PSNH

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United States Nuclear Regulatory Commission
Washington, DC 20555

Attention: Mr. Vincent S. Noonan, Project Director
PWR Project Directorate No. 5

Reference: (a) Construction Permit CPPR-135 and CPPR-136, Docket Nos. 50-443 and 50-444

Subject: FSAR Revisions

Dear Sir:

During discussions with the Staff regarding the Seabrook Station Technical Specifications, and as result of our own in-house review of these technical specifications, changes to the Seabrook Station FSAR were identified. These changes are provided herewith in Attachment 1. Attachment 1 also provides a further clarification of Seabrook Station's conformance to Regulatory Guide 1.151. These revisions will be incorporated into the FSAR by a future amendment.

Very truly yours,

George S. Thomas

Attachment

cc: Atomic Safety and Licensing Board Service List

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ATTACHMENT 1

FSAR Revisions

(Seabrook Station)

3.8 DESIGN OF CATEGORY I STRUCTURES

3.8.1 Concrete Containment

The containment structure houses the major portion of a PWR nuclear steam supply system (NSSS). During the operating life of the plant, it will also provide the following functions:

a. Limiting the leakage rate to the maximum allowable Type "A" test leakage rate, 0.15% ~~0.1%~~ by weight of the containment contained air mass per day at calculated peak pressure and associated temperature, resulting from any loss-of-coolant accident (LOCA) and other postulated accidents.

b. Providing continuing radiation shielding during normal plant operation in accordance with 10CFR20 and during accident conditions in accordance with 10CFR100.

c. Protecting the reactor vessel and all other safety-related systems, equipment and components located inside the containment against all postulated external environmental conditions and resulting loads.

3.8.1.1 Description of Containment

The containment, Figures 1.2-2 through 1.2-6, is a seismic Category I reinforced concrete dry structure, which is designed to function at atmospheric conditions. It consists of an upright cylinder topped with a hemispherical dome, supported on a reinforced concrete foundation mat which is keyed into the bedrock by the depression for the reactor pit and by continuous bearing around the periphery of the foundation mat. The inside diameter of the cylinder is 140 feet and the inside height from the top of the base mat to the apex of the dome is approximately 219 feet; the net free volume is approximately 2,704,000 cubic feet. 44

A welded steel liner plate, anchored to the inside face of the containment, serves as a leaktight membrane. Although not a code requirement, welds that are embedded in concrete and not readily accessible are covered by a leak chase system which permits leak testing of those welds throughout the life of the plant. Exemptions to these inaccessible welds are the welds joining mechanical penetrations X-60 and X-61 to the steel liner plate. (The venting pipes which join the leak chase channels for these penetrations to the atmosphere were not provided; however, these welds underwent proper testing before they became inaccessible). The liner on top of the foundation mat is protected by a four feet thick concrete fill mat which supports the containment internals and forms the floor of the containment. 53

The containment is designed to assure that the base mat, cylinder, and dome behave integrally to resist all loads.

Located outside the containment building and having a similar geometry is the containment enclosure building. This structure provides leak protection for the containment and protects it from certain loads, as discussed in Subsection 3.8.1.3. The containment enclosure building is described in Subsection 3.8.4.

8. Containment Ambient Temperature Monitors

Platinum resistance temperature detectors are strategically located throughout the containment to detect local temperature changes and will assist in localizing a leak. ~~Refer to Figure 5.2-2 Sheet 3 for details.~~

c. RCS Water Inventory Balance 56

The periodic RCS water inventory balance is designed to be conducted during steady state conditions with minimal T-AVG variance. In the course of this inventory, the following parameters are monitored:

1. Time
2. T-Avg
3. Pressurizer Level
4. VCT Level
5. PRT Level
6. RCDT Level
7. BAB Flow Totalizer

Changes in inventory due to sampling, draining, and steam generator tube leakage are accounted for separately. During the conduct of this inventory, every effort is made to avoid additions to the RCS, pump down of the RCDT, or diversion of letdown from the VCT. 52

Changes in the parameters are calculated over a convenient time period (the longer the period the more accurate the results). The inventory change rate is determined by summing the volume change associated with each parameter and dividing this value by the time interval. The difference between the containment sump leakage rate and the inventory change rate will indicate leakage from sources other than the primary system.

5.2.5.4 Intersystem Leakage Detection 49

The following three types of detection methods are employed to monitor systems connected with the RCPB for signs of intersystem leakage:

a. Primary Component Cooling Water System Radiation Monitors

These are gamma sensitive scintillation detectors. Liquid sample is drawn from the discharge side of the primary component cooling water pumps and returned back to the suction side. This system monitors primary component cooling water for radioactivity indicative of a leak from the reactor coolant system or from one of the radioactive systems which exchanges heat with the primary component cooling system. These detectors are provided with the relevant flow information, so as to get the radioactivity in terms of microcuries per cubic centimeter.

b. Condenser Air Evacuation Monitors

This method is employed for detection of steam generator tube leaks. Noble gases present in the steam generator tube or tube sheet coolant

TABLE 5.2-7

REACTOR COOLANT PRESSURE BOUNDARY VALVE NUMBERS

CSV-0002	RCV-0009	RCV-0079	RHV-0031*	SIV-0082*
CSV-0018	RCV-0010	RCV-0080	RHV-0050*	SIV-0086*
CSV-0034	RCV-0013	RCV-0081	RHV-0051*	SIV-0087*
CSV-0050	RCV-0017	RCV-0087*	RHV-0052*	SIV-0106*
CSV-0175	RCV-0022*	RCV-0088*	RHV-0053*	SIV-0110*
CSV-0176	RCV-0023*	RCV-0090	RHV-0059	SIV-0118*
CSV-0178	RCV-0033	RCV-0091	RHV-0061	SIV-0122*
CSV-0179	RCV-0034	RCV-0094	RHV-0063	SIV-0126*
CSV-0181	RCV-0037	RCV-0097	RHV-0065	SIV-0130*
CSV-0182	RCV-0040	RCV-0098	SIV-0003	SIV-0140*
CSV-0185	RCV-0041	RCV-0099	SIV-0005*	SIV-0143
CSV-0186	RCV-0044	RCV-0102	SIV-0006*	SIV-0144*
CSV-0471	RCV-0045	RCV-0109	SIV-0017 ~~SIV-0016~~	SIV-0147
CSV-0472	RCV-0050	RCV-0110	SIV-0020*	SIV-0148*
CSV-0473	RCV-0051	RCV-0115	SIV-0021*	SIV-0151
CSV-0474	RCV-0060	RCV-0116	SIV-0032	SIV-0152*
CSV-0752	RCV-0061	RCV-0117	SIV-0035*	SIV-0155
RCV-0001	RCV-0064	RCV-0122	SIV-0036*	SIV-0156*
RCV-0003	RCV-0067	RCV-0124	SIV-0047	RC-PCV-456A
RCV-0004	RCV-0072	RHV-0015*	SIV-0050*	RC-PCV-456B
RCV-0006	RCV-0073	RHV-0029*	SIV-0051*	RC-LCV-459
RCV-0008	RCV-0076	RHV-0030*	SIV-0081*	RC-LCV-460
				RC-PCV-455A
				RC-PCV-455B

* Reactor Coolant ~~Syste~~ Pressure Isolation Valves which require leakage testing in accordance with the technical specifications.

2. Subsequent Leakage from Components in Safeguards Systems

With respect to piping and mechanical equipment outside the containment, considering the provisions for visual inspection and leak detection, leaks will be detected before they propagate to major proportions. A review of the equipment in the system indicates that the largest sudden leak potential would be the sudden failure of a pump shaft seal. Evaluation of leak rate, assuming only the presence of a seal retention ring around the pump shaft, showed that flows less than 50 gpm would result. Piping leaks, valve packing leaks, or flange gasket leaks tend to build up slowly with time and are considered less severe than the pump seal failure.

Larger leaks in the ECCS are prevented by the following:

(a) The piping is classified in accordance with ANS Safety Class 2 and receives the ASME Class 2 quality assurance program associated with this safety class.

(b) The piping, equipment and supports are designed to ANS Safety Class 2 seismic classification, permitting no loss of function for the design basis earthquake.

(c) The system piping is located within a controlled area on the plant site.

(d) The piping system receives periodic pressure tests, and is accessible for periodic visual inspection.

(e) The piping is austenitic stainless steel which, due to its ductility, can withstand severe distortion without failure.

→ INSERT [redacted] 16.3 A

Based on this review, the design of the primary auxiliary building and related equipment was verified for its ability to handle leaks up to a maximum of 50 gpm. Leakage would drain to and collect in the primary auxiliary building sump. Automatic initiation of the sump pumps at a predetermined set point would be indicated at the main control board and would alert the operator to an abnormal condition. Corrective action would include determining the location of the leak by visual inspection, and remote or manual isolation of the leak point from the rest of the system within 30 minutes.

c. Potential Boron Precipitation

Boron precipitation in the reactor vessel can be prevented by a backflush of cooling water through the core to reduce boil-off and resulting concentration of boric acid in the water remaining in the reactor vessel. This is accomplished by a switch from cold to hot leg recirculation about 18 hours following an accident.

INSERT 16.3A

(f) Instrument tubing is designed to the requirements of Regulatory Guide 1.151 as discussed in Section 7.1.2.12

Instrument error bands were calculated accounting for uncertainties such as measurement accuracy, calibration accuracy, signal drift, environment changes, etc.

The time from accident initiation to the first required manual actions is dependent on initial tank water level, draw-down rate and "lo-lo-1" level alarm point. The minimum time from accident initiation to required action is calculated to be 21.9 minutes. This is the time required to draw 350,000 gallons from the RWST at conservatively high pump flow rates as follows: 53

Pump	Flow Rate/Pump (gpm)
* Safety Injection	450
* Charging	450
* RHR	4,000
** Spray	3,300
Total	16,400

It should be noted that the entire 16,400 gpm is assumed to come from the RWST, neglecting the additional volume available in the spray additive tank.

As can be seen in Figure 6.3-6, the 350,000 gallon injection allowance is contained between the extreme low range of the "tech spec" alarm error band and the extreme upper range of the "lo-lo-1" signal error band. The 30,300 gallon transfer allowance is found between the low range of the "lo-lo-1" alarm and high range of the "empty" alarm. A ~~17,600~~ 16,300 gallon pump shutoff allowance is provided between the low range of the "empty" alarm and the calculated level for potential vortexing assuming the worst single failure. 53 53 58

The time available for the manual portion of the switchover is dependent on the rate of outflow. Table 6.3-10 lists the sequence of operator actions, estimated duration and maximum outflow rate at the end of each action.

In the event of a design basis LOCA, the sump isolation valves would be fully open 29 seconds after receiving the "lo-lo-1" signal. The combination of the containment pressure and elevation head from the sump would seat the check valves in line between the RWST and the CBS and RHR pumps (CBS-V3, -V7, -V55, -V56) reducing the flow rate out of the tank to 1,800 gpm. ~~At this flow rate, at least 12.0 minutes remains above the "empty" alarm for completion of the actions described in Table 6.3-10.~~ Since, at this flow rate, it will take approximately 12 minutes to reach the "empty" alarm, there is sufficient time available for completion of the actions described in Table 6.3-10. 53 58

In an accident for which the RWST water is at the minimum allowed temperature, the containment heat sinks are at a low temperature and the heat transfer rate in the containment is high, the containment pressure may be high enough 45

* 10 second actuation delay
** 30 second actuation delay

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to actuate the spray, but not high enough to seat the check valves referenced above. This would result in a continued high flow rate from the tank until the RWST isolation valves (CBS-V2, V5) are closed (approximately 75 seconds after "lo-lo-1" signal by Table 6.3-10. From this point there is at least 6.2 ~~[illegible]~~ 4.9 minutes of operation at 1,800 gpm, for a total of ~~6.4~~ 6.2 minutes before the "empty" alarm sounds. There is at least ~~31.0~~ 30.0 minutes of operation between the "lo-lo-1" and possible vortexing in this case. 53 58

The limiting single failure for the design is the failure of one of the RWST isolation valves (CBS-V2, -V5) to close. If one of these valves does not close, the flow rate drops from 16,400 to 9,100 gpm (not 1,800). At this high flow rate, the "empty" alarm will sound, alerting the operator to immediately shut off any pumps still taking suction from the tank. There is sufficient volume between the "empty" alarm and the calculated vortexing level for at least ~~1.9~~ 1.8 minutes of operation for shutting off the pumps. 45 58 53

Following the automatic and manual switchover sequence, the two residual heat removal pumps would take suction from the containment sump and deliver borated water directly to the RCS cold legs. A portion of the Number 1 residual heat removal pump discharge flow would be used to provide suction to the two charging pumps which would also deliver directly to the RCS cold legs. A portion of the discharge flow from the Number 2 residual heat removal pump would be used to provide suction to the two safety injection pumps which would also deliver directly to the RCS cold legs. As part of the manual switchover procedure (see Table 6.3-7, Step 4), the suctions of the safety injection and charging pumps are cross-connected so that one residual heat removal pump can deliver flow to the RCS and both safety injection and charging pumps, in the event of the failure of the second residual heat removal pump.

See Section 7.5 for process information available to the operator in the control room following an accident.

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The small break analyses deal with breaks of up to 1.0 ft^2 in area, where the safety injection pumps play an important role in the initial core recovery because of the slower depressurization of the RCS. 48

The RCS depressurization and water level transients show that for a break of approximately 3.0 inch equivalent diameter, the transient is turned around and the core is recovering prior to accumulator injection. For a 3.5 inch equivalent diameter break, the core remains uncovered with a decreasing level until accumulator action. Thus, the maximum break size showing core recovery prior to accumulator injection will be approximately 3.0 inch equivalent diameter. Accumulator injection commences when pressure reaches 600 ~~psig~~ psia, i.e. approximately 1200 seconds for the 3.0 inch break size.

The analysis of this break has shown that the high head portion of the ECCS, together with accumulators, provide sufficient core flooding to keep the calculated peak clad temperature below required limits of 10 CFR 50.46. Hence, adequate protection is afforded by the ECCS in the event of a small break LOCA.

6.3.3.3 Large Break LOCA

A major LOCA is defined as a rupture 1.0 ft^2 or larger of the RCS piping including the double-ended rupture of the largest pipe in the RCS or of any line connected to that system. The boundary considered for LOCA as related to connecting piping is defined in Section 3.6. 48

Should a major break occur, depressurization of the RCS results in a pressure decrease in the pressurizer. Reactor trip occurs and the safety injection system is actuated when the pressurizer low pressure trip setpoint is reached. Reactor trip and safety injection system actuation are also provided by a high containment pressure signal. These countermeasures will limit the consequences of the accident in two ways:

a. Reactor trip and borated water injection provide additional negative reactivity insertion to supplement void formation in causing rapid reduction of power to a residual level corresponding to fission product decay heat.

b. Injection of borated water ensures sufficient flooding of the core to prevent excessive clad temperatures.

When the pressure falls below approximately 600 ~~psig~~ psia the accumulators begin to inject borated water. The conservative assumption is made that injected accumulator water bypasses the core and goes out through the break until the termination of the blowdown phase. This conservatism is again consistent with the Final Acceptance Criteria.

The pressure transient in the reactor containment during a LOCA affects ECCS performance in the following ways. The time at which end of blowdown occurs is determined by zero break flow which is a result of achieving pressure equilibrium between the RCS and the containment. In this way, the amount of accumulator water bypass is also affected by the containment pressure, since

TABLE 6.3-1
(Sheet 1 of 3)

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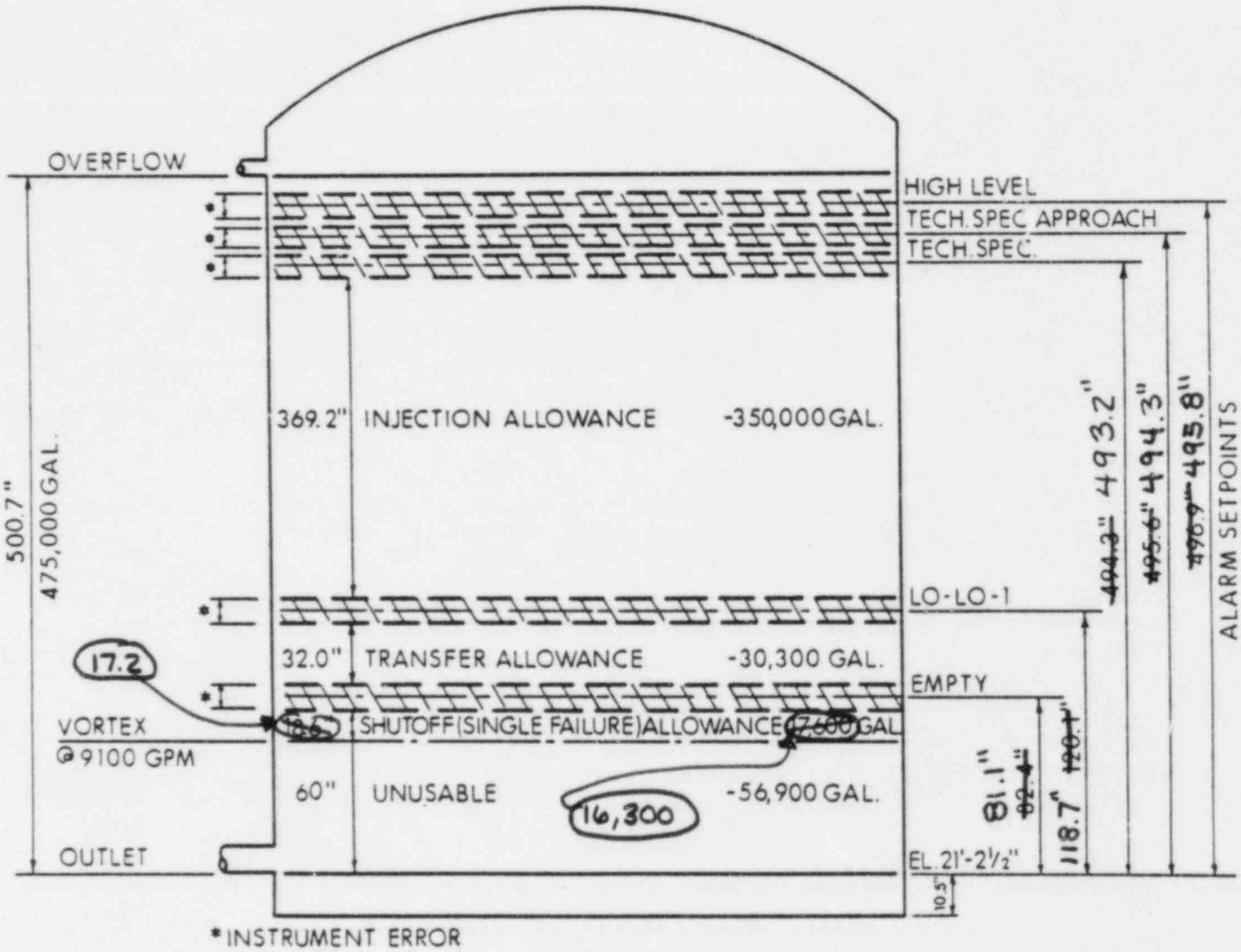
EMERGENCY CORE COOLING SYSTEM
COMPONENT DESIGN PARAMETERS

Accumulators	
Number	4
Design pressure (psig)	700
Design temperature (^{o}F)	300
Operating temperature (^{o}F)	100 to 150
Normal operating pressure (psig)	650
Minimum operating pressure (psig)	~~600~~ 585
Total volume (ft^3)	1350 each
Nominal operating water volume (ft^3)	850 each
Volume N_2 gas (ft^3)	500
Boric acid concentration, minimum (ppm)	1900
Relief valve setpoint (psig)	700
Centrifugal Charging Pumps	
Number	2
Design pressure (psig)	2800
Design temperature (^{o}F)	300
Design flow [(a)] (gpm)	150
Design head (ft)	5800
Maximum flow (gpm)	550
Head at maximum flow (ft)	1400
Discharge head at shutoff (ft)	6200
Motor rating (hp)	600

TABLE 6.3-9

NORMAL OPERATING STATUS OF EMERGENCY CORE COOLING SYSTEM COMPONENTS FOR CORE COOLING

Number of safety injection pumps operable	2
Number of charging pumps operable	2
Number of residual heat removal pumps operable	2
Number of residual heat exchangers operable	2
Refueling water storage tank volume (gal)	477,000 ~~450,000~~ (min.)
Boron concentration in refueling water storage tank, minimum (ppm)	2,000
Boron concentration in accumulator, minimum (ppm)	1,900
Number of accumulators	4
Minimum accumulator pressure (psig)	600
Nominal accumulator water volume (ft^3)	850
System valves, interlocks, and piping required for the above components which are operable	All



REFUELING WATER STORAGE TANK

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE SEABROOK STATION - UNITS 1 & 2 FINAL SAFETY ANALYSIS REPORT	REFUELING WATER STORAGE TANK
	FIGURE 6.3-6

areas, mechanical piping penetration area and engineered safeguard equipment cubicles, so that any fission products leaking from these systems and from the primary containment will be retained in these areas and eventually processed through the filters. The filter unit also accepts the discharge from the post-LOCA containment hydrogen purging duct, as discussed in Subsection 6.2.5.2. 49

2. The exhaust capacity is based on a conservative leak rate of 0.20 percent/day of the containment air mass at maximum internal pressure following a design basis LOCA as given in Table 6.5-7. Each containment enclosure exhaust fan is designed to exhaust at the rate of ~~2025~~ 2100 SCFM, which is equivalent to a volumetric inleakage rate of 325 percent/day from the containment structure to the containment enclosure annulus. 52 56 58 52

3. The time required to reduce the containment enclosure volume and the additional building volumes associated with the electrical penetration areas, mechanical piping penetration tunnel and engineered safeguard equipment cubicles to a negative pressure of at least 0.25 inches of water is ~~approximately~~ CALCULATED TO BE 8.64 minutes after CIS. 55 56 58

4. Sizing of the high efficiency particulate air filters (HEPA) and carbon adsorbers is based on the volumetric flow rate required to maintain the negative pressure in the containment enclosure annulus and connected penetration and engineered safeguard areas, and for fission product removal capability employing the conservative inventories given in Subsection 15.6.5.

5. The containment enclosure emergency air cleaning system is a seismic Category I, Safety Class 2, system.

b. Fuel Storage Building Emergency Air Cleaning System

1. The fuel storage building emergency air cleaning system is designed to maintain a negative pressure of ≥0.25 inches of water within the fuel storage building while in the irradiated fuel handling mode, to remove and retain airborne particulates and radioactive iodine, and to exhaust filtered air to the unit plant vent following a fuel handling accident. 56

2. The exhaust filter system is designed to remove and retain airborne particulate and radioactive iodine, and to exhaust the filtered air to the unit plant vent following a fuel handling accident while either or both filters are operating.

3. Sizing of the HEPA filter and carbon adsorbers is based on the volumetric flow rates required to maintain the required negative pressure in the fuel storage building for both the normal fuel handling mode and the fuel handling accident mode, and for fission product removal capability employing the conservative inventories presented in Subsection 15.6.5.

4. The fuel storage building emergency air cleaning system is a seismic Category I, Safety Class 3 system.

6.5.1.2 System Design

a. Containment Enclosure Emergency Air Cleaning System

The filter system consists of redundant filter trains, fans, dampers and controls and a common ductwork system. The air flow required to maintain a negative pressure in the containment enclosure building is passed through demisters, which also function as prefilters, and through HEPA filters located both upstream and downstream of the carbon filter prior to exhausting through the plant vent (see Figure 9.4-2 for an air flow diagram).

A ductwork cross-connection is provided between the two filter trains at a point between the downstream HEPA filter and the fan inlet. Should the operating fan fail, this cross-connection will insure a continued air flow by manual startup of the redundant fan.

Each redundant filter train is complete, separate and independent from both electrical and control standpoints. Each filter train 59
fan is supplied power from an independent ESF power train source, which will furnish power to its fan during abnormal and post-accident conditions. The operation of mechanical equipment is controlled and monitored in the plant unit control room, as discussed in Section 7.3.

The HEPA filters have a certified test efficiency of 99.97 percent based on DOP smoke test. For impregnated carbon filter efficiencies, see Table 6.5-4. The evaluation of off-site effects due to potential accidents has been made in accordance with Appendix 15B, assuming
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minimum carbon filter efficiencies of ~~99~~ percent for organic iodines and 95 percent for elemental iodines for the conservative case. The carbon filters use a deep bed design which provides a gas residence time of 0.5 seconds. 59
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APPROXIMATELY

6.5.1.3 Design Evaluation

a. Containment Enclosure Emergency Air Cleaning System (CEEACS) 59

The containment enclosure exhaust filter trains are redundant, to insure the maintenance of a negative pressure in the containment enclosure and related areas and to insure cleanup of the exhaust air following an accident. All safety-related equipment and ductwork supports have been designed and seismically analyzed to withstand and function through a Safe Shutdown Earthquake (SSE). The system is designed to limit off-site post accident doses to values below those specified in 10CFR100 (see Subsection 15.6.5 for evaluation of system performance). A single component failure will not result in loss of function of this ESF system.

In the unlikely event that an accident requiring filter operation occurs, both of the redundant filter train fans will be automatically started on the "T" signal (see Drawing 9763-M-503515) to provide an air flow velocity of approximately 40 fpm through their 44 45 associated filter beds. In the further unlikely event of failure of one operating fan, the ductwork cross-connection will provide redundant air flow from the redundant fan across the partially-loaded or fully loaded filter bed. 59

The following analyses have been performed to demonstrate the capability of the system to draw-down the containment enclosure building to a negative pressure of 0.25 inches of water gauge in less than 4 minutes:

1. Air In-Leakage Analysis

A calculation was performed to determine the containment enclosure building air in-leakage through various air flow paths such as electrical, piping and duct penetrations, concrete structure, construction joints, doors, seal plates, metal partitions, ducts and floor drains. Air in-leakages were determined using data from the penetration sealant supplier, analytical calculation and experimental leakage data provided in "Conventional Buildings for Reactor Containment - NAA-SR-10100 (1965)", issued by Atomics International, a Division of North American Aviation Incorporated. The calculated maximum in-leakage was 620 scfm which includes maximum leakage of 4 scfm from the primary containment at a rate of 0.2% of the primary containment volume for the first day following a design basis LOCA. The design capacity of the exhaust system is 2025 scfm. 59

THIS ASSUMPTION IS CONSERVATIVE BECAUSE PRIMARY CONTAINMENT LEAKAGE IS LIMITED TO 0.15% BY WEIGHT

Note: All drawings referenced in this section will be provided under a separate submittal to the NRC (see Section 1.7).

2. Air Change Analysis

An alternate calculation was performed considering one air change per day as the minimum required exhaust capacity of an exhaust system to produce the required negative pressure of 0.25 inches of water within the enclosure. This approach required 615 scfm exhaust capacity. The exhaust capacity actually provided is ~~2005~~ 2100 scfm which has the potential for exhausting 3.25 volumes per day. 59

The calculated wind speed that would initiate building exfiltration is 17 miles per hour. At this or at a higher wind velocity, any exfiltration will be adequately dispersed.

HEPA filters and carbon adsorbers were tested at the expected accident environmental conditions for this secondary system. Results indicated no degradation of filtering efficiency. Subsection 15.6.5 analysis conservatively assumes lower efficiencies.

The systems are designed to meet the intent of Regulatory Guides 1.4 and 1.52. See Table 6.5-1 for a discussion relative to conformance with Regulatory Guide 1.52, Rev. 2. 56

b. Fuel Storage Building Emergency Air Cleaning System (FSBEACS)

The fuel storage building exhaust filter trains are redundant, to insure cleanup capability and the ability to maintain a negative pressure following a fuel handling accident. All safety-related air handling equipment, equipment support and ductwork supports are designed to operate during and following an SSE. The system is designed to limit off-site post-accident doses to values not exceeding the requirements of 10CFR100 (see Chapter 15). Loss of one emergency exhaust filter train will not prevent the safety function from being performed. During fuel handling, only one set of filters and fan will normally be operating. In the unlikely event of an accident, the second set of filters and fan can be manually started to provide redundancy. The operating filter will provide an air flow velocity of approximately 40 fpm through its associate filter bed. In the further unlikely event of failure of the operating fan, the ductwork cross-connection will provide redundant air flow across the partially-loaded or fully-loaded filter bed. 59

HEPA filters and carbon adsorbers have been tested at the expected accident environmental conditions for this secondary system. Results indicated no degradation of filtering efficiency; however, conservative parameters based on Regulatory Guide 1.25 were used in the conservative analysis in Subsection 15.7.4. 56

The systems are designed to meet the intent of Regulatory Guides 1.25 and 1.52. See Table 6.5-2 for a discussion relative to conformance with Regulatory Guide 1.52, Rev. 2. 56

The iodine removal function and effectiveness of the containment building spray system is discussed in Subsection 6.5.2. This system will begin operation within 62 seconds after receipt of a LOCA-generated "P" signal, as described in Subsection 6.2.1.1.

The function of the containment isolation systems is discussed in Subsection 6.2.4.

No credit is taken for iodine removal by the containment online purge system since it is only operated intermittently during normal plant operation and will isolate on a containment isolation signal if operating at the onset of an accident. Radiological consequences of this occurence are addressed in Subsection 15.6.5.

The combustible gas control system hydrogen recombiners, permanently located inside the containment, are designed to be operational within seven days following a DBA as described in Subsection 6.2.5. Should both recombiners be inoperable for 50 days after the DBA, hydrogen concentration in the containment will be controlled by use of the hydrogen purge line to the plant vent via the containment enclosure emergency cleanup system described in Subsection 6.5.1.

6.5.3.2 Secondary Containment

The secondary containment is comprised of a reinforced concrete cylindrical structure with a concrete hemispherical dome, the engineered safety features (ESF) equipment cubicles, and the pipe and electrical penetration areas. 56

The release of airborne contamination following an accident due to leakage into the containment enclosure (the secondary containment) is controlled by a filtered exhaust system which maintains a subatmospheric (-0.25" W.G.) 56 pressure in each subcompartment. The containment enclosure emergency cleanup system (CEECS) is the only fission product control system in the secondary containment. This system directs a nominal 2000 cfm of charcoal filtered exhaust air to the plant vent. Actual exhaust flow rate will be the sum of the primary containment leakage (see Subsection 6.5.3.1) and the inleakage from the surrounding environment. The CEECS, which is powered by the emergency busses, starts up within 12 seconds and will establish the design 4 subatmospheric pressure of at least -0.25" W.G. within 3.09 minutes following the containment isolation signal, as described in Subsection 6.5.1. Iodine 56 removal efficiency of the charcoal beds is assumed to be 90% for organic 95 iodide and 95% for inorganic iodine for the conservative case; for the realistic case, the iodine removal efficiency is assumed to be 95% for organic iodines and 99% for inorganic iodines. CEECS fans are shown in Figure 6.5-2. 56

TABLE 6.5-4
(Sheet 2 of 2)

Component	Parameter
b. Batch Requirements	
Low Temperature Ambient Pressure Methyl Iodide at 95% RH and 30°C	97%
High Temperature Ambient Pressure Methyl Iodide at 95% RH and 80°C Except Pre and Post Sweep at 25°C	99%
Elemental Iodide Retention at 180°C	99.9% Loading 99.5% Retentivity
Media	Activated Coconut Shell Carbon
Impregnating Material	KI_3
Ignition Temperature (ASTM D3466)	330°C
Density (ASTM D2854)	0.38g/cc (min)
Hardness (ASTM D3802)	97%
Mesh Size (ASTM D2862)	5% Maximum Retention on 8 90-100% Thru 8 on 16 (8 x 12 Mesh 40-60%) (12 x 16 Mesh 40-60%) 5% Maximum Thru 16 1% Maximum Thru 18
Depth of carbon bed	4 inches
Total weight of carbon	804 lbs
Carbon Bed Envelope Material	Type 304 Stainless Steel
4) Filter Mounting Frames	Type 304 Stainless Steel
5) Filter System Housing	Epoxy Coated Carbon Steel
6) Ductwork	Galvanized Steel
7) Fan	Carbon Steel

56 58 45 56

NOTE: REFER TO CH. 15 APP. B FOR FILTER EFFICIENCIES ASSUMED FOR DESIGN BASIS ACCIDENTS.

TABLE 6.5-5
(Sheet 2 of 2)

Component	Parameter
Low Temperature Ambient Pressure Elemental Iodine at 95% RH and 30°C	99.9%
High Temperature Ambient Pressure Methyl Iodide at 95% RH and 80°C	99%
b. Batch Requirements	
Low Temperature Ambient Pressure Methyl Iodide at 95% RH and 30°C	97%
High Temperature Ambient Pressure Methyl Iodide at 95% RH and 80°C Except Pre and Post Sweep at 25°C	99%
Elemental Iodine Retention at 180°C	99.9% Loading 99.5% Retentivity
Media	Activated Coconut Shell Carbon
Impregnating Material	KI_3
Ignition Temperature (ASTM D3466)	330°C
Density (ASTM D2854)	0.38 g/cc (min)
Hardness (ASTM D3802)	97%
Mesh Size (ASTM D2862)	5% Maximum Retention on 8 90-100% Thru 8 on 16 (8 x 12 Mesh 40-60%) (12 x 16 Mesh 40-60%) 5% Maximum Thru 16 1% Maximum Thru 18
Depth of carbon bed	4 inches
Total weight of carbon	6500 lbs
Carbon bed envelope material	Type 304 Stainless Steel
5) Filter Mounting Frames	Type 304 Stainless Steel
6) Filter System Housing	Epoxy Coated Carbon Steel
7) Ductwork	Galvanized Steel
8) Fan	Carbon Steel

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58
45
56

NOTE: REFER TO CH.15 APP. B FOR FILTER EFFICIENCIES ASSUMED FOR DESIGN BASIS ACCIDENTS.

7.1.2.12 Conformance to Regulatory Guide 1.151

The recommendations of ISA Standard S67.02, 1980, as endorsed by Regulatory Guide 1.151, have been followed for the design and installation of safety-related instrument sensing lines, with the exceptions and clarifications listed below. See Subsections 7.1.2.2, 7.1.2.3 and 7.7.2 for discussion of specific sections.

1. The instrumentation defined as Category 1 by Regulatory Guide 1.97 is the only instrumentation considered to be required to monitor safety-related systems.

2. In clarification of paragraph 5.2.2 (2) of ISA S67.02, where instrument tubing penetrates a shield wall, measures have been taken to reduce potential personnel exposure for radiation "streaming" from radioactive sources unless the radiation from piping nearby would be the larger source of exposure. These measures have included:

   a. Locating penetrations high enough to eliminate a concern from a radiation protection stand point.

   b. Locating some penetrations so as to avoid a direct streaming path from the source of radiation.

   c. When the above two methods were not used, apply a radiation absorbing penetration sealant.

3. The sensing lines from safety-related HVAC ductwork are designed to the same standard as the ductwork.

4. The sealed sensing lines for containment pressure, wide range reactor coolant pressure and the reactor vessel level indication system (RVLIS) are Safety Class 2 and installed to requirements of ANSI B31.1, seismic Category 1, rather than ASME Class 2, as recommended by Regulatory Position C.2.b or ISA S67.02, Section 4.1. The sealed sensing lines are supplied by Westinghouse and are in accordance with their standard design.

   The containment penetration sleeve is part of the BOP scope and is ASME Class 2.

5. Common instrument taps are used for redundant sensors for pressurizer pressure and RCS flow (low pressure tap only). This is in conformance with the standard Westinghouse design. 56

→ INSERT "7.1A"

7.1.3 References

1. Gangloff, W. C. and Loftus, W. D., "An Evaluation of Solid State Logic Reactor Protection in Anticipated Transients," WCAP-7706-L, July, 1971 (Proprietary) and WCAP-7706, July, 1971. (Non-Proprietary).

2. Marasco, F. W. and Siroky, R. M., "Westinghouse 7300 Series Process Control System Noise Tests," WCAP-8892-A, June, 1977.

3. Letter dated April 20, 1977 from R. L. Tedesco (NRC) to C. Eicheldinger (Westinghouse).

INSERT "7.1 A"

[redacted]

6. An evaluation has been performed of those instrument lines which were downgraded in accordance with the provisions of this regulatory guide from ASME Class 2 or 3 to ANSI B31.1. This evaluation was done to determine if the failure of any of these lines would affect the safety function of the associated system. Where a passive failure of the instrument line would adversly affect the safety function of the system, an inspection of the line has been done to equivalent quality assurance requirements of ANS Safety Class 2 lines. Also , the lines have been installed to Seismic Category 1 criteria. Hence, a passive failure of one of these lines is not postulated to occur.

Figure 7.2-1, Sheet 5, shows the logic for overtemperature ΔT trip function.

(b) Overpower ΔT Trip

This trip protects against excessive power (fuel rod rating protection) and trips the reactor on coincidence as listed in Table 7.2-1, with one set of temperature measurements per loop. The setpoint for each channel is continuously calculated using the following equation:

$$\Delta T \left(\frac{1 + \tau_1 S}{1 + \tau_2 S}\right) \left(\frac{1}{1 + \tau_3 S}\right)$$

$$\leq \Delta T_o \left\{ K_4 - K_5 \left(\frac{\tau_7 S}{1 + \tau_7 S}\right) \left(\frac{1}{1 + \tau_6 S}\right) T - K_6 \left[T \left(\frac{1}{1 + \tau_6 S}\right) - T'' \right] - f_2(\Delta I) \right\}$$

Where:

ΔT = Measured ΔT by RTD manifold instrumentation;

τ_1, τ_2 = Time constants utilized in lead-lag controller for ΔT;

τ_3 = Time constant utilized in the lag compensator for ΔT;

ΔT_o = Indicated ΔT at rated thermal power;

K_4 = Preset bias;

K_5 = A constant which compensates for piping and instrument time delay;

τ_7 = Time constant utilized in rate-lag controller for T_{avg};

τ_6 = Time constant utilized in the measured T_{avg} lag compensator;

K_6 = A constant which compensates for the change in density flow and heat capacity of the water with temperature;

T = Average temperature ^oF;

T'' = Indicated T_{avg} at rated thermal power;

$f_2(\Delta I)$ = 0 for all ΔI

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S = Laplace transform operator, sec^{-1}

The stator windings are cooled by de-ionized water circulating in a closed loop between the generator and a generator stator cooling water unit on the ground floor. The heat absorbed by the de-ionized water is removed in a heat exchanger by the secondary component cooling water. Failure of the stator cooling water system initiates a unit power runback which reduces power to 22%.

10.2.2.3 Steam Extraction Connections

Turbine steam extraction connections are provided for six stages of feedwater heating. Steam is extracted from one stage of the high pressure turbine, from the high pressure turbine exhaust piping, and from four stages of the low pressure turbines. A combination of positively-assisted check valves in the extraction steam lines and automatically controlled heater drain valves protects the turbine against water induction. Check valves are provided in extraction steam lines 3 through 6. There are no check valves in extraction steam lines 1 and 2, since these lines are located within the condenser neck. However, in all cases, the combination of valving and heater drain valve controls is such that no single equipment failure will result in water entering the turbine. The check valves in extraction steam lines 3 through 6 will also provide additional protection against turbine overspeed following a load reduction. The extraction steam valves will close in less than 2 seconds under low flow conditions. The positive-assist action on the check valves is provided by spring-load air actuators. Limit switches on the air cylinders will allow plant personnel to verify, by periodic tests, that the operating pistons are free to move under the action of the spring when the air pressure is released. 55

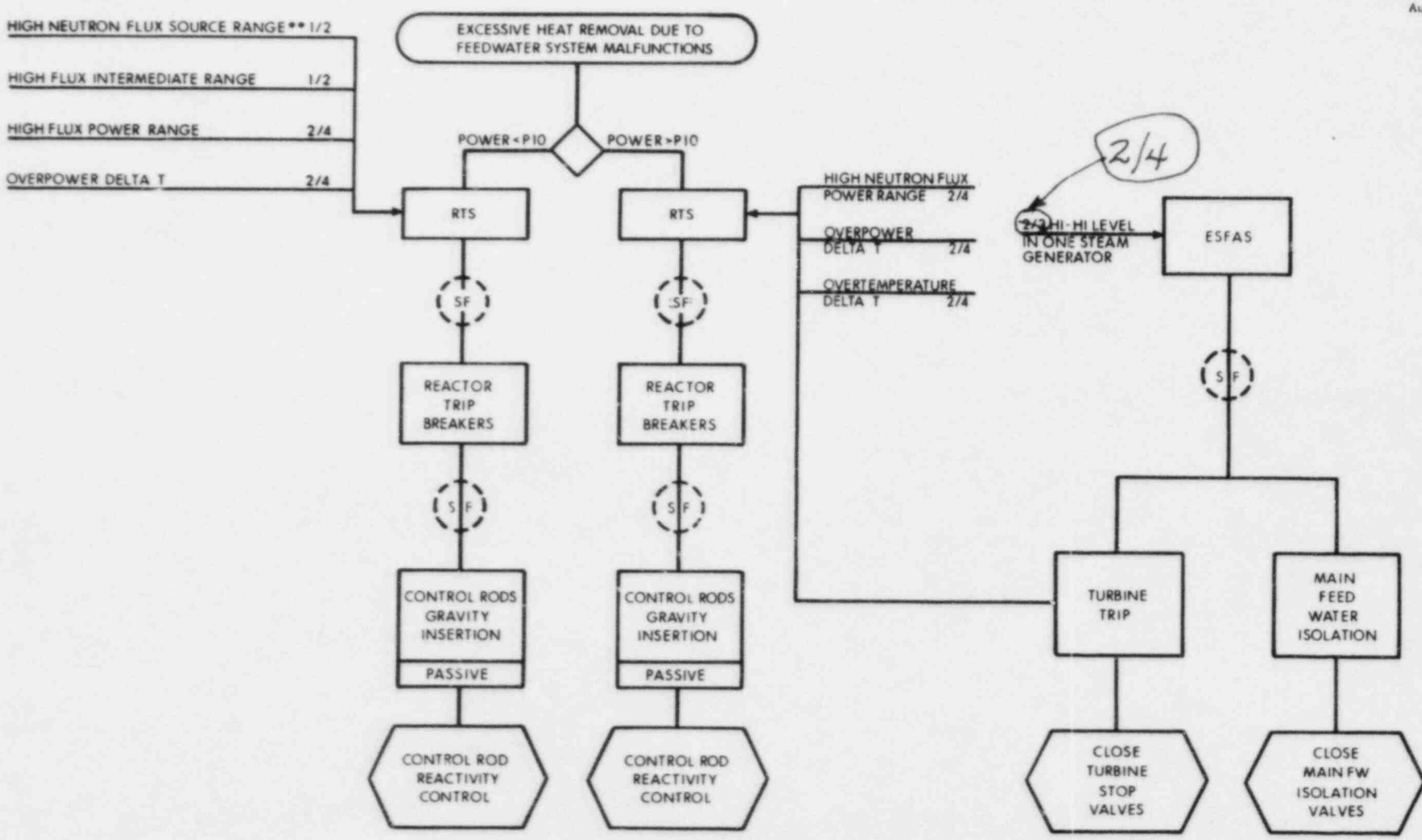
10.2.2.4 Automatic Controls

The automatic control functions are programmed to protect the reactor coolant system with appropriate corrective actions, as explained in Chapter 7. The turbine is tripped every time the reactor is tripped. A reactor trip is initiated upon a turbine trip above approximately ~~50%~~ 20% of full power.

The turbine generator is controlled and protected by an electro-hydraulic control system (EHC) that combines solid state electronic and high pressure hydraulic components to control the steam flow through the turbine. Single failure of any component will not lead to destructive overspeed. The probability of multiple failures involving undetected electronic faults and/or stuck valves at the instant of load loss is extremely low due to the high reliability of the control system components and periodic in-service testing and inspection of the main steam and intermediate reheat valves.

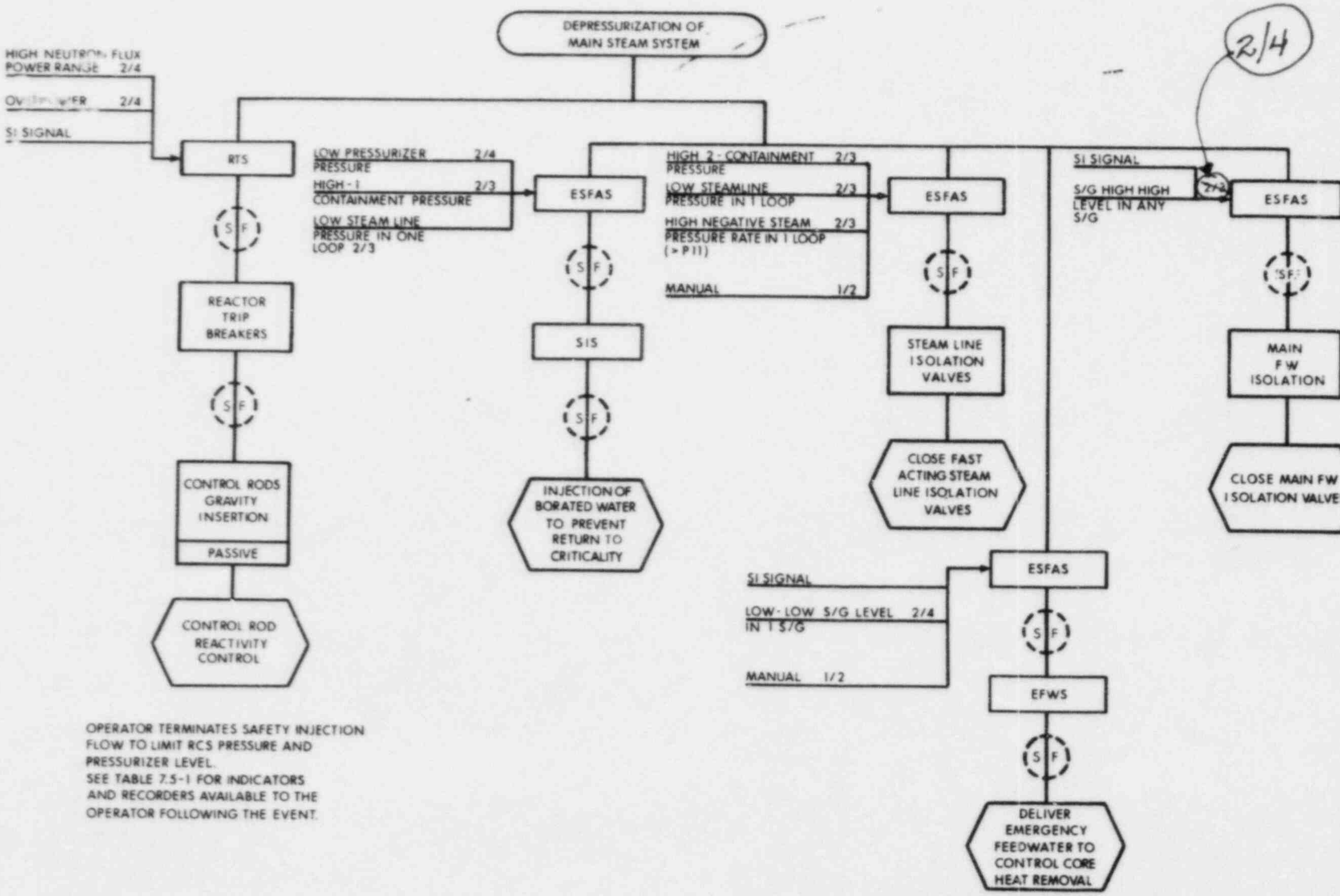
The EHC system consists of the following subsystems:

a. Speed Control Unit
b. Load Control Unit
c. Flow Control Unit



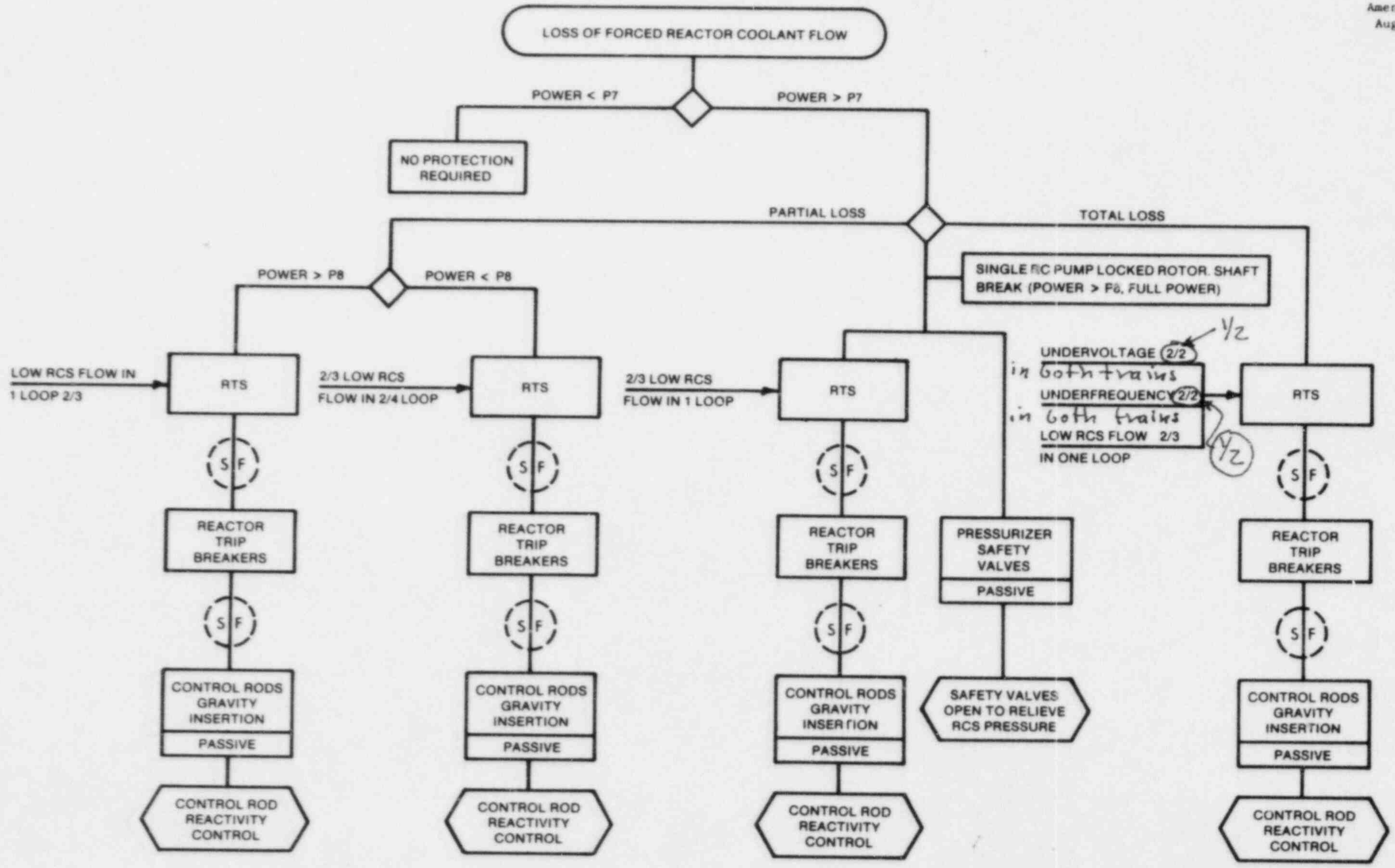
** FOR POWER < P6

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE SEABROOK STATION - UNITS 1 & 2 FINAL SAFETY ANALYSIS REPORT	FEEDWATER SYSTEM MALFUNCTION
	FIGURE 15.0-8

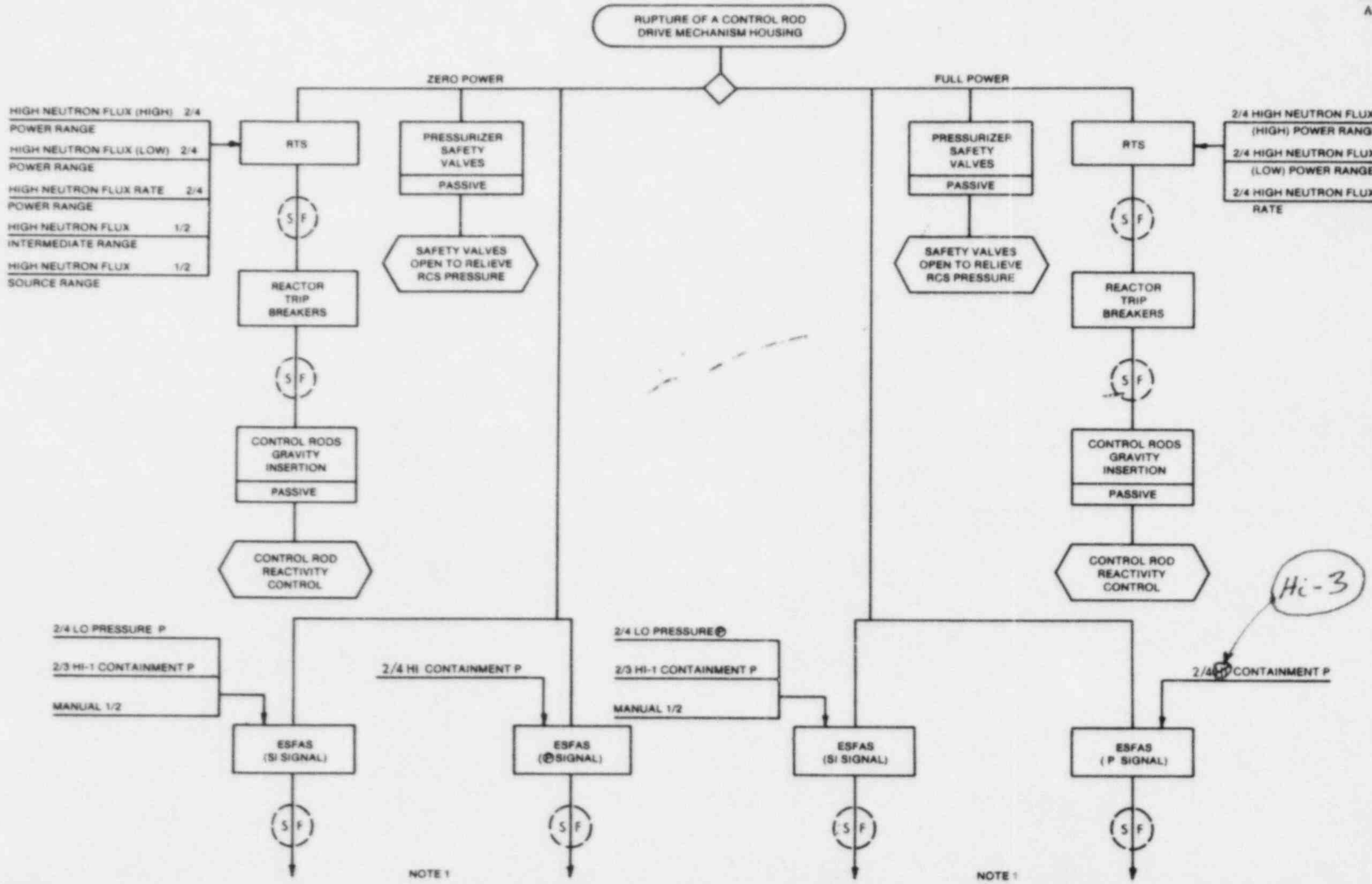


OPERATOR TERMINATES SAFETY INJECTION FLOW TO LIMIT RCS PRESSURE AND PRESSURIZER LEVEL.
SEE TABLE 7.5-1 FOR INDICATORS AND RECORDERS AVAILABLE TO THE OPERATOR FOLLOWING THE EVENT.

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE SEABROOK STATION - UNITS 1 & 2 FINAL SAFETY ANALYSIS REPORT	DEPRESSURIZATION OF MAIN STEAM SYSTEM
	FIGURE 15.0-10



PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE SEABROOK STATION - UNITS 1 & 2 FINAL SAFETY ANALYSIS REPORT	LOSS OF FORCED REACTOR COOLANT FLOW FIGURE 15.0-15



NOTE 1: SEQUENCE FOLLOWING ESFAS ACTUATION IS SIMILAR TO THAT FOR A SMALL LOSS OF COOLANT EVENT (LOCA)

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE SEABROOK STATION - UNITS 1 & 2 FINAL SAFETY ANALYSIS REPORT	RUPTURE OF CONTROL ROD DRIVE MECHANISM HOUSING
	FIGURE 15.0-21

15.4.5 A Malfunction or Failure of the Flow Controller in a BWR Loop That Results in an Increased Reactor Coolant Flow Rate

Not applicable to Seabrook.

15.4.6 Chemical and Volume Control System Malfunction That Results in a Decrease in the Boron Concentration in The Reactor Coolant

15.4.6.1 Identification of Causes and Accident Description

Reactivity can be added to the core by feeding makeup water into the reactor coolant system (RCS) via the reactor makeup portion of the chemical and volume control system (CVCS). A boric acid blend system is provided to permit the operator to match the boron concentration of reactor makeup water during normal charging to that in the RCS. The boric acid from the boric acid tank is blended with primary grade water in the blender and the composition is determined by the preset flow rates of boric acid and primary grade water on the control board. The CVCS is designed to limit, even under various postulated failure modes, the potential rate of dilution to a value which, after indication through alarms and instrumentation, provides the operator sufficient time to correct the situation in a safe and orderly manner.

The opening of the reactor makeup water (RMW) control valve and one of the stop valves provides a flow path to the RCS, which can dilute the reactor coolant. Inadvertent dilution from this source can be readily terminated by closing the control valve. The rate of addition of unborated makeup water to the RCS when it is not at pressure is limited by the capacity of the RMW pumps. Normally, only one RMW pump is operating while the other is on standby. In order for makeup water to be added to the RCS at pressure, at least one charging pump must be running in addition to a RMW pump. With the RCS at pressure, the maximum delivery rate is limited by the capacity of the charging pumps, which is more limiting than the capacity of the RMW pumps.

Information on the status of the RMW is continuously available to the operator. Lights are provided on the control board to indicate the operating condition of the pumps in the CVCS. Alarms are actuated to warn the operator if boric acid or demineralized water flow rates deviate from preset values as a result of system malfunction.

An additional source of unborated water which can dilute the reactor coolant is the boron thermal regeneration system (BTRS). Borated RCS water is depleted of boron as it passes through the BTRS.

The combined dilution capability from the RMW System and the BTRS potentially represents the worst possible case for RCS boron dilution. However, the BTRS is excluded as a potential source of unborated water during refueling, cold shutdown, and hot shutdown. Technical Specifications require that ~~this be redundantly accomplished by rendering the BTRS chiller compressor inoperable and bypassing the BTRS regenerative demineralizers~~. Thus, the limiting dilution flow rate during these three modes of operation is assumed to be the maximum flow capacity of ~~the RMW system~~. one RMW pump

one RMW pump and the BTRS be rendered inoperable in these modes 56

C. Valve Movement Times

Discussed in applicable accident analyses.

D. Adsorption and Filtration Efficiencies

1. Containment Enclosure Emergency Exhaust Filter Efficiencies:

Conservative Analysis

Elemental Iodine - 95%

Organic Iodine - ~~90%~~ 85%

Particulate Iodine - 95%

Realistic Analysis

Elemental Iodine - 99%

Organic Iodine - 95%

Particulate Iodine - 99%

Note: No credit for filters (Filter Efficiency = 0) for the first 8 minutes following the accident. No credit for mixing within the annulus region for the conservative analysis and 50% mixing credit for the realistic analysis. 56 58

Containment Enclosure Emergency Exhaust Filter By-Pass Fractions:

Conservative Analysis = 0.60 La 58

Realistic Analysis = 0.075 La 58

2. Fuel Storage Building Exhaust Filter Efficiencies:

Same as given above for Containment Enclosure Filters* except Organic Iodine – 90%

3. Control Room Makeup Air Intake Filter Efficiencies:

Conservative Analysis, not applicable.

Realistic Analysis

Elemental Iodine - 99%

Organic Iodine - ~~85%~~ 95%

Particulate Iodine - 99% 58

E. Recirculation System Parameters

Not applicable.

F. Containment Spray Parameters (Refer to Section 6.2.2 for details)

<u>Conservative Case</u>

λ(elemental) = 10.0 hr^{-1}

λ(organic) = 0.0 hr^{-1}

λ(particulate) = 0.45 hr^{-1}