are furnished, provisions that prevent paralleling of the redundant onsite Class 1E power supplies will be included.

-- Provisions for the manual connection (i.e., nonautomatic interconnecting means) of the onsite Class 1E power supply associated with one load group to any other redundant load group (except for the spare battery chargers) will not be included in the ABWR electrical system design.

-- Design provisions will be included in the ABWR design to allow one spare battery charger to be connected to either of two divisions and another spare battery charger to be connected to either of two other divisions.

-- The spare chargers for the dc power supply may be manually connected to either of the two divisions, but only when their loads are switched to the same division. Key interlocks will mechanically ensure that these standby chargers can only be used in one division at a time.

-- There will be no loads in the ABWR design which can accept source power from more than one Class 1E division.

-- The ABWR electrical system design will not have interconnections between redundant divisions.

-- The divisional battery charger will be normally fed from its divisional 480 volt motor control center bus.

-- Each standby power system division, including the diesel generator, its auxiliary systems and the distribution of power to various Class 1E loads through the 6.9 KV and 480 volt systems, will be segregated and separated from the other divisions. No automatic interconnection will be provided between the Class 1E divisions. Each diesel generator set will operate independently of the other sets.

-- Control power (for the 480 volt auxiliaries) will be from the Class 1E 125 volt dc power system of the same division.

-- Each dc system load group will have its own battery charger with no automatic interconnecting provision with other redundant load groups.

-- There will be no provision for automatically interconnecting redundant dc system load groups.

-- No provision will be made for automatically or manually transferring loads between Class 1E dc power sources.

-- The ABWR design will not have interconnections between redundant divisions of the dc system.

-- Each battery power supply will be independent of other redundant battery supplies.

-- Each battery charger will be independent of other redundant battery chargers.

-- The ac and dc switchgear power circuit breakers in each division will receive control power from their respective load groups.

-- Loss of one 125 volt dc system will not jeopardize the Class 1E power supply to the Class 1E buses of the other load groups.

-- The differential relays in one division and all the interlocks associated with these relays will be from one 125 volt dc system. There will be no cross connections between the redundant dc systems through protective relaying.

-- With respect to electrical interconnection between redundant safety division, key interlocks will be installed which will mechanically ensure that two independent open disconnect links, locked open breakers, or other equivalent open devices are always maintained between redundant divisions.

-- The fault interrupt capability of breakers supplying Class 1E loads including the division I non-Class 1E load will be coordinated with the fault interrupting capability of each load's upstream supply breaker so that failure of a greater part of the Class 1E division due to the single failure of a load will be minimized to the extent feasible.

-- The non-safety load will have zone selective interlocks to provide additional assurance that failure of a portion of a Class 1E division due to the single failure of the non-Class 1E load will be minimized to the extent practical.

-- The circuits associated with the fine motion control rod drive motors from the output of the load center transformer will be classified as non safety and will be physically and electrically independent of all safety related circuits (i.e., the circuit cables will not be routed in the same raceway with cables of any safety related division or in the same raceway with cables that are considered isolated from a safety related division by devices defined in Section 7.2.2.2 of IEEE Std 384-1981).

-- The fault interrupt capability of all Class 1E breakers, fault interrupt coordination between the supply and load breakers for each Class 1E load and the division 1 non Class 1E load, and the zone selective interlock feature of the breaker for the non Class 1E load will have the capability of being tested.

-- Other than the fine motion control rod drive motor load connected to division 1, non-safety loads will not be powered from any Class 1E ac, dc, or vital I&C ac power systems.

-- The division 1 onsite and offsite power supplies will have sufficient capacity and capability with margin to supply all Class 1E loads and the additional non-safety loads during all modes of plant operation.

-- Analysis will demonstrate that failure of the fine rod control rod drive motors and/or failure of the system that isolates it from the Class 1E power system will not degrade the Class 1E power system below and acceptable level.

-- The non-safety-related ac standby lighting system will be comprised of lighting powered from three nonessential load groups.

-- Each nonessential load group will be supplied from a different Plant Investment Protection (PIP) bus which can be connected to the nonessential standby power supply Combustion Turbine Generator (CTG).

-- The non-safety-related standby lighting system will supply a minimum of 50% of the lighting needs of the nonessential equipment areas.

-- The non-safety-related standby lighting system will supply 100% (50% from each of two nonessential load groups) of the lighting needs in passageways and stairwells leading to nonessential equipment areas.

-- The non-safety-related standby lighting system will supply up to 50% of the lighting needs in essential equipment areas and in passageways and stairwells leading to essential equipment areas.

-- The non-safety-related standby lighting system will supply 100% (50% from each of two nonessential load groups) of the lighting needs for plant security lighting.

-- The non safety related lighting in the essential equipment areas and the passageways and stairwells leading to them will be supplied from the same nonessential load group as the essential load group in the same area.

-- The safety-related ac standby lighting system will be comprised of lighting from three essential safety divisions.

-- Each safety related ac standby lighting system will be supplied power from the Class 1E divisional bus, which will be connected to the safety related standby power supply Diesel Generator (DG) in its respective division.

-- Each safety-related standby lighting system will supply a minimum of 50% of the lighting needs to the essential equipment areas in its respective division.

-- Each safety-related standby lighting system will supply 50% of the lighting in passageways and stairwells leading to essential equipment areas in its respective equipment areas.

-- The division I safety related standby lighting system will supply a minimum of 50% of the lighting needs to division IV essential equipment areas (i.e., division IV battery room and other division IV instrumentation and control areas).

-- The division II and III safety related standby lighting systems will each supply a minimum of 50% of the lighting needs to the main control room.

-- The safety related standby lighting system circuits from their power source to and including the lighting fixtures and light bulb will be Class 1E.

-- The safety related standby lighting system circuits will be routed in seismic Category I raceways.

-- The lighting fixtures will be seismically qualified.

-- The light bulb may fail during and/or following a seismic event such that there will be no light. However, the light bulb (1) will not fail in such a manner to possibly cause failure to other safety systems, (2) will be replaceable following a seismic event, and (3) will not become a hazard to personnel or safety equipment during or following a seismic event.

-- The safety-related dc emergency lighting system will provide the emergency lighting needs to the Main Control Room, the Remote Shutdown Panel Room, the emergency diesel generator areas and control rooms, and the essential electrical equipment rooms.

-- The safety-related dc emergency lighting power for identified essential areas will be supplied from the Class 1E 125 volt dc system in the same divisions as the area.

-- The safety-related dc emergency lighting power to the main control room will be supplied from the divisions II and III Class 1E 125 volt dc systems.

-- The safety related dc emergency lighting system circuits from their power supplies to the lighting fixtures will be Class 1E, will be routed in seismic Category I raceways, and will be routed separately from all other cables.

-- The safety related dc emergency lighting fixtures will be seismically qualified.

-- The light bulb may fail during and/or following a seismic event such that there will be no light. However, the light bulb (1) will not fail in such a manner to possibly cause failure to other safety systems, (2) will be replaceable following a seismic event, and (3) will not become a hazard to personnel or safety equipment during or following a seismic event.

-- The non-safety-related dc emergency lighting system will provide the emergency lighting needs to the radwaste building control room, the combustion turbine generator area and control room, the non-essential electrical equipment areas, and for plant security.

-- Lighting power for the radwaste building control room will be supplied from the nonessential 250 volt dc system.

-- Lighting power for the nonessential electrical equipment rooms will be supplied from the nonessential 125 volt dc system in the same nonessential load group as the equipment in the room.

-- Lighting power for the nonessential combustion turbine generator area and control room will be supplied from one of the nonessential 125 volt dc systems.

-- The non safety related dc emergency lighting system circuits will be classified as non Class 1E and will be routed in non seismic raceways.

-- Lighting power for plant security will be supplied from one or more of the nonessential 125 volt dc systems such that continued operation of the security lighting system will be maintained for at least 30 minutes in the event of an interruption of ac power.

-- The guide lamp light system will be provided for stairways, exit routes, and major control areas such as the main control room and remote shutdown panel areas.

-- The guide lamps will have self-contained battery pack units.

-- The self contained battery pack units will contain a rechargeable battery with an 8-hour capacity.

-- The self contained battery pack units will also contain a charger and an initiating switch which energizes the fixture from the battery in the event of loss of the ac power supply and de-energizes the fixture upon return of ac power to the standby light following a time delay of 15 minutes.

-- The guide lamps will be supplied ac power from the same power supply that supplies the standby lighting system in the area in which they are located.

-- The guide lamp light system will be seismically qualified in safety related areas.

-- Each of the lighting systems will meet or exceed the lighting level requirements of the Illuminating Engineering Society (IES) Lighting Handbook.

-- Each of the lighting systems will have the capability of being functionally tested on a periodic basis.

-- Purchase specification for both safety and non-safety related equipment will contain a list of common industrial standards, as appropriate, for the assurance of quality manufacturing.

-- The ABWR electrical system design will provide controls and indicators in the main control room.

-- The design will include provisions for control and indication outside the main control room for (a) circuit breakers that switch Class 1E buses between the preferred and the standby power supply, (b) the standby power supply, and (c) circuit breakers, contactors, and other equipment as required for safety systems that must function to bring the plant to a safe shutdown condition.

-- Operational status information will be provided for Class 1E power systems in the main control room.

-- Class 1E power systems required to be controlled from outside the main control room will also have operational status information provided outside the central control room at the equipment itself, at its power supply, and at an alternate central location.

-- The operator will be provided with accurate, complete, and timely information pertinent to the status of the execute features in the control room.

-- Indication will be provided in the control room of electrical systems protective actions and execute features unavailability.

-- Electric power systems and equipment will have the capability of being periodically tested.

-- Testability of electrical systems and equipment will not be so burdensome operationally that required testing at intervals of 1, 2, or 3 months cannot be included in the technical specifications if deemed necessary.

-- An acceptable level of reliability for the remaining operable safety systems will exist when one train is taken out of service for a specified period of time for preplanned or unplanned maintenance and the single failure criterion is not met.

-- An acceptable level of reliability for the remaining operable safety systems will be established by a probability risk analysis.

-- The 125 volt dc non-Class 1E system will provide power to non safety related switchgear, valves, converters, transducers, controls, and instrumentation.

-- The non-Class 1E 125 volt dc system will have three load groups with one battery, charger, and bus per load group.

-- The 250 volt dc non-Class 1E system will provide power for non safety computers and turbine turning gear motor.

-- The non-Class 1E 125 and 250 volt dc systems will provide power only to non safety loads.

-- The non-Class 1E 125 and 250 volt dc systems will be physically and electrically independent of the Class 1E ac and dc systems.

-- Each of the four Class 1E 125 volt batteries will be capable of starting and operating its required steady state and transient loads.

-- Each of the four Class 1E 125 volt batteries will be immediately available during both normal operations and following the loss of power from the alternating current system.

-- Each of the four Class 1E 125 volt batteries will have sufficient stored energy to provide an adequate source of power for starting and operating all required LOCA and/or LOPP loads and circuit breakers for two hours with no ac power.

-- Each of the four Class 1E 125 volt batteries will have sufficient stored energy to provide power in excess of the capacity of the battery charger when needed during all modes of plant operation and when the battery is being restored to its fully charged state following restoration of alternating current to the battery charger.

-- Each of the four Class 1E 125 volt batteries will be sized in accordance with industry recommended practice defined in IEEE Std 485-1978.

-- Each of the four Class 1E 125 volt batteries will have a capacity design margin of 5 to 15 percent to allow for less than optimum operating conditions.

-- Each of the four Class 1E 125 volt batteries will have a 25 percent capacity design margin to compensate for battery aging.

-- Each of the four Class 1E 125 volt batteries will have a 4 percent capacity design margin to allow for the lowest expected electrolyte temperature of 70 degrees F.

-- The number of battery cells for each of the four Class 1E 125 volt batteries will match the battery to system voltage limitations (i.e., the number of cells should be 58).

-- The first minute of each of the four Class 1E 125 volt batteries duty cycle will be based on the sum of all momentary, continuous, and noncontinuous loads that can be expected to operate during the one minute following LOCA and/or LOPP.

-- Each of the four Class 1E 125 volt batteries will be installed in accordance with industry recommended practice defined in IEEE Std 484-1987.

-- Each of the four Class 1E 125 volt batteries will meet the recommendations of section 5 of IEEE Std 946.

-- Each of the four Class 1E 125 volt batteries will be designed so that the each battery's capacity can be periodically verified.

-- The division 1 battery (in addition to having sufficient stored energy to operate all required LOCA and/or LOPP loads and circuit breakers for two hours) will have sufficient stored energy to provide an adequate source of power for starting and operating all required loads and circuit breakers for eight hours with no ac power.

-- The heating/ventilation system will maintain electrolyte temperature above 70°F.

-- Each standby (diesel generator) power source will be capable of energizing or starting and accelerating to rated speed, in the required sequence, all the required safety system loads.

-- Each standby (diesel generator) power source will be capable of attaining rated frequency and voltage within 20 seconds after receipt of a start signal.

-- Each standby (diesel generator) power source will have a continuous load rating of 6.25 MVA @ 0.8 power factor.

-- Each standby (diesel generator) power source will have a short time rating[1] of 110 percent of the continuous load rating for a two-hour period out of any 24 hour period, without exceeding the manufacturer's design limits and without reducing the maintenance interval established for the continuous rating.

-- Each standby (diesel generator) power source will be available following the loss of the preferred power supply within a time consistent with the requirements of the safety function under normal and accident conditions.

-- Each standby (diesel generator) power source will have stored energy (Fuel) at the site in its own storage tank with the capacity to operate the standby diesel generator power supply while supplying post accident power requirem... to a unit for seven days.

-- Each standby (diesel generator) power source will have stored energy (fuel) at the site in its own day tank with the capacity to operate the standby diesel generator power supply while supplying post accident power requirements for 8 hours.

-- Each standby (diesel generator) power source will have a fuel transfer system with the capability of automatically replenishing the day tank from the storage tank such that the 8 hour fuel capacity of the day tank is maintained.

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[1] Operation at this rating does not limit the use of the diesel generator unit at its continuous rating

-- Each standby (diesel generator) power source will be capable of operation in its service environment during and after any design basis event, without support from the preferred power supply.

-- Each standby (diesel generator) power source will be capable of starting, accelerating, and being loaded with the design load, within an acceptable time (a) from the diesel engine's normal standby condition, (b) with no cooling available, for a time equivalent to that required to bring the cooling equipment into service with energy from the diesel generator unit, (c) on a restart with an initial engine temperature equal to the continuous rating full load engine temperature.

-- Each standby (diesel generator) power source will be capable of accepting design load following operation at light or no load for a period of 4 hours.

-- Each standby (diesel generator) power source will be capable of maintaining voltage and frequency at the generator terminals within limits that will not degrade the performance of any of the loads comprising the design load below their minimum requirements, including the duration of transients caused by load application or load removal.

-- Each standby (diesel generator) power source will be capable of carrying its continuous load rating for 22 hours followed by 2 hours of operation at its short time rating.

-- Each standby (diesel generator) power source will start from each automatic and remote manual signal and then accelerate to rated voltage and frequency, and then properly sequences its loads if there is no offsite power available or operate at no load if offsite power is available.

-- Each standby (diesel generator) power source will start but not sequence its loads by a local manual start signal.

-- Each standby (diesel generator) power source will be capable of being manually started, of automatic acceleration to rated voltage and frequency, and of the bus being manually energized without ac or dc external electric power.

-- The maximum loads expected to occur for each division (according to nameplate ratings) will not exceed 90% of the continuous power output rating of the diesel generator.

-- Each diesel generator's air receiver tanks will have sufficient capacity for five starts without recharging.

-- Following one successful manual start of the diesel generator without ac or dc external power, each diesel generator's air receiver tanks will have sufficient air remaining for four more starts.

-- Following one unsuccessful manual or automatic start of the diesel generator with and without ac or dc external power, each diesel generator's air receiver tanks will have sufficient air remaining for three more successful starts without recharging.

-- Automatic load sequence will begin at ≤ 20 seconds and will end at ≤ 65 seconds.

-- Following application of each load during load sequencing, voltage will not drop more than 25% from nominal voltage measured at the bus.

-- Following application of each load during load sequencing, frequency will not drop more than 5% from nominal frequency measured at the bus.

-- Frequency will be restored to within 2% of nominal, and voltage will be restored to within 10% of nominal within 60% of each load sequence time interval.

-- During recovery from transients caused by step load increases or resulting from the disconnection of the largest single load, the speed of the diesel generator unit will not exceed the nominal speed plus 75% of the difference between nominal speed and the overspeed trip setpoint or 115% of nominal, whichever is lower.

-- The transient following the complete loss of load will not cause the speed of the unit to attain the overspeed trip setpoint.

-- Bus voltage and frequency will recover to 6.9 KV±10% at 60±2% Hz within 10 seconds following trip and restart of the largest load.

-- Each of the design commitments associated with the capacity and capability of the standby diesel generator power sources and their load sequencers to supply required power to safety system loads will have the capability of being periodically verified.

-- Each of the four redundant Class 1E Constant Voltage Constant Frequency (CVCF) power supplies will have a capacity based on the largest combined demands of the various continuous loads plus the largest combination of noncontinuous loads that would likely be connected to the power supply simultaneously during normal or accident plant operation whichever is higher.

-- The design will include the capability to periodically verify the capacity for each of the CVCF power supplies.

-- Each of the four redundant Class 1E dc battery chargers will have a capacity based on the largest combined demands of the various continuous steady-state loads plus charging capacity to restore the battery from the design minimum charge state to the fully charged state within the time stated in the design basis regardless of the status of the plant during which these demands occur.

-- Each of the four redundant Class 1E dc battery chargers will have a disconnecting device in its ac power incoming feeder and its direct current power output circuit for isolating the charger.

-- Each of the four redundant Class 1E dc battery chargers will be designed to prevent the ac power supply from becoming a load on the battery.

-- Each of the four redundant Class 1E dc battery chargers will have provisions to isolate transients from the ac system from affecting the dc system and vice versa.

-- Each of the four redundant Class 1E dc battery chargers will be sized in accordance with the guidelines of IEEE Std 946-1985.

-- The design will include the capability to periodically verify the required capacity for each of the battery charger power supplies.

-- Each Class 1E distribution circuit will be capable of transmitting sufficient energy to start and operate all required loads in that circuit for all plant conditions described in the design basis.

-- The design will include the capability to periodically verify the required capacity for each distribution circuit.

-- Any one of the three divisions of RHR will be sufficient to safely shut down the plant.

-- Restoration of ac power to any one division at the end of the 8-hour coping period will with margin be capable of maintaining the plant within required design limits and to permit completion of plant shutdown.

-- The three independent diesel generators will be designed with bypass valves for their dc solenoids such that each can be started manually without dc power (i.e, assuming the dc batteries are discharged following 8 hours of coping).

-- The combustion turbine generator will be able to be started by a smaller self-contained diesel with its own battery.

-- The ac power from any one of the three diesel generators will be capable of being manually connected to required loads within its associated division without dc control power.

-- The ac power from the offsite preferred system or from the combustion turbine generator will be capable of being manually connected to required loads within each of the three Class 1E ac divisions without dc control power.

-- The plant design is to be such that specified temperature limits will not be exceeded in the RCIC or Control Rooms for at least eight hours following station blackout.

-- Equipment required for the SBO event located in the RCIC room will be designed and qualified to a temperature in excess of 151°F (66°C) (i.e., the specified temperature limit).

-- Equipment required for the SBO event located in the control room will be designed and qualified to a temperature in excess of 122°F (i.e., the specified temperature limit).

-- The initial temperature in the heat-up calculations of 104°F (40°C) for the RCIC Room will prevent the equipment from reaching the design temperature of 151°F (66°C) for at least 8 hours.

-- The initial temperature in the heat-up calculations of 79°F (26°C) for the Main Control Room will prevent the equipment from reaching the design temperature of 122° (50°C) for at least 8 hours.

-- Environments expected during and following the 8-hour coping time through out the plant for the station blackout event will not exceed the environment for which equipment is designed and qualified.

-- The division I battery will be sized with sufficient capacity to supply all required SBO loads without load shedding.

-- The RCIC systems will have sufficient capacity and capability to maintain the plant in a safe shutdown condition for 8 hours.

-- The alternate ac power source will be a combustion turbine generator.

-- The alternate ac power source will be provided with a fuel supply that is separate from the fuel supply for the onsite emergency ac power system (i.e., a separate day tank supplied from a common storage tank).

-- The alternate ac power source fuel will be sampled and analyzed consistent with applicable standards).

-- The alternate ac power source will be capable of operating during and after a station blackout without any ac support systems powered from the preferred power supply or the blacked-out units Class 1E power sources affected by the event.

-- The alternate ac power source will be designed to power all the normal and/or Class 1E shutdown loads necessary within 1 hour or less of the onset of the station blackout, such that the plant is capable of maintaining core cooling and containment integrity.

-- The alternate ac power source will be protected from design basis weather events (except seismic and tornado missiles) to the extent that there will be no common mode failures between offsite preferred sources and the combustion turbine generator power source.

-- The alternate ac power source will be subject to quality assurance guidelines commensurate with its importance to safety.

-- The alternate ac power source will have sufficient capacity and capability to supply one division of Class 1E loads.

-- The alternate ac power source will have sufficient capacity and capability to supply the normal non-Class 1E loads used for safe shutdown.

-- The alternate ac power source will undergo factory testing similar to those required for the Class 1E diesel generator.

-- The alternate ac power source will not supply power to nuclear safety related equipment except on condition of complete failure of the emergency diesel generators and all offsite power.

-- The alternate ac power source will not be a single point vulnerability with onsite emergency ac power sources.

-- The alternate ac power source will be subject to site acceptance testing, periodic preventative maintenance, inspections, etc.

3. Additional Design Requirements:

In our evaluation of electrical systems, ABWR design commitments were not identified for the following items. For each of these items, identify the related design commitments and for each identified design commitment either (1) include each as acceptance criteria with appropriate inspection, test, and/or analysis in accordance with requirements of paragraph (a)(1)(vi) of 10 CFR Part 52.47 or (2) provide justification for the identified design commitments non inclusion.

-- Offsite system outside the ABWR scope of supply

-- The normal configuration for the connection of offsite circuit to the onsite Class 1E distribution

-- Special color coding to assure neutron-monitoring, scram solenoid, and dc emergency lighting cables will be installed in their associated raceway in accordance with design basis protection and independence requirements.

-- Level of protection to be afforded Class 1E power systems due to failure of redundant Class 1E components that can be subjected to the environments of the same design basis event (e.g., fire, fire suppressant, and non-seismic structures) for which they may not be designed or qualified.

-- The adequacy of the lighting in essential areas under postulated design basis event and/or off normal conditions.

-- What constitutes an acceptable level of reliability for the remaining operable safety systems when one train is taken out of service for a specified period of time for preplanned or unplanned maintenance and the single failure criterion is not met.