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| DENTON,H.R. | Office of Nuclear Reactor Regulation, Director |

SUBJECT: Forwards Amend 7 to FSAR, in response to draft SER Open Items 132,156,157,198,199,203,204 & 207.

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JUN 30 1983

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
United States Nuclear Regulatory Commission
Washington, DC 20555

SHEARON HARRIS NUCLEAR POWER PLANT
UNIT NOS. 1 AND 2
DOCKET NOS. 50-400 AND 50-401
FINAL SAFETY ANALYSIS REPORT - AMENDMENT NO. 7

Dear Mr. Denton:

Carolina Power & Light Company (CP&L) hereby transmits three originals and sixty copies of Amendment No. 7 to the Shearon Harris Nuclear Power Plant (SHNPP) Final Safety Analysis Report (FSAR). This information is being submitted in response to the SHNPP Draft Safety Evaluation Report (DSER) CP&L Open Item Nos. 132, 156, 157, 198, 199, 203, 204, and 207.

An index of DSER Open Item responses, associated FSAR Safety Review Questions, and affected FSAR Sections is provided for your convenience.

Each revised page bears the amendment number. Only those changes which are technical in nature are indicated by vertical bars. Instructions for entering the revised pages are included.

As required by Commission regulations, this amendment is signed under oath by a duly authorized officer of CP&L.

Yours very truly,

M. A. McDuffie

M. A. McDuffie
Senior Vice President
Engineering & Construction

PS/mf (6789PSA)
Enclosures

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Sworn to and subscribed before me this 30th day of June, 1983

Lisa M. Randall
Notary (Seal)

LISA RANDALL NOTARY *** PUBLIC WAKE COUNTY, N.C.

My commission expires: 5/18/88

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# 9.1 FUEL STORAGE AND HANDLING

## 9.1.1 NEW FUEL STORAGE

### 9.1.1.1 Design Bases

In the event additional space is required, the new fuel pools are designed for the storage of both new PWR and spent PWR and BWR fuel. Consequently, they are designed for both wet and dry storage. The maximum storage capacity of these two pools is 762 PWR fuel assemblies with no BWR fuel or 108 BWR fuel assemblies with 654 PWR fuel assemblies. The actual number and type of assemblies being stored will vary depending on the total number of spent PWR and BWR fuel assemblies being stored in the Fuel Handling Building. Each new fuel storage pool, which stores fuel for two Units, has a storage capacity of more than 2/3 core. The fuel is stored in a combination of 6x5 PWR rack modules, 6x6 PWR rack modules, 6x4 PWR rack modules, 4x5 PWR rack modules, 5x5 PWR rack modules, and 9x9 BWR rack modules. The 6x6 PWR rack modules are interchangeable with the 9x9 BWR rack modules as these modules have the same floor embedment locations. The racks are designed for underwater removal and installation on existing pool floor embedments should rack arrangements be desired to provide additional storage capacity for spent BWR fuel assemblies. Rearrangement of the racks would have no effect on maximum stored fuel criticality.

Each rack consists of individual vertical cells fastened together through top and bottom supporting grid structures to form integral modules. These modules are bolted to anchors in the floor of the new fuel storage area to provide seismic restraint. The PWR rack modules have a center-to-center spacing of 13 in. between cells (see Figure 9.1.1-1). The BWR rack modules have a center-to-center spacing of 8.125 in. between cells (see Figure 9.1.1-2). These spacings are sufficient to maintain a subcritical array even in the event the pools are flooded with unborated water.

### 9.1.1.2 Facilities Description

The new fuel storage pools are located in the Fuel Handling Building as shown on Figures 1.2.2-55 through 1.2.2-59. 1

There are two new fuel pools, the first associated with Units 1 and 4 and the second with Units 2 and 3. These two pools are interconnected by means of a transfer canal which runs the length of the Fuel Handling Building. These pools are normally isolated by means of removable gates.

The new fuel pools are concrete structures with a stainless steel liner for compatibility with the pool water. Provisions are provided to limit and detect leakage of the new fuel pools as discussed in Section 9.1.3. A description of the pool liner is given in Section 9.1.3.

### 9.1.1.3 Safety Evaluation

The Fuel Handling Building is designed in accordance with Regulatory Guide 1.13, "Spent Fuel Storage Facility Design Basis," and provides protection to the fuel racks and other pieces of equipment against natural phenomena such as tornadoes, hurricanes, and floods as discussed in Sections 3.3, 3.4, and 3.5.

The design and safety evaluation of the fuel racks is in accordance with the NRC position paper, "Review and Acceptance of Spent Fuel Storage and Handling Applications."

The racks, being ANS Safety Class 3 and Seismic Category I structures, are designed to withstand normal and postulated dead loads, live loads, loads due to thermal effects, and loads caused by the operating bases earthquakes and safe shutdown earthquake events in accordance with Regulatory Guide 1.29, and stress allowables defined by ASME Code, Section III. The racks can withstand an uplift force equal to the maximum uplift capability of the spent fuel bridge crane.

The design of the racks is such that with the fuel of the highest anticipated enrichment (3.5 percent for PWR fuel, and 3.0 percent for BWR) and the pool flooded with unborated water, $K_{eff} \leq 0.95$. If the unborated water is replaced by other effective modulators such as foam or water mist, $K_{eff} \leq 0.98$.

Consideration is given to the inherent neutron absorbing effect of the materials of construction. Fuel handling accidents will not alter the rack geometry to the extent that the criticality acceptance criteria is violated. The criticality safety analysis is discussed in Section 4.3.2.6.

All materials used in construction are compatible with the storage pool environment, and all surfaces that come in contact with the fuel assemblies are made of annealed austenitic stainless steel.

## 9.1.2 SPENT FUEL STORAGE

### 9.1.2.1 Design Bases

In the event additional space is needed, the spent fuel pools are designed for the storage of both PWR fuel and BWR fuel. The maximum storage capacity of the two spent fuel pools is 2024 PWR assemblies with no BWR fuel, or 2916 BWR assemblies with 728 PWR assemblies. Thus, the total storage capacity of both the new and spent fuel pools is 2786 PWR assemblies with no BWR fuel, or 3024 BWR assemblies with 1382 PWR assemblies. The actual number and type of assemblies being stored will vary. This capacity exceeds the storage requirements of 2 2/3 cores of Shearon Harris fuel. The additional capacity would be available for the storage of spent fuel from other nuclear plants in the CP&L system, should the need arise. 1

The fuel is stored in a combination of 6x5 PWR rack modules, 4x5 PWR rack modules, 5x5 PWR rack modules, 6x6 PWR rack modules, 6x4 PWR rack modules, and 9x9 BWR rack modules. The 6x6 PWR rack modules are interchangeable with the 9x9 BWR rack modules as these rack modules have the same floor embedment locations. The racks are designed for underwater removal and installation on existing pool floor embedments should rack rearrangements be desired. Rearrangement of the racks would have no effect on maximum stored fuel criticality.

Each rack consists of individual vertical cells fastened together through top and bottom supporting grid structures to form integral modules. These modules are bolted to anchors in the floor of the spent fuel storage area to provide seismic restraint. The PWR rack modules have a center-to-center spacing of 13 in. between cells. The BWR rack modules have a center-to-center spacing of 8.125 in. between cells. These spacings are sufficient to maintain a subcritical array of $K_{eff} \leq 0.95$ even in the event the fuel pools are flooded with unborated water.

The design of the spent fuel storage racks precludes fuel insertion in other than prescribed locations, thereby preventing any possibility of accidental criticality. A lead-in opening is provided for each storage location, and the storage cells provide full length guidance for the fuel assembly. PWR fuel assemblies will not fit in a BWR spent fuel rack. Insertion of a BWR fuel assembly into a PWR spent fuel rack will result in a subcritical array of $K_{eff} \leq 0.95$.

### 9.1.2.2 Facilities Description

The spent fuel storage facility is located in the Fuel Handling Building as shown in Figures 1.2.2-55 through 1.2.2-59. The spent fuel is transferred from the Containment to the fuel transfer canal through the fuel transfer tube. The spent fuel bridge crane is used to transport the spent fuel to the spent fuel racks and later to the spent fuel cask. This procedure is carried out with the spent fuel assemblies totally submerged.

There are two spent fuel pools, the first associated with Units 1 and 4 and the second with Units 2 and 3. These two pools are interconnected by means of the main fuel transfer canal which runs the length of the Fuel Handling Building. These pools are normally isolated by means of removable gates.

The spent fuel pools are concrete structures with a stainless steel liner for compatibility with the pool water. Provisions are provided to limit and detect leakage of the spent fuel pools as discussed in Section 9.1.3. A description of the pool liner is given in Section 9.1.3.

9.1.2.3 Safety Evaluation

The Fuel Handling Building is designed in accordance with Regulatory Guide 1.13, "Spent Fuel Storage Facility Design Basis," and provides protection to the fuel racks and other pieces of equipment against natural phenomena such as tornadoes, hurricanes and floods as discussed in Sections 3.3, 3.4, and 3.5.

The design and safety evaluation of the fuel racks is in accordance with the NRC position paper, "Review and Acceptance of Spent Fuel Storage and Handling Applications."

The racks, being ANS Safety Class 3 and Seismic Category I structures, are designed to withstand normal and postulated dead loads, live loads, loads due to thermal effects, loads caused by the operating bases earthquakes, and safe shutdown earthquake events in accordance with Regulatory Guide 1.29, and stress allowables defined by ASME Code, Section III.

Consideration is given to the inherent neutron absorbing effect of the materials of construction. The design of the racks is such that $K_{eff} \leq 0.95$ under all conditions, including fuel-handling accidents. Due to the close spacing of the cells, it is impossible to insert a fuel assembly in other than design locations. Inadvertent insertion of a fuel assembly between the rack periphery and the pool wall is considered a postulated accident and, as such, realistic initial conditions such as boron in the water can be taken into account. This condition has an acceptable $K_{eff}$ less than 0.95. A discussion of the criticality analysis is provided in Section 4.3.2.6.

The racks are also designed with adequate energy absorption capabilities to withstand the impact of a dropped fuel assembly from the maximum lift height of the spent fuel bridge crane. Handling equipment capable of carrying loads heavier than a fuel assembly is prevented by interlocks or administrative controls, or both, from traveling over the fuel storage area. When such loads must travel over the spent fuel storage area, redundant holding systems as described in Table 9.1.4-1 are used. The racks can withstand an uplift force equal to the maximum uplift capability of the spent fuel bridge crane.

All materials used in construction are compatible with the storage pool environment, and all surfaces that come into contact with the fuel assemblies are made of annealed austenitic steel. All the materials are corrosion resistant and will not contaminate the fuel assemblies or pool environment.

Shielding considerations are discussed in Section 12.3. Radiological conditions associated with the fuel handling accident are discussed in Section 15.7.

## 9.1.3 FUEL POOL COOLING AND CLEANUP SYSTEM

### 9.1.3.1 Design Basis

The design bases for the Fuel Pool Cooling and Cleanup System (FPCCS) are as follows:

a) Each of the two fuel storage facilities consists of a new fuel pool, a spent fuel pool, two 100 percent cooling systems, and cleanup equipment to remove the particulate and dissolved fission and corrosion products resulting from the spent fuel.

b) Fuel can be transferred between the storage facilities, as shown on Figure 1.2.2-55.

c) The FPCCS is designed to maintain water quality in the fuel storage pools and remove residual heat from the spent fuel.

d) The cooling system serving one fuel storage facility has been designed to remove heat loads generated by the quantities of fuel stored in the pool as indicated in Table 9.1.3-1.

The fuel pool loading schedule, heat loads, equilibrium temperatures, heat-up times and equipment design data are presented in Tables 9.1.3-1 and 9.1.3-2.

e) The maximum pool temperature with the maximum heat load occurring simultaneously with a loss of a single fuel pool cooling loop will be 145 F. The pool concrete design temperature is 150 F.

The determinations of the fuel pool heatup times indicated in Table 9.1.3-2 were calculated using the following assumptions:

1) No credit for operation of the FPCCS.

2) No evaporative heat losses.

3) No heat absorption by concrete or liner.

4) No water interchange between fuel pools and/or transfer canal.

f) The cleanup loop pumps have the capacity to provide makeup water at a rate greater than the loss of water due to normal system leakage and evaporation.

g) Safe water level (and thus sufficient radiation shielding) is maintained in the new and spent fuel pools since the cooling connections are at the top of the pools.

h) Components and structures of the system are designed to the safety class and seismic requirements indicated in Table 3.2.1-1.

i) The FPCCS will perform its safety related function assuming a single active failure.

### 9.1.3.2 System Description

Two Fuel Pool Cooling and Cleanup Systems are provided as shown on Figures 9.1.3-1, 9.1.3-2, 9.1.3-3, and 9.1.3-4. Each FPCCS is common to two Units and is comprised of a new fuel pool, a spent fuel pool, a transfer canal, two fuel pool heat exchangers, two fuel pool cooling pumps, two fuel pool strainers, a fuel pool demineralizer, fuel pool demineralizer filter, a fuel pool and a refueling water purification filter, two fuel pool and refueling water purification pumps, five spent fuel pool skimmers, three new fuel pool skimmers, two transfer canal skimmers, one main transfer canal skimmer, one cask loading pool skimmer (Unit 1 & 4 FPCCS only), a fuel pool skimmer pump, a fuel pool skimmer strainer, and a fuel pool skimmer filter.

The two spent fuel pools are interconnected by the main fuel transfer canal (see Figure 1.2.2-55). The spent fuel is placed in the spent or new fuel pool during refueling, and stored until it is shipped to a reprocessing facility or otherwise disposed.

The new fuel pools are also interconnected by the main fuel transfer canal. In case of spent fuel pool unavailability, cooling of spent fuel can be accomplished in the new fuel pools since they are serviced by the fuel pool cooling system. Gates are provided to isolate the new fuel pools so that new fuel can be stored dry.

The common Fuel Handling Building is centrally located adjacent to the four Containment Buildings and is designed to Seismic Category I requirements and to the tornado criteria as stated in Section 3.3.

The fuel pools in the Fuel Handling Building will not be affected by any loss of coolant accident in the Containment Buildings. The water in the pools is isolated from that in the refueling cavity during most of the refueling operation. Only a very small amount of interchange of water will occur as fuel assemblies are transferred during refueling.

Each FPCCS is designed for removal of sensible heat from the pool water equivalent to the decay heat generated by approximately 4 1/3 complete cores and additional fuel assemblies from the H. B. Robinson and Brunswick plants as shown in Table 9.1.3-1. For this mode of operation, the equilibrium temperature in the pool is approximately 125 F, with both pumps and both heat exchangers per FPCCS operating. With only one pump and one heat exchanger operating the equilibrium temperature in the pool is approximately 145 F. The location of the inlet and outlet connections to the pool precludes the possibility of coolant flow "short circuiting" the pool.

The clarity and purity of the fuel pool water is maintained when desired or necessary by passing approximately five percent of the cooling system flow through a cleanup loop consisting of two filters and a demineralizer. The fuel pool cooling pump suction line, which can be used to lower the pool water level, penetrates the fuel pool wall approximately 18 ft. above the fuel assemblies. The penetration location precludes uncovering the fuel assemblies as a result of a postulated suction line rupture.

### 9.1.3.3 Safety Evaluation

All fuel pools are cooled by two independent cooling loops, either of which can remove the decay heat loads generated by the quantities of fuel on Table 9.1.3-1. Each fuel pool cooling water heat exchanger will receive component cooling water from separate headers of the Component Cooling Water System (Section 9.2.2).

To assure reliability, each of the fuel pool cooling pumps is powered from two separate buses so that each pump receives power from a different source. If a total loss of offsite power should occur, the operator has the option of transferring the pumps to the emergency power source. The operator also has the option of transferring the power source of each of the fuel pool cooling pumps to an emergency power source of another unit. Thus, the Unit 1 & 4 fuel pool cooling pumps may be powered from the Unit 1 or Unit 4 emergency power source and the Unit 2 & 3 fuel pool cooling pumps may be powered from the Unit 2 or Unit 3 emergency power source. Details of this transfer are given in Section 8.3.

In addition, emergency cooling connections are provided in the loops to permit the installation of portable pumps to bypass the fuel pool cooling pumps should they become inoperable when cooling is required in either pool.

Compliance of the Fuel Pool Cooling and Cleanup System to the guidance of NRC Regulatory Guide No. 1.13, "Fuel Storage Facility Design Basis," is addressed in Section 1.8.

The cooling loop piping and components are designed to Seismic Category I criteria. The cleanup loop is not designed to Seismic Category I criteria; however, suitable valving is provided between the cooling loop and the cleanup loop to permit isolation of the cleanup loop. The cooling loop portion of the FPCCS is protected against externally generated missiles. The fuel pool cooling pumps and associated piping are located in an area of the plant where there are no postulated internally generated missiles. The fuel pool cooling pumps have not been considered credible sources of internally generated missiles. The no-load speed of the pumps is equal to the synchronous speed of the electric motors; consequently, there are no pipe-break plus single failure combinations which could result in a significant increase in pump suction or discharge head. In addition, the FPCCS is protected against the effects of high energy and moderate energy fluid system piping failures (Section 3.6).

The FPCCS is manually controlled and may be shut down safely for reasonable time periods for maintenance or replacement of malfunctioning components.

Whenever a leaking fuel assembly is transferred from the fuel transfer canal to the spent fuel pool, a small quantity of fission products may enter the fuel pool cooling water. The cleanup loop is provided to remove fission products and other contaminants from the water.

The cleanup loop will normally be run on an intermittent basis as required by fuel pool water conditions. It will be possible to operate the purification system with either the ion exchanger or filter bypassed. Local sample points are provided to permit analysis of ion exchanger and filter efficiencies.

In the event of a high radiation alarm in the Fuel Handling Building, the purification system will be manually started. The cleanup loop is not started automatically since the short delay to manually initiate purification would not significantly speed the reduction of contamination in the pool.

The skimmer system for the new and spent fuel pools consists of surface skimmers, a skimmer pump and filter. The surface skimmers float on the water surface and are connected via flexible hose to the pump suction piping at various locations on the perimeter of the pools. Flow from the pump is routed through the skimmer filter and returned to the fuel pools below the water level.

Syphoning of the pools is prevented by limiting the skimmer hose length to approximately five (5) feet. In addition, the skimmer system return piping enters the pool at a point five (5) feet below the normal pool water level and
5 terminates flush with the pool liner. Therefore, water loss due to failures in the skimmer system piping would be limited to five (5) feet.

A failure of the skimmer system piping would not uncover spent fuel nor interrupt fuel pool cooling since the fuel pool cooling water suction connections are located more than five (5) feet below the normal water level.

Draining or syphoning of the spent and new fuel pools via piping or hose connections to these pools or transfer canals is precluded by the location of the penetrations, limitations on hose length and termination of piping penetrations flush with the liner. The slow heatup rate of the fuel pool would allow sufficient time to take any necessary action to provide adequate cooling using the backup provided while the cooling capability for the fuel pool is being restored.

Normal makeup water to the fuel pool is supplied by either of two Seismic Category I refueling water storage tanks through two separate and independent supply systems. A backup system for filling the fuel pool is available through valved and flanged emergency connections which can be connected to a Seismic Category I water source. This method is for use during construction in the interim period in which only one Unit is operational.

Makeup water is normally pumped to the pool by the fuel pool cooling pumps and may be pumped by the fuel pool cleanup loop pumps. Each of these pumps has the capacity to provide makeup water at a rate greater than the loss of water resulting from normal system leakage and evaporation.

Floor and equipment drain sumps and pumping systems are provided to collect and transfer FPCCS leakage to the Waste Management System. High level alarms are annunciated in the Control Room when high sump level is reached.

Fuel handling equipment is designed such that the equipment cannot fall into the pool under SSE conditions (Section 9.1.4). In addition, the Fuel Handling Building is tornado missile resistant (Section 3.5).

The new fuel pools and spent fuel pools are furnished with stainless steel liners. Although they are classified as non-Nuclear Safety, the fuel pool liners are designed and constructed to the applicable portions of the ASME

TABLE 9.1.3-1

FUEL POOL COOLING AND CLEANUP SYSTEM
MAXIMUM FUEL POOL HEAT LOAD

| TIME AFTER SHUTDOWN x $10^3$ SEC. | REACTOR OPERATING TIME x $10^3$ SEC. | FUEL SOURCE (POWER PLANT) | NUMBER OF ASSEMBLIES | FUEL TYPE | OPERATING POWER (MWt) | HEAT LOAD x $10^6$ BTU/HR. |
|---|---|---|---|---|---|---|
| 554169 | 85,104 | HBR | 47 | PWR | 2200 | .16282 |
| 507081 | 85,104 | HBR | 38 | PWR | 2200 | .15071 |
| 495331 | 103,421 | BSEP | 4 | BWR | 2436 | .00493 |
| 448416 | 103,421 | BSEP | 68 | BWR | 2436 | .07061 |
| 436406 | 85,104 | HBR | 9 | PWR | 2200 | .02795 |
| 406080 | 103,421 | BSEP | 104 | BWR | 2436 | .09333 |
| 401760 | 103,421 | BSEP | 60 | BWR | 2436 | .05385 |
| 398390 | 85,104 | HBR | 52 | PWR | 2200 | .15157 |
| 371088 | 103,421 | BSEP | 68 | BWR | 2436 | .07313 |
| 367545 | 103,421 | BSEP | 58 | BWR | 2436 | .06423 |
| 365731 | 85,104 | HBR | 52 | PWR | 2300 | .18106 |
| 335059 | 85,104 | HBR | 48 | PWR | 2300 | .17505 |
| 333675 | 103,421 | BSEP | 70 | BWR | 2436 | .07580 |
| 325209 | 103,421 | BSEP | 72 | BWR | 2436 | .08384 |
| 302140 | 103,421 | BSEP | 72 | BWR | 2436 | .08491 |
| 291995 | 103,421 | BSEP | 74 | BWR | 2436 | .08727 |
| 270604 | 103,421 | BSEP | 62 | BWR | 2436 | .08415 |
| 259545 | 103,421 | BSEP | 86 | BWR | 2436 | .13076 |
| 239068 | 103,421 | BSEP | 10 | BWR | 2436 | .01602 |
| 228009 | 103,421 | BSEP | 2 | BWR | 2436 | .00307 |
| 206236 | 80,352 | SHNPP | 52 | PWR | 2900 | .32425 |
| 172108 | 80,352 | SHNPP | 52 | PWR | 2900 | .32753 |
| 142646 | 80,352 | SHNPP | 52 | PWR | 2900 | .33081 |
| 99532 | 80,352 | SHNPP | 52 | PWR | 2900 | .34391 |
| 82771 | 85,104 | HBR | 42 | PWR | 2300 | .36322 |

TABLE 9.1.3-1 (Continued)

FUEL POOL COOLING AND CLEANUP SYSTEM
MAXIMUM FUEL POOL HEAT LOAD

| TIME AFTER SHUTDOWN x $10^3$ SEC. | REACTOR OPERATING TIME x $10^3$ SEC. | FUEL SOURCE (POWER PLANT) | NUMBER OF ASSEMBLIES | FUEL TYPE | OPERATING POWER (MWt) | HEAT LOAD x $10^6$ BTU/HR. |
|---|---|---|---|---|---|---|
| 67996 | 80,352 | SHNPP | 52 | PWR | 2900 | .52405 |
| 51235 | 85,104 | HBR | 17 | PWR | 2300 | .20237 |
| 45964 | 80,352 | SHNPP | 52 | PWR | 2900 | .70751 |
| 36460 | 80,352 | SHNPP | 52 | PWR | 2900 | .75326 |
| 14428 | 80,352 | SHNPP | 52 | PWR | 2900 | 1.76853 |
| 4924 | 80,352 | SHNPP | 52 | PWR | 2900 | 3.68475 |
| 1295 | 80,352 | SHNPP | 52 | PWR | 2900 | 7.40226 |
| 554 | 4,838 | SHNPP | 157 | PWR | 2900 | 21.59249 |

TOTAL 40.10684 x $10^6$ Btu/Hr

NOTES:

(1) Heat loads were calculated using the procedures utilized in Branch Technical Position APCSB 9-2 and the reactor operating times, initial reactor operating power, and time after shutdown shown in the Table.

(2) For a full core discharge, the following reactor irradiation times were assumed: 1/3 of the core operating for 90 days, 1/3 of the core operating for one year + 90 days, and the other 1/3 of the core operating for two years + 90 days.

TABLE 9.1.3-2

FUEL POOL COOLING AND CLEANUP SYSTEM PARAMETERS

| | |
|---|---|
| Fuel Pool Heat Loads (one end of Fuel Handling Building) | |
| Maximum (approximately 1-2/3 core, plus fuel from other plants) | $40.1 \times 10^6$ |
| | |
| Fuel Pool Equilibrium Temperature | |
| Maximum load, two cooling loops operating, F | 125 |
| Maximum load, one cooling loop operating, F | 145 |
| | |
| Spent Fuel Pool Water Heat Inertia, No Heat Removal | |
| Time to heat from 125 to 150F, hr. (maximum load) | 1.72 |
| Time to heat from 145 to 150F, hr. (maximum load) | .345 |
| | |
| Fuel Pool Heat Exchanger | |
| Quantity (per FPCCS) | 2 |
| Type | Shell and Two Pass Straight Tube |
| UA (per Heat Exchanger), Btu/hr.-F | $21.1 \times 10^5$ |
| | |
| Shell Side (Component Cooling Water) | |
| Inlet temperature, F | 105 |
| Outlet temperature, F | 110 |
| Flowrate, lb./hr. | $3.147 \times 10^6$ |
| Design pressure, psig | 150 |
| Design temperature, F | 200 |
| Material | Carbon Steel |
| | |
| Tube Side (Fuel Pool Water) | |
| Inlet temperature, F | 120 |
| Outlet temperature, F | 113 |
| Flowrate, lb./hr. | $2.256 \times 10^6$ |
| Design pressure, psig | 150 |
| Design temperature, F | 200 |
| Material | Stainless Steel |

TABLE 9.1.3-2 (Continued)

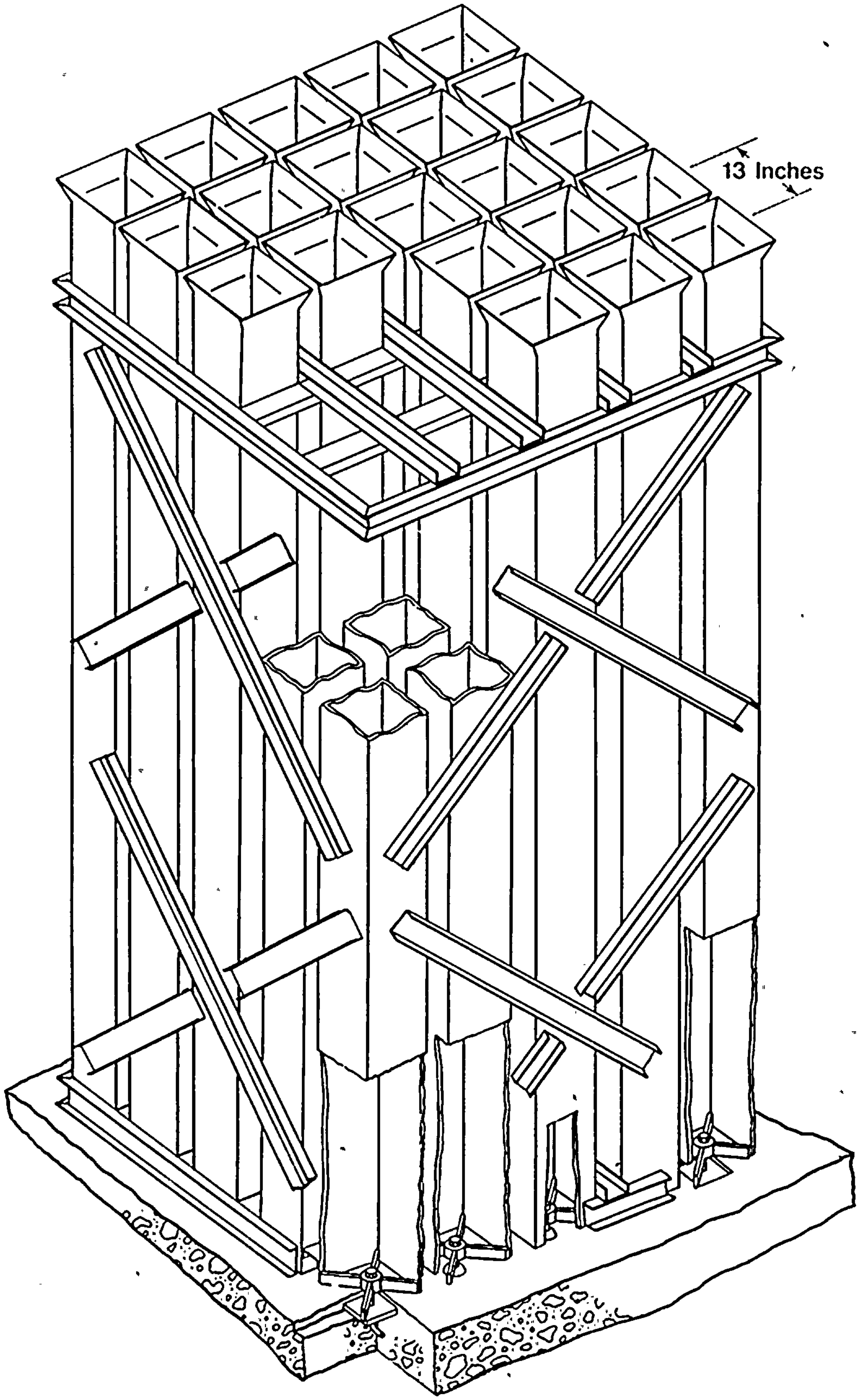
FUEL POOL COOLING AND CLEANUP SYSTEM PARAMETERS

| | | |
|---|---|---|
| **Fuel Pool Cooling Pump** | | |
| Quantity (per FPCCS) | 2 | |
| Type | Horizontal Centrifugal | |
| Design flowrate, gpm | 4800 | |
| TDH, ft. $H_2O$ | 95 | |
| Motor horsepower | 150 | |
| Design pressure, psig | 150 | |
| Design temperature, F | 200 | |
| Material | Stainless Steel | |
| **Spent Fuel Pool** | | |
| Volume (per Spent Fuel Pool), gals. | 403,920 | |
| Boron concentration, ppm | 2,000 | |
| Liner material | Stainless Steel | |
| **New Fuel Pools** | Pool 1 & 4 | Pool 2 & 3 |
| Volume (per New Fuel Pool), gals. | 147,804 | 191,480 |
| Boron concentration, ppm | 2,000 | 2,000 |
| Liner material | Stainless Steel | |
| **Fuel Pool Demineralizer Filter** | | |
| Quantity (per FPCCS) | 1 | |
| Type | Flushable | |
| Design pressure, psig | 400 | |
| Design temperature, F | 200 | |
| Flow, gpm | 325 | |
| Maximum differential pressure across filter element at rated flow (clean filter), psi | 5 | |
| Maximum differential pressure across filter element prior to backflush, psi | 60 | |

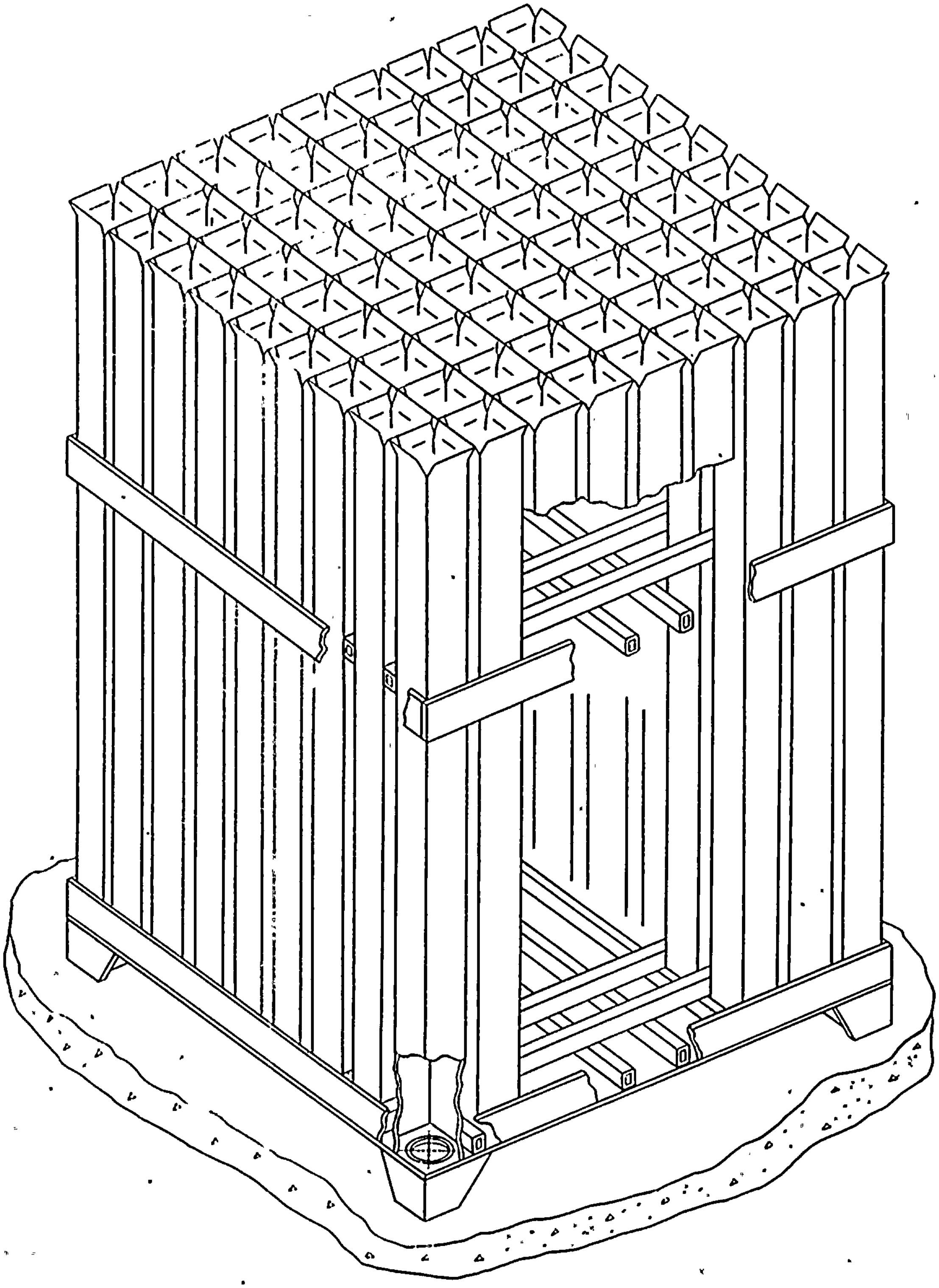
TABLE 9.1.3-2 (Continued)

FUEL POOL COOLING AND CLEANUP SYSTEM PARAMETERS

| | | |
|---|---|---|
| Fuel Pool Cooling and Cleanup System Piping and Valves | | |
| Material | Stainless Steel | |
| Design pressure, psig | 150 | |
| Design temperature, F | 200 | |
| Fuel Pool Skimmers | Quantity | gpm each |
| Spent Fuel Pool (per FPCCS) | 5 | 35 |
| New Fuel Pool (per FPCCS) | 3 | 30 |
| Fuel Transfer Canal (per FPCCS) | 2 | 25 |
| Main Fuel Transfer Canal (per FPCCS) | 1 | 20 |
| Cask Loading Pool (Unit 1 & 4 FPCCS only) | 1 | 50 |




| SHEARON HARRIS<br>NUCLEAR POWER PLANT<br>Carolina<br>Power & Light Company<br>FINAL SAFETY ANALYSIS REPORT | Typical 13 Inch Fuel Rack Module | FIGURE<br>9.1.1-1 |
|---|---|---|



NOTE: CENTER TO CENTER SPACING 8.125 INCHES.

| | | |
|---|---|---|
| SHEARON HARRIS<br>NUCLEAR POWER PLANT<br>Carolina<br>Power & Light Company<br>FINAL SAFETY ANALYSIS REPORT | TYPICAL 8.125 INCH<br>BWR FUEL RACK MODULE | FIGURE<br>9.1.1-2 |

Table 9.4.4-1. The ventilation system is a once-through type and consists of a supply system and a filtered exhaust system.

a) Supply System - The supply system consists of an outside air intake louver with bird screen and evaporative air cooler. The evaporative air cooler includes, in the direction of airflow, a pneumatic damper, a medium efficiency filter, an electric heating coil, an air washer and two 100 percent capacity centrifugal fans, arranged in parallel (one operating -one standby). Each fan is provided with a pneumatic inlet damper and discharge damper to prevent air recirculation through the idle fan.

The fan inlets are connected to a common plenum and air is drawn from outside through the system and continuously supplied to the condensate polishing demineralizer areas, corridor areas and H&V Equipment Room through a sheet metal ductwork distribution system.

b) Filtered Exhaust System - The Condensate Polishing Demineralizer Areas Exhaust System consists of a filtered exhaust unit. The exhaust unit includes, in the direction of air-flow a medium efficiency filter, HEPA filter, charcoal adsorber, and two 100 percent capacity centrifugal fans, arranged in parallel (one operating - one standby). Each fan is provided with variable inlet vanes and a pneumatic discharge damper to prevent air recirculation through the idle fan.

Air is continuously exhausted from the potentially contaminated spaces of the condensate polishing demineralizer area, through the filter system and discharged to the atmosphere.

A bypass duct with pneumatic isolation dampers is provided for the filtration system so that during maintenance of filters, charcoal adsorber and HEPA filter air can be continuously exhausted from condensate polishing demineralizer areas.

9.4.4.2.2 Electrical and Battery Room Ventilation System

The Electrical and Battery Room Ventilation System is shown on Figure 9.4.4-1. Design data for principal system components are presented in Table 9.4.4-2. The ventilation system is a once-through type during summer operation and a major part of the system for the electrical equipment room is an economizer cycle type during winter season. The Electrical and Battery Room Ventilation System consists of a supply unit and a separate exhaust unit for the battery room.

The supply unit includes, in the direction of airflow, an outside air intake louver with bird screen, an automatic isolation damper, a medium efficiency filter, an electric heating coil and two 100 percent capacity centrifugal fans, arranged in parllel (one operating - one standby). Each fan is provided with a pneumatic discharge damper to prevent air recirculation through the idle fan. Air is drawn from outside through the air handling unit and supplied to the electrical equipment room and battery room.

A separate exhaust system is provided for the battery room and air from the electrical equipment room is discharged to atmosphere through louvers. The exhaust system for the battery room consists of two 100 percent, centrifugal fans (one operating - one standby), with automatic pneumatic inlet dampers to prevent air recirculation through the idle fan. In addition, a separate zone electric re-heat coil is provided in the air supply duct of the battery room ventilation system to maintain proper supply air temperature. A large portion of air from the electrical equipment room is returned to the air handling unit for recirculation during winter conditions.

#### 9.4.4.2.3 General Service Switchgear Room and Cable Vault Ventilation System

The General Service Switchgear Room and Cable Vault Ventilation System is shown on Figure 9.4.4-1. Design data for principal system components are presented in Table 9.4.4-3. The ventilation system for the general service switchgear room will be a once-through type during summer operation and an economizer cycle during winter operation. The ventilation system consists of a supply unit which includes in the direction of airflow, an outside air intake louver with bird screen, an automatic isolation damper, a medium efficiency filter, an electric heating coil and two 100 percent capacity fans arranged in parallel (one operating - one standby). Each fan is provided with a discharge isolation damper to prevent air recirculation.

Air is supplied to the switchgear rooms through louvers and discharged to the
atmosphere through gravity dampers; each louver is provided with an isolation
2 damper. Some air from the switchgear rooms is returned to the air handling
units for recirculation.

The cable vault area is ventilated by the same supply unit of the switchgear ventilation system. Air is supplied to the area and discharged to the atmosphere through a louver located in the switchgear room with ductwork connection.

#### 9.4.4.2.4 Condensate Vacuum Pump Effluent Treatment System

The Condensate Vacuum Pump Effluent Treatment System (CVPETS) is shown on Figure 9.4.4-1. Design data for principal system components are presented in Table 9.4.4-4. The treatment system includes a demister, an electric heating coil, a HEPA pre-filter, chrcoal adsorber, HEPA after-filter and two 100 percent capacity centrifugal fans arranged in parallel (one operating - one standby). Each fan is provided with an inlet isolation valve and an outlet isolation valve to prevent air from recirculating through the idle fan.

When the CVPETS is in use, air is drawn from the condensate vacuum pump discharge line through the treatment system and released to the vent stack through a ductwork connection (see Section 10.4.2).

#### 9.4.4.2.5 Elevator Machine Room Ventilation System

The Elevator Machine Room Ventilation System is shown on Figure 9.4.4-1. The Ventilation System consists of a centrifugal supply fan. Air is drawn from the outside through an isolation damper, a medium efficiency filter and supplied to the machinery room. Air is discharged to the outside through a pressure relief damper and louver. In the winter seasons all air is drawn from the elevator machine room and returned for recirculation; supplementary heating is provided by an electrical unit heater located in the elevator machine room.

The Sampling Room HVAC System consists of a self-contained air conditioning unit, electric wall fin heater and a wall exhaust fan.

During summer seasons only the self-contained air conditioning is on. In the winter seasons, the sampling room is heated by an electric wall fin heater and ventilation air is drawn in from outside through louvers by a wall exhaust fan.

Design data for the Elevator Machine Room Ventilation System and the Sampling Room HVAC System are shown in Table 9.4.4-5.

9.4.4.2.6 Electric Equipment Room (North End) Ventilation System

The Electric Equipment Room (North End) Ventilation System is shown on Figure 9.4.4-1. Design data for principal system components are presented in Table 9.4.4-6. The Electric Equipment Room (North End) Ventilation System is a once-through type during summer operation and an economizer cycle type during the winter season. The Electric Equipment Room (North End) Ventilation System includes a supply air handling unit. The supply air handling unit includes, in the direction of airflow, an outside air intake louver with bird screen, a pneumatic isolation damper, a medium efficiency filter, an electric heating coil and two 100 percent capacity centrifugal fans, arranged in parallel (one operating -one standby). Each fan is provided with a pneumatic discharge damper to prevent air recirculation through the idle fan. Air is drawn from outside through the air handling unit and supplied to the electrical equipment room (North End) through a ductwork distribution system. Air is discharged to the atmosphere through louvers. A large portion of air from the electrical equipment room is returned to the air handling unit for recirculation during winter conditions.

9.4.4.3 <u>Safety Evaluation</u>

The Turbine Building Area Ventilation Systems are not safety related. The systems will not be required to operate during accident conditions. Upon a loss of power, the ventilation systems will shut down.

9.4.4.4 <u>Inspection and Testing Requirements</u>

Refer to Section 14.2 for a discussion of testing provisions as they apply to the Turbine Building HVAC Systems.

# CHAPTER 10
# STEAM AND POWER CONVERSION SYSTEM

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STEAM AND POWER CONVERSION SYSTEM

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# 10.4 OTHER FEATURES OF STEAM AND POWER CONVERSION SYSTEM

## 10.4.1 MAIN CONDENSER

### 10.4.1.1 Design Basis

The main condenser is designed to function as the steam cycle heat sink and collection point for the following flows:

a) Main turbine exhaust;

b) Main turbine last stage moisture removal drains;

c) Condensate, condensate booster and steam generator feedwater pumps minimum flow recirculation;

d) Steam Dump System;

e) Condensate makeup;

f) Feedwater heater, drains and vents;

g) Steam generator blowdown;

h). Main and extraction steam piping drains;

i) Gland steam condenser condensate.

Design data of the main condenser at normal full-load operation of the plant is shown in Table 10.4.1-1.

The main condenser is also designed to:

a) Condense up to 40 percent of the full load main steam flow bypassed directly to the condenser by the Steam Dump System. The steam flow is devided equally between the two condenser zones during steam bypass operation. This condition could occur in case of a sudden load rejection by the turbine-generator, a turbine trip or during start-up and shutdown, as described in Section 10.4.1.3; 5

b) Provide for removal of noncondensible gases from the condensing steam through the Main Condenser Evacuation System as described in Section 10.4.2;

c) Deaerate the condensate before it leaves the condenser hotwell;

d) Include supports for Low Pressure Feedwater Heaters Nos. 1A and 1B in the Condenser Neck.

The main condenser is constructed in accordance with the Heat Exchanger Institute Standards for steam surface condensers, and is designed to minimize air leakage. The condenser is a one shell, two zone unit employing a transverse partition. The partition is welded around its full circumference thus sealing one zone from the other. Equipment and piping connected to the condenser shell are designed to minimize air leakage to the condenser. 5

### 10.4.1.2 System Description

The main condenser is a single shell, multipressure, two zone deaerating surface condenser. The condenser is a divided waterbox, single-pass type with the condenser tubes oriented parallel to the turbine shaft. Cooling water for the condenser is provided by the Circulating Water System. The condenser is sized to condense exhaust steam from the main turbine under full-load conditions.

The condenser will accept up to 40 percent of steam generator rated steam flow in the event of an electrical load drop in excess of 10 percent without exceeding maximum turbine back pressure of 5.5 inches Hg abs, as specified by the turbine manufacturer.

Condenser hogging and vacuum holding is accomplished by two mechanical vacuum pumps. The condenser is a deaerating type, which removes dissolved air and other noncondensible gases from the condensate, during all modes of operation. Removal of these gases is discussed in Section 10.4.2.

The condenser hotwell provides storage capacity to allow system inventory to vary during operating transients and supplies condensate to the condensate pump suction connections. The hotwell storage capacity of 11,290 cubic feet issufficient for five minutes of full load operation between normal and low water levels. Condenser level is automatically maintained by makeup from the Condensate Storage System (see Section 9.2.6), from which condensate is caused to flow by atmospheric pressure, gravity, or condensate transfer pump head, into the condenser. The automatic makeup is performed through a level control valve which receives a low water level signal from the condenser. There is a manually operated bypass valve around this level control valve for backup, startup filling, and freeze protection. For high water level in the hotwell during normal plant operation, separate piping with a level control valve is provided from the condensate pump discharge to the condensate storage tank. The system flow diagram showing connections to the condenser is presented on Figure 10.1.0-4.

In order to reduce impurity ingress into the steam/condensate system in the event of tube to tubesheet joint leakage, the condenser is provided with integral grooved tube sheets (IGTS) which are filled with condensate maintained at a pressure above circulating water system pressure. This is accomplished during manufacture by boring an annular groove in each tube hole midway through the tube sheet. The outside diameter of each groove is
5 selected such that each groove overlaps its adjacent grooves, thereby providing a communicating flow path to every tube to tubesheet joint location. The tubesheet is then drilled at three points on its external surface in order to provide external access to the network of grooves. These points are then piped to a condensate water supply from the IGTS pressurization tank. The result is that in the event of a tube to tubesheet joint leak, condensate, rather than circulating water, enters the condenser shell. This system is shown on FSAR Figure 10.2.2-6.

## 10.4.2 MAIN CONDENSER EVACUATION SYSTEM

### 10.4.2.1 Design Bases

The Main Condenser Evacuation System (MCES) shown on Figure 10.1.0-4 is designed to establish and maintain condenser vacuum during plant start-up and shut-down and to remove air and noncondensable gasses during plant operation.

The equipment quality group classifications to which the system is designed are: Category 1 non-nuclear safety for the condensate vacuum pump - effluent treatment system, and Category 2 non-nuclear safety for the mechanical vacuum pumps.

### 10.4.2.2 System Description

The system flow diagram is presented in Figure 10.1.0-4. Condenser hogging and vacuum holding is accomplished by two 100 percent capacity mechanical vacuum pumps and all necessary piping, valves, instruments and electric devices for automatic operation of the system. Energizing the condenser vacuum pump starter automatically starts the seal water system associated with the condenser vacuum pump assembly. Each pump is designed to remove 30 CFM of free dry air at 1 in. Hg abs.

During the start-up period, one or two of the condenser vacuum pumps may be used for evacuating a combined turbine and main condenser steam space of 132,090 cubic feet to a pressure of 3 in. Hg abs within a maximum period of 105.1 minutes using one pump or 52.6 minutes using two pumps and thereafter to maintain a regular condenser pressure.

During normal operation, only one condenser vacuum pump is required. The noncondensible gases and water vapor mixture are drawn directly from the condenser shell. The mixture flows through the condenser vacuum pump(s), then to the separator, where most of the water vapor is condensed. The noncondensible gases are monitored for radiation and then released to the vent stack. A Noble Gas monitor (1TV-3534) is used for monitoring (See Section 11.5.2.7). The monitor's high radiation setpoint is set at a value corresponding to a predetermined primary to secondary leak rate. On high radiation alarm, valves 7AE-B4-1, 7TV-B3-1 and 7TV-B1-1 open and fan E-79 1A is started. This directs the condenser vacuum pump discharge to the Condensate Vacuum Pump Effluent Treatment System (CVPETS) which is described in Section 9.4.4. Later, valve 7AE-B3-1 is manually closed. This sequence 5
assures the passage of high activity effluent through a series of HEPA and charcoal filters prior to discharge to the atmosphere. No hydrogen buildup is anticipated in the condenser. The specific treatment system is shown on FSAR Figure No. 9.4.4-1. The condensed water from the mechanical vacuum pumps is drained to the industrial waste sumps. As it is discharged through line 8MD4-119-1, it is monitored through radiation monitor REM 3528 shown in Figure 9.3.3-2 of the FSAR. A description of this monitor is given in Section 11.5.2.5.7 of the FSAR. If radioactive contamination is detected, the liquid stream is diverted to the Secondary Waste System in the Waste Processing Building for processing. Normally, one condenser vacuum pump is on standby and is controlled to start up on failure of the running pump.

During initial hogging operation at plant start-up and prior to turbine operation the vacuum pump discharges directly to the atmosphere in the turbine building area. During start-up, prior to the turbine operation, off gas from the hogging operation would be discharged to the turbine building area. This
5 discharge will be monitored by a noble gas monitor because valve 7AE-B3-1 is a normally open butterfly valve, thus creating dual exit paths for discharge. Upon detection of excess radiation limits, action can be taken to close both valves causing off gas to be rerouted through the effluent treatment system.

Upon start of turbine operation, the discharge is directed to the vent stack directly or, on a high radiation signal, through the Condenser Vacuum Pump Effluent Treatment System (CVPETS), with the atmospheric discharge valve and the CVPETS bypass valves closed.

5 Gases are monitored for radioactivity levels downstream of the CVPETS. Any contamination, as monitored by the radiation monitors, will initiate an alarm.

### 10.4.2.3 Safety Evaluation

The noncondensible gases and vapor mixture discharged to the vent stack and to atmosphere during hogging operation, as described in Section 10.4.2.2, are not normally radioactive. The noncondensible gases and condensed water from the condenser vacuum pump(s) are monitored for radioactivity prior to being discharged to the vent stack and to the industrial waste sump, respectively. The presence of radioactivity would indicate a primary-to-secondary system leak in the steam generator(s). High radiation levels downstream of the CVPETS will cause an alarm. High radiation levels in the condensed water would cause the condensed water to be diverted to the Liquid Waste Processing System, as described in Sections 9.3.3, 9.4.4, 11.2 and 11.5 Low condenser vacuum will cause a turbine trip as discussed in Section 7.7.

5 There are no potentially explosive gaseous mixtures present in the Main Condenser Evacuation System during normal start-up and shut-down operations.

### 10.4.2.4 Test and Inspections

Preoperational testing ensures proper operation of valves and equipment and verifies pressure switch setpoints.

The need to test the MCES during normal operation will be minimal since the system will be in use. The system can be shut down for short periods of time during plant operation for inspection if required without adversely affecting condenser performance. Preoperational and startup tests are conducted as described in Section 14.2.

### 10.4.2.5 Instrumentation Applications

A radiation monitor is provided in the MCES noncondensible gas exhaust common header and will alarm on high radioactivity.

Should radioactivity be present in the condensed water, a radiation monitor will cause the valve on the normal discharge line to the industrial waste sump to close and the valve on the line to the Liquid Waste Processing System to open which ensures that there will be no radioactive condensed water discharge into the industrial waste sumps, as described in Sections 9.3.3, 11.2 and 11.5.

Local indicating devices, including pressure and temperature indicators, are provided to monitor system operation. Status indicating lights are provided on the main control board (MCB) for each condenser vacuum pump and it's auxiliaries.

The following alarms are provided in the control room for each condenser vacuum pump:

a) High differential pressure across strainer on pump suction (temporary for startup only)

b) High discharge temperature

c) Vacuum pump trip

d) Hogging valve open

e) Low lube oil pressure

CHAPTER 14
INITIAL TEST PROGRAM

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## 14.2.7 CONFORMANCE OF TEST PROGRAMS WITH REGULATORY GUIDES

The following applicable regulatory guides will be used as guidance in development of the initial test program:

a) Regulatory Guide 1.20, May, 1976, Comprehensive Vibration Assessment Program for Reactor Internals During Preoperational and Initial Startup Testing.

b) Regulatory Guide 1.37, March, 1973, Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water-Cooled Nuclear Plants.

c) Regulatory Guide 1.41, March, 1973, Preoperational Testing of Redundant On-Site Electric Power Systems to Verify Proper Load Group Assignments.

d) Regulatory Guide 1.52, Rev. 2, March, 1978, Design, Testing, and Maintenance Criteria for Engineered - Safety - Feature Atmosphere Cleanup System Air Filtration and Absorption Units of Light-Water-Cooled Nuclear Power Plants. 4

e) Regulatory Guide 1.68, August, 1979, Initial Test Programs for Water-Cooled Nuclear Power Plants.

f) Regulatory Guide 1.68.2, July, 1978, Initial Startup Test Program to Demonstrate Remote Shutdown Capability for Water-Cooled Nuclear Power Plants.

g) Regulatory Guide 1.79, September, 1975, Preoperational Testing of Emergency Core Cooling Systems for Pressurized Water Reactors with the following clarifications/exceptions:

| Reg. Position | Clarifications/Exceptions |
|---|---|
| C.1.b.(2) | The capability to realign valves for recirculation shall be tested for both Units 1 and 2. Test of a recirculation sump to demonstrate vortex control, acceptable pressure drops across suction lines and valves, and adequate NPSH will be conducted for Unit 1 by model tests and referenced for Unit 2. CP&L will verify by appropriate physical examination and flow demonstration test that recirculation sump suction lines are not obstructed and that valves are properly installed for Units 1 and 2. 4 |

C.1.c.(1)

Blowdown will be into the open reactor vessel at ambient pressure. This condition will allow the rapid accumulator dump which is necessary for evaluation of the system performance. Accumulator pressure will be less than normal operation pressure.

C.1.c.(3)

Initial RCS pressure for this test will be greater than the normal accumulator precharge pressure but less than the normal RCS operating pressure. Flow will be injected through a test line from the hydro pump and will not come from the accumulator discharge.

h) Regulatory Guide 1.68.3, April, 1982, Preoperational Testing of Instrument and Control Air Systems.

i) Regulatory Guide 1.95, February, 1975, Protection of Nuclear Power Plant Control Room Operators Against an Accidental Chlorine Release.

4 j) Regulatory Guide 1.140, March, 1978, Design, Testing, and Maintenance Criteria for Normal Ventilation Exhaust System Air Filtration and Adsorption Units of Light - Water - Cooled Nuclear Power Plants.

k) Regulatory Guide 1.108, Revision 1, August, 1977, Periodic Testing of Diesel Generator Units Used as On-site Electric Power Systems at Nuclear Power Plants.

2) The communication link between monitors and the main computer will be checked by interrogating each monitor from the main display computer.

3) All functions of the monitors will be checked locally and remotely to verify operability. (This will entail loading data base locally and remotely and verifying the operability of the function buttons.)

4) Communications link redundancy will be verified by lifting leads of communications cable to simulate a sever of communications lines and establishing communications with the monitor by both primary and backup main display computers.

5) The backup capability of each of the main display computers will be verified by artificially inducing failure of one computer to see that the other computer can carry on monitor functions.

6) The on board check source for each monitor will be activated from the main display computer to check for proper operation.

7) Graphic software will be operationally tested to verify proper indication.

8) Each safety-related monitor that provides contacts to operate dampers, valves, pumps or other equipment will include the equipment in operability tests such that when contacts actuate the operation of connected equipment will be verified.

d) Acceptance Criteria:

All acceptance Criteria for operability of equipment and software are based on vendor supplied technical manuals.

14.2.12.1.15 Excore Nuclear Instrumentation System (NIS) Test Summary

a) Test Objective

1) To demonstrate the operability of the excore nuclear instrumentation, including its ability to supply signals to the Reactor Protection System for generating appropriate trip signals and alarms, and indicating power levels.

b) Prerequisites

1) The NIS is aligned in accordance with the vendor's technical manual, and the associated NIS readout devices are calibrated.

2) Source range instrumentation is calibrated in accordance with vendor technical manuals. 4

3) The general prerequisites are met.

c) Test Methods

1) Simulate signals, as required, to verify that the NIS functions in accordance with the vendor's technical manual, and that the associated readout devices and analog devices receive the proper input signals.

2) Verify by simulating inputs to the NIS that analog output signals to associated equipment are of proper polarity and span in accordance with the vendor's technical manual.

d) Acceptance Criteria

1) Each NIS channel, interlock, permissive, trip, and indication operate in accordance with the vendor's technical manual and the Precautions, Limitations, and Setpoint Document.

14.2.12.1.16 Emergency Diesel Generator Test Summary

a) Test Objective

To demonstrate the operability of the diesel generator unit and associated support systems to include: starting performance, load acceptance performance, rated load capability, design load capability, load rejection capability, electrical performance, and subsystem performance.

b) Prerequisite

1) DC power is available for control and protective circuitry.

2) The following Emergency Diesel Generator Support Systems are in service: air start, jacket water (including emergency service water and potable water), lube oil, and fuel oil storage and transfer.

3) Diesel Building Ventilation in operation.

4) Fire Protection available.

5) General prerequisites are met.

c) Test Method

1) With the diesel generator unit in a standby status, conduct local and manual starts and operate in an unloaded condition to verify the operation of and establish base-line data for diesel engine components, auxiliary systems, alarms, indications, interlocks and protective devices.

4 2) Conduct local and remote starts and synchronization of each unit and verify operation of the generator, generator excitation and voltage regulation, engine-generator controls, indication, alarms systems.

3) Conduct automatic and manual load acceptance and rejection testing to verify the voltage, frequency of speed control performance of each diesel generator unit.

14.2.12.1.57 Containment Ventilation Test Summary 4

a) Test Objectives

The test objectives will be to demonstrate the proper operation of the Containment Ventilation System as delineated in sections 6.2 and 9.4.7.

b) Prerequisites

1) The general prerequisites are met.

2) Specific prerequisites will be delineated in the system preoperational test procedure.

c) Test Methods

Operate at flow rates which will demonstrate the system will function (controls, automatic isolations) as required to meet the test objectives and the acceptance criteria. When applicable, testing will be done in accordance with ANSI/ASME N510-1980. 4

d) Acceptance Criteria

These criteria are delineated in sections 6.2 and 9.4.7.

14.2.12.1.58 Plant HVAC Test Summary

a) Test Objectives

The test objectives will be to demonstrate the proper operation of the Reactor Auxiliary Building, Control Room, Diesel Generator Building, Fuel Handling Building, Waste Process Building, and Turbine Building (Condensate Polishing Demineralizer Areas, Electrical and Battery Room, General Service Switchgear Room, Condenser Vacuum Pump Effluent) HVAC systems.

Proper operation is delineated in the FSAR sections listed in d) Acceptance Criteria.

b) Prerequisites

1) The general prerequisites (listed in section 14.2.12.1)

2) Specific prerequisites will be delineated in the system Preoperational Test Procedure.

c) Test Methods

Operate at flow rates which will demonstrate the system will function (controls, automatic isolations) as required to meet the test objectives and the acceptance criteria. When applicable, testing will be done in accordance with ANSI/ASME N510-1980. 4

d) Acceptance Criteria

These criteria are delineated in the applicable sections as follows:

| | |
|---|---|
| Reactor Auxiliary Building | 6.5.1, 9.4.3, 9.4.5 |
| Control Room | 6.4, 9.4.1 |
| Diesel Generator Building | 9.4.5 |
| Fuel Handling Building | 6.5.1, 9.4.2 |
| Waste Processing Building | 9.4.3 |
| Turbine Building | |
| Condensate Polishing Demineralizer Areas | 9.4.4 |
| Electrical and Battery Room | 9.4.4 |
| General Service Switchgear Room | 9.4.4 |
| Condenser Vacuum Pump Effluent | 9.4.4, 10.4.2 |
| Fuel Oil Transfer Pump House | 9.4.5 |
| Emergency Service Water Intake Structure | 9.4.5 |

14.2.12.1.59 Engineered Safety Features Integrated Test Summary

a) Test Objective

To demonstrate the integrated operation of the ESF systems with and without the loss of off-site power, upon receipt of the proper actuation signals.

b) Prerequisites

1) Preoperational testing of the following ESF systems must be completed:

(a) Emergency Core Cooling

(b) Containment Isolation

(c) Containment Spray

(d) Containment Cooling

(e) Auxiliary Feedwater

(f) Main Feedwater Isolation

(g) Emergency Exhaust

(h) Emergency Power (Diesel Generators)

(i) Control Room Isolation

(j) Component Cooling Water

(k) Containment Vacuum Relief

(l) Essential Service Chilled Water

(m) RAB ESF Equipment Cooling

d) Acceptance Criteria

1) The automatic temperature control of the sampled fluids is regulated per Ebasco specification.

2) The Secondary Sample Cabinets instrumentation and alarms function per FSAR Section 9.3.2.5 and Ebasco Specification.

3) Sample points have been verified per FSAR Table 9.3.2.1.

4) Operation of the "Hotwell Sample" pumps are in accordance with system design wiring diagrams and Ebasco Specification.

14.2.12.1.79 Loss of Instrument Air Test Summary

a) Test Objectives

1) To demonstrate that a reduction and loss of instrument air pressure causes fail-safe operation of pneumatically-operated valves and dampers both safety and nonsafety related.

b) Prerequisites

1) The general prerequisites are met. 4

2) Specific prerequisites will be delineated in the system preoperational test procedure.

c) Test Method

1) Where safe to personnel and equipment, a slow reduction in pressure and a loss of pressure test will be performed. Testing will be done in small segments/individually and response noted for both safety and nonsafety-related valves and dampers.

d) Acceptance Criteria

1) Proper fail-safe operation of valves and dampers subject to a reduction and loss of instrument air is verified.

14.2.12.2 <u>Start-Up Test Summaries</u>

The following is an index of start-up test summaries described in this Section:

1. Movable Incore Detector Test Summary

2. Rod Control and Position Indication System Test Summary

3. Rod Drive Mechanism Timing Test Summary

4. Rod Drop Time Measurement Test Summary

5. Reactor Coolant System Flow Measurement Test Summary
6. Reactor Coolant System Flow Coastdown Test Summary
7. Calibration of Nuclear Instrumentation Test Summary
8. Rod Control System Test Summary
9. Flux Distribution Measurement Test Summary
10. Core Performance Test Summary
11. Power Coefficient and Power Defect Measurement Test Summary
12. Control Rod Reactivity Worth Test Summary
13. Boron Reactivity Worth Test Summary
14. Automatic Rod Control Test Summary
15. Psuedo Rod Ejection Test Summary
16. Steam Generator Moisture Carryover Test Summary
17. Load Swing Test Summary
18. Large Load Reduction and Generator Trip From 100 Percent Power Test Summary
19. Turbine Trip From 100 Percent Power Test Summary
20. Remote Shutdown Test Summary
21. Loss of Offsite Power Test Summary
22. Pressurizer Heaters and Spray Valves Capability Test Summary
23. Failed Fuel Detection Test Summary
24. Pressurizer Continuous Spray Flow Verification Test Summary
25. Reactor Coolant System Leakrate Test Summary
26. Natural Circulation Test Summary
27. Main Steam and Feedwater Systems Test Summary
28. Shield Survey Test Summary
29. Loss of Feedwater Heaters Test Summary
30. Main Steam Isolation Valve Test Summary
31. Steam Generator Test for Condensation-Induced Water Hammer

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Superseded Pages Per Amend 8 to FSAR (50-400)
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| 6.2.1-9 | 5 | 6.2.1-49 | 0 |
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| 6.2.1-11 | 5 | 6.2.1-51 | 0 |
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| 6.2.1-14 | 5 | 6.2.1-54 | 0 |
| 6.2.1-15 | 5 | 6.2.1-55 | 0 |
| 6.2.1-16 | 5 | 6.2.1-56 | 0 |
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| 6.2.1-18 | 5 | 6.2.1-58 | 0 |
| 6.2.1-19 | 5 | 6.2.1-59 | 0 |
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| 6.2.1-25 | 5 | 6.2.1-65 | 0 |
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| 6.2.1-26e | 5 | 6.2.1-71 | 0 |
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| 6.2.1-172 | 5 |
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| 6.2.2-2 | 5 |
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| 6.2.2-4 | 5 |
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| 6.2.2-11 | 2 |
| 6.2.2-12 | 2 |

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| 6.2.2-30 | 2 |
| 6.2.2-31 | 2 |
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| 6.2.5-4 | 5 |
| 6.2.5-5 | 5 |
| 6.2.5-6 | 5 |
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| 6.2.6-6 | 5 |
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| Ref. 6.2 pg. 2 | 5 |
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The assumptions used in the analysis of an inadvertent containment spray system actuation are listed in Table 6.2.1-11. The calculated external (differential) pressure transient, as a function of initial containment humidity, is shown as a function of time on Figure 6.2.1-15. The containment external (differential) pressure design provides substantial margin over this conservatively calculated value as shown in Table 6.2.1-3. There is no single failure which could result in the operation of both containment spray trains as was assumed for the purposes of this analysis.

Protection of the containment vessel against excessive external pressure is provided by two independent vacuum relief lines, each sized to prevent the differential pressure between the containment and the Reactor Auxiliary Building atmosphere from exceeding the design value of 2.0 psi. The vacuum system conforms to the requirements of Paragraph NE-7116 of ASME Section III.

The containment vacuum relief system is shown on Figure 6.2.2-3. The system consists of a check valve and an automatic air operated butterfly valve outside the containment building. The check valve is provided with a short pipe spool permanently attached to the valve, and a removable test flange. Actuation of the butterfly valve is controlled by differential pressure between outside atmosphere and the Containment. One differential pressure transmitter provides a signal for control action to open the butterfly valve when differential pressure between Containment and outside reaches (-) 2.5 inches water gauge (w.g.).

Another differential pressure transmitter, of a different manufacturer, provides a continuous signal for indication and also to alarm at "High Containment Vacuum" on the MCB. A manual override switch on the MCB for each butterfly valve shall open the valve at the discretion of the operator.

The design basis accident for the vacuum relief system is the accidental initiation of the containment spray system (both pumps) while two (2) fan coolers are in operation and the containment is at its maximum normal operating temperature of 120 F. The containment spray pumps are assumed to reach full runout flow (4750 gpm total for both) instantaneously, the initial humidity is assumed to be 5 percent, and one (1) vacuum relief subsystem is assumed not operating. This is the worst combination for negative pressure. The outside air is taken as 40 F and 5 percent humidity. The temperature of the spray water is taken as 40 F and the temperature of the service water to the fans is taken as 33 F; both are the lowest and the most conservative temperatures. For other assumptions and data see Table 6.2.1-11.

An analysis was performed to size the vacuum relief system. Calculations were performed with the computer code CONTEMPT LT which considers conditions in the Containment and allows only leakage from atmosphere to Reactor Auxiliary Building and from Reactor Auxiliary Building to the Containment. Refer to Sections 6.2.1.1 and 6.2.1.2 for a discussion of the Containment subcompartment analysis. As a result of the analysis, a 24-inch nominal vacuum relief valve is used.

The vacuum relief check valve is set to open at a differential pressure of 1.5 in. w.g. and the butterfly valve is set to open at a differential pressure of 2.5 in. w.g. The total friction factor for the Containment Vacuum Relief System is 6.5 as shown on Figure 6.2.1-306.

Both the vacuum relief check valves inside the Containment and the butterfly valves outside the Containment perform the dual safety functions of providing an open flow path for relieving negative containment pressure and providing containment pressure integrity for positive containment pressures. These valves are designed to satisfy Safety Class 2 and Seismic Category I requirements. Each valve is designed to take the full containment design pressure.

Four pressure transmitters are provided to monitor the containment pressure in the control room. Low pressure alarms will be annunciated when the differential pressure between the Containment and the outside reaches (-) 4 inches w.g.

Since the containment vacuum relief check valves also perform as containment isolation valves in the event of a LOCA, the pneumatically operated butterfly valves are designed to fail closed. A Seismic Category I air accumulator is provided for each butterfly valve to ensure a reliable energy source for operation of each valve. Each air accumulator is sized to allow three cycles of operation of its associated air operated valve. The Seismic Class I air supply is isolated from the normal Non-Seismic Class I air supply system by a set of check valves which will prevent the loss of air from the accumulator in the event of failure of the Non-Seismic Category I air supply system. Refer to Table 6.2.1-64 for a single failure analysis of the Containment Vacuum Relief System.

Each vacuum relief assembly is provided with independent instrumentation and controls in accordance with IEEE-279 requirements. The electrical supply for the control operations of each valve is from a separate emergency 125V DC bus. No single failure of system component can prevent operation of the Containment Vacuum Relief System.

The Containment Vacuum Relief System pre-operational tests are described in Section 14.2.12.1.67. Periodic tests as required by the Technical Specifications in Section 16.2 will be performed. In-service inspection will be performed in accordance with Section 6.6 and valve testing requirements in Section 3.9.6 will be followed.

### 6.2.1.2 Containment Subcompartments

#### 6.2.1.2.1 Design Bases

The containment subcompartments are subject to pressure transients and jet impingement forces caused by the mass and energy releases from postulated high energy pipe ruptures within their boundaries. Subcompartments within which high energy ruptures are postulated include the reactor cavity, the pressurizer subcompartment, and the three steam generator subcompartments.

Analyses were made to determine the peak pressure that could be produced by a line break discharging into the subcompartments. Venting of these chambers is

Results

The design value and peak calculated valves for pressure in the subcompartments is shown in Tables 6.2.1-1, 6.2.1-3, and 6.2.1-27.

Graphs of the subcompartment pressure response versus time for the limiting break for the reactor cavity, steam generator loop 1, steam generator loop 3, steam generator loop 2, and pressurizer subcompartments are given in Figures 6.2.1-28 through 6.2.1-75, Figures 6.2.1-76 through 6.2.1-132, Figures 6.2.1-133 through 6.2.1-195, Figures 6.2.1-196 through 6.2.1-248, and Figures 6.2.1-249 through 6.2.1-301, respectively. Peak pressure differentials for all cases analyzed are given in Table 6.2.1-3. The peak calculated differential pressure is limited to a small portion of the total wall area and is less than the design pressures.

### 6.2.1.3 Mass and Energy Release Analyses for Postulated Loss-of-Coolant Accidents

This analysis presents the mass and energy releases to the Containment subsequent to a hypothetical loss-of-coolant accident (LOCA). The release rates are calculated for pipe failure at three distinct locations:

(a) Hot leg (between vessel and steam generator).
(b) Pump suction (between steam generator and pump).
(c) Cold leg (between pump and vessel).

During the reflood phase, these breaks have the following different characteristics. For a break in the pump suction or cold leg piping a portion of the accumulator or safety injection flow in the intact loops can bypass the downcomer and flow directly to the break. For a cold leg pipe break, all of the fluid which leaves the core must pass through a steam generator and be vaporized by heat addition to the primary from the secondary. However, relative to breaks at the other locations, the core flooding rate (and therefore the rate of fluid leaving the core) is low, because all the core vent paths include the resistance of the reactor coolant pump. For a hot leg pipe break the vent path resistance is relatively low, which results in a high core flooding rate but the majority of the fluid which exits the core bypassses the steam generators in venting to the Containment. The pump suction break combines the effects of the relatively high core flooding rate, as in the hot leg break, and steam generator heat addition as in the cold leg break. As a result, the pump suction breaks yield the highest energy flow rates during the post-blowdown period. The peak containment pressure is reached during the blowdown period of a hot leg break.

The spectrum of breaks analyzed includes the largest cold and hot leg breaks, reactor inlet and outlet respectively, and a range of pump suction breaks from the largest to a 3.0 $ft.^2$ break. Table 6.2.1-28 presents the specific cases analyzed and a list of tables which contain the results for each case.
As discussed above, the pump suction break location is the worst case in terms of the reflood transient. For this reason a spectrum of break sizes has been used in this analysis for the pump suction location. Smaller break sizes at

the hot leg and cold leg locations, result in less severe transients than full double ended guillotine breaks. This has been shown with the previous model in Reference 6.2.1-11. Thus, even if a hot leg or cold leg case becomes limiting, smaller breaks at these locations need not be analyzed. The hot leg and cold leg locations have, therefore, only been analyzed with an assumed double ended guillotine break.

The containment heat removal system is sufficient to remove the heat being added to the containment atmosphere at a rate such that the reflood peak pressure is low. The peak containment pressure occurs during the blowdown portion of the hot leg break. Thus, the hot leg break is limiting in terms of containment peak pressure. However, the long term pressure transient for the pump suction break is clearly limiting over the hot leg break in terms of magnitude and duration. Thus, the pump suction break should still be used to evaluate the long term containment pressure transient.

The LOCA transient is typically divided into four phases:

(a) Blowdown - which includes the period from accident occurrence (when the reactor is at steady state operation) to the time when the total break flow stops.

(b) Refill - the period of time when the lower plenum is being filled by accumulator and safety injection water. (This phase is conservatively neglected in computing mass and energy releases for containment evaluations).

(c) Reflood - begins when the water from the lower plenum enters the core and ends when the core is completely quenched.

(d) Post-Reflood - describes the period following the reflood transient. For the pump suction and cold leg breaks, a two-phase mixture exits the core, passes through the hot legs, and is superheated in the steam generators. After the broken loop steam generator cools, the break flow becomes two phase.

Figures 6.2.1-307 and 6.2.1-308 show a comparison of containment pressure transients for the Shearon Harris FSAR and PSAR analyses. The PSAR analysis used the currently approved mass and energy release model.(except for FROTH), while the FSAR used a model currently being reviewed by the NRC. The differences in the hot leg transient (Figure 6.2.1-307) are minor and are due both to changes in the containment analysis input (volume, heat sinks, heat removal systems) as well as differences in the mass and energy release model. The differences in the transient for the double-ended pump suction break are larger and are due mainly to differences in the Reflood mass and
5 energy releases. During Reflood a two-phase mixture is pushed into the core where steam is generated. Steam and water travel to the steam generators where the water is evaporated. The steam exiting the broken loop steam generator passes directly to the break and into the containment. The steam leaving the intact steam generator flows into the cold legs and is condensed by safety injection flow. The currently approved model assumed that the safety injection flowed directly to the downcomer without mixing with steam from the intact steam generator. In addition any flow that was greater than

from the intact steam generator. In addition any flow that was greater than was required to keep the downcomer full, was spilled directly to the containment.

This is very conservative for two reasons. First the steam would mix with the safety injection water and spill onto the floor of the containment rather than 5
being released as steam into the containment atmosphere. Secondly, the back pressure on the downcomer is much greater if the uncondensed steam flows backwards through the Reactor Coolant Pump. This increased driving head results in faster core recovery and an increased mass and energy release rate. By modeling the mixture of steam and water in a realistic way, the releases of steam into the containment are substantially reduced, and the overall peak containment pressure is lowered.

6.2.1.3.1 Mass and Energy Release Data

<u>Blowdown Mass and Energy Release Data</u> - Tables 6.2.1-29 through 6.2.1-34 present the calculated mass and energy releases for the blowdown phase of the various breaks analyzed with the corresponding break size.

<u>Reflood Mass and Energy Release Data</u> - Tables 6.2.1-35 through 6.2.1-39 present the calculated mass and energy releases for the reflood phase of the various breaks analyzed along with the corresponding safeguards assumption (maximum or minimum). The reflood results have been omitted for the hot leg break since the blowdown releases are sufficient to determine the peak containment pressure for this break location.

<u>Dry Steam Post-Reflood Mass and Energy Release Data</u> - The calculated mass and energy releases for the post-reflood phase with dry steam are provided in the reflood mass and energy release tables (Tables 6.2.1-38 and 6.2.1-39) after end of 10 ft. entrainment (flooded to 10 ft. above bottom of core) occurs.

<u>Two Phase Post-Reflood Mass and Energy Release Data</u> - Tables 6.2.1-40
and 6.2.1-41 present the two phase (FROTH) mass and energy release data for a 5
double-ended pump suction break using maximum and minimum safeguards assumptions, respectively. Table 6.2.1-42 presents the results for a 0.6 ft.$^2$ double-ended pump suction break using minimum safeguards. The double ended pump suction minimum safeguards case is normally limiting. The two phase results are provided for the other cases to prove that an upper bound calculation has been performed. This information is not provided for the three foot square pump suction split or the double ended cold leg or hot leg cases. The peak containment pressures for these cases will occur during the blowdown phase of the transient.

<u>Equilibration and Depressurization Energy Release Data</u> - The equilibration and depressurization energy release has been incorporated in the post-reflood mass and energy release data. This eliminates the need to determine additional releases due to the cooling of steam generator secondaries and primary metal.

6.2.1.3.2 Mass and Energy Sources

The sources of mass considered in the LOCA mass and energy release analysis are given in the mass balance tables (Tables 6.2.1-43 through 6.2.1-48). These sources are:

(a) Reactor Coolant System

(b) Accumulator

(c) Pumped injection

(d) Decay heat

(e) Core stored energy

(f) Primary metal energy

(g) Secondary metal energy

(h) Steam generator secondary energy

(i) Secondary transfer of energy (feedwater into and steam out of the steam generator secondary)

The balances are presented at the following times:

(a) Time zero (initial conditions)

(b) End of blowdown time

(c) End of refill time (The only difference that will be noted from the values at the end of blowdown is that some accumulator water will be transferred to the reactor coolant. Thus, the low plenum will be full at the beginning of the reflood transient.)

(d) End of reflood time

(e) The time when the broken loop steam generator reaches thermal equilibrium (for froth cases only)

(f) The time when the intact loop steam generator reaches thermal equilibrium (for froth cases only)

(g) Time for full depressurization (for froth cases only)

The methods and assumptions used to release the various energy sources are given in Reference 6.2.1-10.

The following items ensure that the core energy release is conservatively analyzed for maximum containment pressure.

TABLE 6.2.1-20 (continued)

| Junction[1] No. | Volume From | Volume To | Area | Elev. | Inertia Coefficient | Loss Coefficient Forward | Loss Coefficient Reverse |
|---|---|---|---|---|---|---|---|
| 44 | 15 | 16 | 1.410 | 245.720 | 5.2278 | 0.3025 | 0.3025 |
| 45 | 9 | 10 | 1.620 | 238.050 | 4.1877 | 0.2568 | 0.2568 |
| 46 | 3 | 4 | 14.750 | 228.650 | 0.4589 | 0.2423 | 0.2423 |
| 47 | 28 | 29 | 122.880 | 273.100 | 0.0742 | 0.0172 | 0.0172 |
| 48 | 22 | 23 | 27.060 | 254.670 | 0.2149 | 0.4458 | 0.4458 |
| 49 | 16 | 17 | 1.410 | 245.720 | 5.2278 | 0.3027 | 0.3027 |
| 50 | 10 | 11 | 1.620 | 238.050 | 4.1877 | 0.2569 | 0.2569 |
| 51 | 4 | 5 | 14.750 | 228.650 | 0.4589 | 0.2423 | 0.2423 |
| 52 | 29 | 30 | 122.880 | 273.100 | 0.0742 | 0.0172 | 0.0172 |
| 53 | 23 | 24 | 26.780 | 254.670 | 0.2149 | 0.4537 | 0.4537 |
| 54 | 17 | 18 | 1.410 | 245.720 | 5.2278 | 0.3027 | 0.3027 |
| 55 | 11 | 12 | 1.620 | 238.050 | 4.1877 | 0.2569 | 0.2569 |
| 56 | 5 | 6 | 14.750 | 228.650 | 0.4589 | 0.2423 | 0.2423 |
| 57 | 30 | 31 | 122.800 | 273.100 | 0.0742 | 0.0172 | 0.0172 |
| 58 | 24 | 25 | 27.060 | 254.670 | 0.2149 | 0.4458 | 0.4458 |
| 59 | 18 | 19 | 1.410 | 245.720 | 5.2278 | 0.3026 | 0.3026 |
| 60 | 12 | 13 | 1.620 | 238.050 | 4.1877 | 0.2568 | 0.2568 |
| 61 | 6 | 7 | 14.750 | 228.650 | 0.4589 | 0.2422 | 0.2422 |
| 62 | 31 | 32 | 210.610 | 273.100 | 0.0690 | 0.4547 | 0.3443 |
| 63 | 25 | 26 | 26.780 | 254.670 | 0.2149 | 0.4537 | 0.4537 |
| 64 | 19 | 20 | 1.410 | 245.720 | 5.2278 | 0.3026 | 0.3026 |
| 65 | 13 | 14 | 1.620 | 238.050 | 4.1877 | 0.2569 | 0.2569 |
| 66 | 7 | 8 | 14.750 | 228.650 | 0.4589 | 0.2422 | 0.2422 |
| 67 | 2 | 1 | 152.873 | 217.500 | 0.107 | 0.0504 | 0.1097 |
| 68 | 21 | 33 | 2.5252 | 253.750 | 1.787 | 1.6899 | 1.6899 |
| 69 | 22 | 33 | 2.2814 | 253.750 | 1.965 | 1.9007 | 1.9007 |
| 70 | 23 | 33 | 2.9708 | 253.750 | 1.552 | 1.6643 | 1.6643 |
| 71 | 24 | 33 | 2.2814 | 253.700 | 1.965 | 1.9007 | 1.9007 |
| 72 | 25 | 33 | 2.5252 | 253.700 | 1.552 | 1.6643 | 1.6643 |
| 73 | 26 | 33 | 2.2814 | 253.700 | 3.009 | 2.0087 | 2.0086 |
| 74 | 1 | 33 | 30.0000 | 223.500 | 0.040 | 1.5000 | 1.5000 |
| 75 | 0 | 23 | 0.5000 | 253.750 | 0.000 | 0.0000 | 0.0000 |
| 76 | 0 | 24 | 0.5000 | 253.750 | 0.000 | 0.0000 | 0.0000 |
| Fill Junctions for Cold Leg Guill. Break | | | | | | | |
| 75 | 0 | 22 | 0.5000 | 253.750 | 0.0 | 0.0 | 0.0 |
| 76 | 0 | 23 | 0.5000 | 253.750 | 0.0 | 0.0 | 0.0 |
| Fill Junctions for Hot Leg Guill. Break | | | | | | | |

Note: (1) See Figure 6.2.1-22

## 6.2.4 CONTAINMENT ISOLATION SYSTEM*

### 6.2.4.1 Design Bases

The Containment Isolation System consists of the valves and actuators required to isolate the Containment following a loss-of-coolant accident, steam line rupture, or fuel handling accident inside the Containment.

The Containment Isolation System is designed to the following bases:

a) The Containment Isolation System provides isolation of lines penetrating Containment, which are not required to be open for operation of the Engineered Safety Features Systems, to limit the release of radioactive materials to the atmosphere during a loss-of-coolant accident (LOCA).

b) Upon failure of a main steam line, the Main Steam Line Isolation System, described in Section 7.3, isolates the faulted steam generator to prevent excessive cooldown of the Reactor Coolant System or overpressurization of the Containment, and as described in Section 7.3, the Containment Isolation System isolates the Containment.

c) Upon failure of a main feedwater line, the Main Feedwater Isolation System, described in Section 7.3, isolates the faulted steam generator, and as described in Section 7.3, the Containment Isolation System isolates the Containment.

d) Upon detection of high containment atmosphere radioactivity, isolation valves in the Containment Atmosphere Purge Exhaust System, discussed in Section 9.4.7, are shut to control release of radioactivity to the environment. The Containment Purge Isolation Actuation System is discussed in Section 7.3. Airborne radioactivity monitoring is discussed in Section 12.3.4.

All containment purge and vent isolation valves close automatically on a high radiation signal generated as a result of inputs from containment airborne radiation sensors. All the automatically actuated valves have status indication lights in the Main Control Room. The only exception to the above is th outside containment isolation valve on the hydrogen purge system which is manually operated locally and locked closed. 5

e) The Containment Isolation System is designed in accordance with 10CFR50, Appendix A, General Design Criterion 54 and Westinghouse Systems Standard Design Criteria, Number 1.14, Rev. 2.

f) There are no lines that are part of the reactor coolant pressure boundary (RCPB) that penetrate the Containment (i.e., no safety class 1 lines), therefore GDC 55 is not applicable to SHNPP. However, for lines such as charging, safety injection, and letdown there is not an applicable GDC because these lines are connected to the RCPB but not part of the RCPB. Each line that is connected to the reactor coolant pressure boundary is provided with containment isolation valves in accordance with 10CFR50, Appendix A,

*Further information is contained in the TMI Appendix

General Design Criterion 55, with the exception of the RHR hot leg suction lines as described below.

g) Each line that connects directly to the containment atmosphere and penetrates Containment, with the exception of the residual heat removal and containment spray recirculation sump lines as discussed below, is provided with containment isolation valves in accordance with 10CFR50, Appendix A, General Design Criterion 56.

h) Each line that forms a closed system inside Containment, with the exception of the containment pressure sensing lines as described below, is provided with containment isolation valves in accordance with 10CFR50, Appendix A, General Design Criterion 57.

i) Emergency power from the diesel generators is provided to ensure system operation in the event of a loss of offsite power.

j) All air/spring-actuated valves are designed to fail to their required position to perform their safety function upon loss of the instrument air supply and/or electrical power.

k) The containment isolation system design is such that the containment design leakage rate is not exceeded during a design basis accident.

l) The Containment Isolation System is designed to remain functional during and following the safe shutdown earthquake.

m) Closure times for containment isolation valves are established on the basis to minimize the release of containment atmosphere to the environment, to mitigate the offsite radiological consequences, and to assure that emergency core cooling system effectiveness is not degraded by a reduction in the containment back-pressure.

n) Relief valves which are located between containment isolation valves are designed to meet the requirements for containment isolation valves.

o) The steam generator shell and lines connected to the secondary side of the steam generator are considered to be an extension of the Containment and therefore, need no containment isolation valves located inside the Containment.

p) The welding and qualification requirements for all welds associated
with the spare penetration sleeve assemblies listed in Table 6.2.4-1 are in
accordance with the appropriate requirements of Section III of the ASME B & PV
Code. Provisions are made for leak testing the weld between the closure
plate/cap and the embedded wall sleeve. The design requirements for spare
penetration sleeves including their closure plates/caps listed in FSAR
5 Table 6.2.4-1 are further described in Sections 3.8.2.2 through 3.8.2.7
inclusive, for Type II penetrations.

q) The containment setpoint pressure that initiates containment isolation for nonessential penetrations must be reduced to the minimum compatible with normal operating conditions. The value of 4.5 psig has been established based on results of Shearon Harris containment accident analysis. This value was selected to optimize (a) ability of safety injection systems to maintain containment within maximum allowable pressure and (b) provide sufficient response time for instruments. 5

6.2.4.2 System Design

The Containment Isolation System, in general, closes fluid penetrations that support those systems not required for emergency operation. Fluid penetrations supporting Engineered Safety Features (ESF) Systems have remote manual isolation valves which may be closed from the Control Room, if necessary. Automatic isolation valves close upon receipt of an isolation signal from a sensor. All power operated isolation valves have position indication in the Control Room.

Design information regarding the containment isolation provisions for fluid system lines and fluid instrument lines penetrating the Containment is presented in Table 6.2.4-1.

6.2.4.2.1 Codes and Standards

The portions of the Containment Isolation System which are a part of the reactor coolant pressure boundary are designed and constructed in accordance with Quality Group A recommendations of Regulatory Guide 1.26. The remainder of the Containment Isolation System is designed and constructed in accordance with Quality Group B recommendations of Regulatory Guide 1.26.

The Containment Isolation System is designed in accordance with Seismic Category I requirements as discussed in Section 3.2.1.

6.2.4.2.2 System Integrity

All containment isolation valves are located inside either the Containment, the Reactor Auxiliary Building, or the Fuel Handling Building. These structures are of Seismic Category I design and are protected against damage from missiles. The reinforced concrete containment provides a major mechanical barrier for protection against missiles which may be generated external to the Containment. Protection against damage from missiles is provided for isolation valves, actuators, and controls. Refer to Section 3.5 for a discussion of missile protection. Section 3.6 contains a discussion of protection provided against dynamic effects of pipe-whip, while Section 3.7 contains a discussion of the seismic design analysis performed on containment penetration piping.

Screens are provided on the open-ended containment atmosphere purge exhaust system lines inside Containment to minimize the debris entering the lines and, in turn, entering the purge isolation valves.

6.2.4.2.3 Valve Operability

Each containment isolation valve is designed to ensure its peformance under all anticipated environmental conditions including maximum differential pressure, seismic occurrences, steam-laden atmosphere, high temperature, and high humidity. Section 3.11 presents a discussion of the environmental conditions, both normal and accident, for which the Containment Isolation System is designed.

Dynamic analysis procedures, used in the design of Seismic Category I mechanical equipment, are discussed in Section 3.9.1. The analytic and empirical methods used for design of valves are discussed in Section 3.9.3. A discussion of the vibration operational test program to verify that the piping and piping restraints have been designed to withstand dynamic effects for valve closures is included in Section 3.9.2. A discussion of the inservice testing program for valves to assure their operability is included in Section 3.9.6.

The valve types utilized for containment isolation service are designs which provide rapid closure and near zero leakage. Therefore, essentially no leakage is anticipated through the containment isolation valves when in closed position. Verification that actual leakage rates from the Containment are within design limits is provided by periodic leakage rate testing in accordance with 10CFR50, Appendix J as described in Section 6.2.6

6.2.4.2.4 Isolation Barriers

As stated in Section 6.2.4.1, the design of isolation valving for lines penetrating the Containment follows the intent of GDC 54 through 57, and Westinghouse Systems Standard Design Criteria Number 1.14, Rev. 2. Isolation valving for instrument lines which penetrate the Containment follows the guidance of Regulatory Guide 1.11. Those cases where literal interpretation of GDC 54 through 57 have not been followed are included in the following discussions.

6.2.4.2.4.1 General Design Criterion 54

All piping penetrations meet the intent of GDC 55, 56, or 57. In doing so, they also conform to the intent of GDC 54 to the extent that all piping systems penetrating the Containment are provided with containment isolation capabilities which reflect the importance to safety isolating these piping systems. In addition, Table 6.2.4-1 lists each piping penetration to be tested periodically in accordance with 10CFR50, Appendix J.

In some penetrations, sealed closed barriers are used. Sealed closed barriers include blind flanges and locked closed isolation valves, which may be closed manual valves, closed remote-manual valves, and closed automatic valves which remain closed after a loss-of-coolant accident. Locked closed isolation valves are under administrative control to assure that they cannot be inadvertently opened.

6.2.4.2.4.2 General Design Criterion 55

There are no lines that are part of the reactor coolant pressure boundary (RCPB) that penetrate the Containment (however, there are some safety Class 1 valves within the containment boundary), therefore GDC 55 is not applicable to SHNPP. However, for lines such as charging, safety injection and letdown there is not an applicable GDC because these lines are connected to the RCPB but not part of the RCPB. Lines which are connected to the reactor coolant pressure boundary are shown in Table 6.2.4-1. Each penetration is provided with one of the following valve arrangements conforming to the requirements of 10CFR50, Appendix A, General Design Criterion 55, as follows:

a) One locked-closed-isolation valve inside and one locked-closed-isolation valve outside Containment; or

b) One automatic-isolation valve inside and one locked-closed-isolation valve outside Containment; or

c) One locked-closed-isolation valve inside and one automatic-isolation valve outside Containment; a simple check valve is not used as the automatic-isolation valve outside Containment; or

d) One automatic-isolation valve inside and one automatic-isolation valve outside Containment; a simple check valve is not used as the automatic-isolation valve outside Containment.

Isolation valves are located as close to the Containment as practical and, upon loss of actuating power, solenoid and air-operated automatic-isolation valves fail closed.

An exception of GDC 55 is taken for the RHR suction lines. The lines from the RCS hot legs to the RHR pump suctions each contain two remote manual (motor operated) valves, which are locked closed during normal plant power operation and are under administrative control to assure that they cannot be inadvertently opened, in accordance with SRP Section 6.2.4 Item II.f. The valves are interlocked such that they cannot be opened when the RCS pressure is greater than the design pressure of the RHR system. This valve arrangement is provided in accordance with Westinghouse Systems Standard Design Criteria, Number 1.14, Revision 2 and Appendix B of ANSI Standard N271-1976. 5

An exception to Criterion 55 is taken for several isolation valves in lines which penetrate Containment and are required to perform safeguards functions 5 following an accident. Lines which fall into this category include the RHR and safety injection lines, and RCP seal injection lines. Since these valves must remain open or be opened, a trip signal cannot be used. Instead, each of these motor operated valves is capable of remote manual operation. Upon 5 completion of the safeguards function of the line, the operator can close the isolation valve from the Control Room. Leak detection capabilities for these lines is discussed in Section 5.2.5.

6.2.4.2.4.3 General Design Criterion 56

The lines that penetrate the Containment and communicate directly with both the atmosphere inside and outside of the Containment are of two types. The first type communicates directly with the atmospheres inside and outside of Containment, i.e., the atmosphere purge line. The second type encompasses those penetrations for non-nuclear safety class lines penetrating the Containment, i.e., service air, fire protection, etc.

As stated in GDC 56, two isolation valves, one inside and one outside Containment, are required in lines which penetrate the Containment and connect directly to the containment atmosphere. However, GDC 56 allows for alternatives to these explicit isolation requirements where the acceptable basis for each alternative is defined. The following are alternatives to explicit conformance with GDC 56.

An exception is taken to Criterion 56 for the lines from the containment recirculation sumps to the suctions of the residual heat removal (RHR) pumps
5 and containment spray pumps. Each line is provided with motor operated gate valves. These valves are enclosed in valve chambers that are leaktight at containment design pressure. Each line from the containment sump to the valve is enclosed in a separate concentric guard pipe which is also leaktight. A seal is provided so that neither the chamber nor the guard pipe is connected directly to the containment sump or to the containment atmosphere. This design arrangement is provided in accordance with Westinghouse Systems Standard Design Criteria Number 1.14, Revision 2 and Appendix B of ANSI Standard N271-1976.

The vacuum relief lines to the Containment are essential for containment integrity. Isolation is provided through a power-to-close, spring-to-open butterfly valve and a check valve inside Containment. Power from divisional electrical buses is applied to the butterfly valves at all times to keep the valves closed, except when air is required to relieve a vacuum inside the Containment.

When relief valves are provided in fluid system penetrations as overpressure protection devices, the relief set point is greater than 1.5 times the containment design pressure. Because of the orientation required, each of these relief valves are isolation valves for the applicable penetration. The piping and valve designs are Quality Group B, Seismic Category I, and will withstand temperatures and pressures at least equal to the containment design pressure and temperature. Should the postulated loss-of-coolant accident occur, containment pressure would be felt on the downstream side of a relief valve inside the Containment and would act in conjunction with the spring pressure setting of the relief valve to further enhance seating.

6.2.4.2.4.4 General Design Criterion 57

Closed systems used as an isolation barrier, either inside or outside the Containment, meet the following requirements:

a) The systems are protected against postulated missiles and pipe-whip.

b) The systems are designed to Seismic Category I.

c) The systems meet Quality Group B and C standards and are inservice inspected as described in Section 6.6.

## ABBREVIATIONS FOR TABLE 6.2.4-1

### Fluid

A - Air

G - Gas

S - Steam

W - Water

### Valve Type

BF - Butterfly

CK - Check

DA - Diaphragm

GA - Gate

GL - Globe

RG - Regulating

RL - Relief

### Actuator

AO - Air Operator

EH - Electro-hydraulic

M - Manual

MO - Motor Operator

SA - Self-Actuating

SO - Solenoid Operator

### Primary/Secondary Actuation Modes

A - Automatic

M - Manual

RF - Reverse Flow

RM - Remote Manual

### Valve Position

AI - As Is

C - Closed

Cy - Cycle

LC - Locked Closed

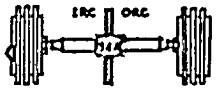
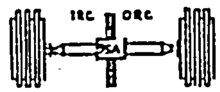
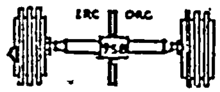
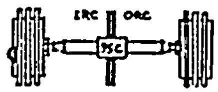
LO - Locked Open

O - Open

TH - Throttled

TL - Locked Throttled

TABLE 6.2.4-1
CONTAINMENT ISOLATION SYSTEM DATA

| PENETRATION DATA: PENETRATION DETAIL | P&ID NUMBER | GENERAL DESIGN CRITERION | FLUID | HIGH ENERGY LINE | BYPASS LEAKAGE PATH | VALVE DATA: SYSTEM TITLE | VALVE NUMBER | POWER TRAIN | LENGTH of PIPE | VALVE TYPE | ACTUATOR | PRIMARY ACTUATION MODE | SECONDARY ACTUATION MODE | ISOLATION SIGNAL | ACCIDENT SIGNAL | RESPONSE TIME | NORMAL | VALVE POSITION: SHUTDOWN | POST-ACCIDENT | POWER FAILURE | ILRT | ENGINEERED SAFETY FEATURE | CONTAINMENT ISOLATION VALVE | TYPE C TEST | NOTE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | B-30 31.18 | 56 | A | NO | NO | CONTMT VACUUM RELIEF-SENSING B | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | TYPE A TEST | |
|  | B-30 31.18 | 56 | A | NO | NO | CONTMT VACUUM RELIEF-SENSING B | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | TYPE A TEST | |
|  | LATER | 56 | CF | NO | NO | CONTMT PRESS WIDE RANGE-SENSING B | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | TYPE A TEST | |
|  | B-30 31.17 | 56 | A | NO | NO | CONTMT VACUUM RELIEF-SENSING A | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | TYPE A TEST | |
|  | B-30 31.17 | 56 | A | NO | NO | CONTMT VACUUM RELIEF-SENSING A | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | TYPE A TEST | |
|  | LATER | 56 | CF | NO | NO | CONTMT PRESS WIDE RANGE-SENSING A | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | TYPE A TEST | |

5

TABLE 6.2.4-2 (Cont'd)

CONTAINMENT ISOLATION VALVE POSITION
FOLLOWING AN ACCIDENT

| Penetration No. | Penetration Name | Essential or Non Essential | Valve Position |
|---|---|---|---|
| M80 | INSTR AIR SUPPLY | NE | CLOSED |
| M81-M85 | SPARES | | N/A |
| M86A | CONTAINMENT ATM RADIATION MONITOR | NE | CLOSED* |
| M86B | CONTAINMENT ATM RADIATION MONITOR | NE | CLOSED* |
| M87-M89 | SPARES | | N/A |
| M90 | DEMIN. WATER TO FUEL TRANSFER SYSTEM CONTR PANEL & REFUELING CAVITY DECON | | CLOSED |
| M91 | CONTAINMENT FAN COIL UNITS SW - OUT | NE | CLOSED |
| M92 | CONTAINMENT FAN COIL UNITS SW - IN | NE | CLOSED |
| M93-M95 | SPARES | | |
| M96 | CONTAINMENT LEAK RATE TEST SUPPLY & EXHAUST | NE | CLOSED |
| M97 | SPARE | | N/A |
| M98 | VACUUM RELIEF B | NE | CLOSED |
| M99-M104 | SPARES | | N/A |
| M105 | FIRE PROTECTION SPRINKLER SYS HDR | NE | CLOSED |
| M106-M107 | SPARE | | N/A |
| M108 | AUX FEEDWATER TO SG A | E | OPENED + |
| M109 | AUX FEEDWATER TO SG B | E | OPENED + |
| M110 | AUX FEEDWATER TO SG C | E | OPENED + |

* ISOLATION VALVE CLOSED ON PHASE A CONTAINMENT ISOLATION SIGNAL. REOPEN MANUALLY FOR POST ACCIDENT $H_2$ SAMPLING.

** NORMALLY CLOSED. OPEN ON CONTAINMENT SPRAY ACTUATION SIGNAL.

*** A "P" SIGNAL IS DEFINED AS A CONTAINMENT PHASE B SIGNAL.

\+ WILL BE CLOSED TO ISOLATE FAULTED STEAM GENERATOR (ie., LOSS OF SG PRESSURE BOUNDARY)

1) ESSENTIAL: LINES REQUIRED TO MITIGATE AN ACCIDENT, OR WHICH, IF UNAVAILABLE COULD INCREASE THE MAGNITUDE OF THE EVENT.

2) NON-ESSENTIAL: LINES WHICH ARE NOT REQUIRED TO MITIGATE AN ACCIDENT, AND WHICH IF REQUIRED AT ALL WOULD BE REQUIRED FOR LONG TERM RECOVERY ONLY; ie., DAYS OR WEEKS FOLLOWING AN ACCIDENT.



3

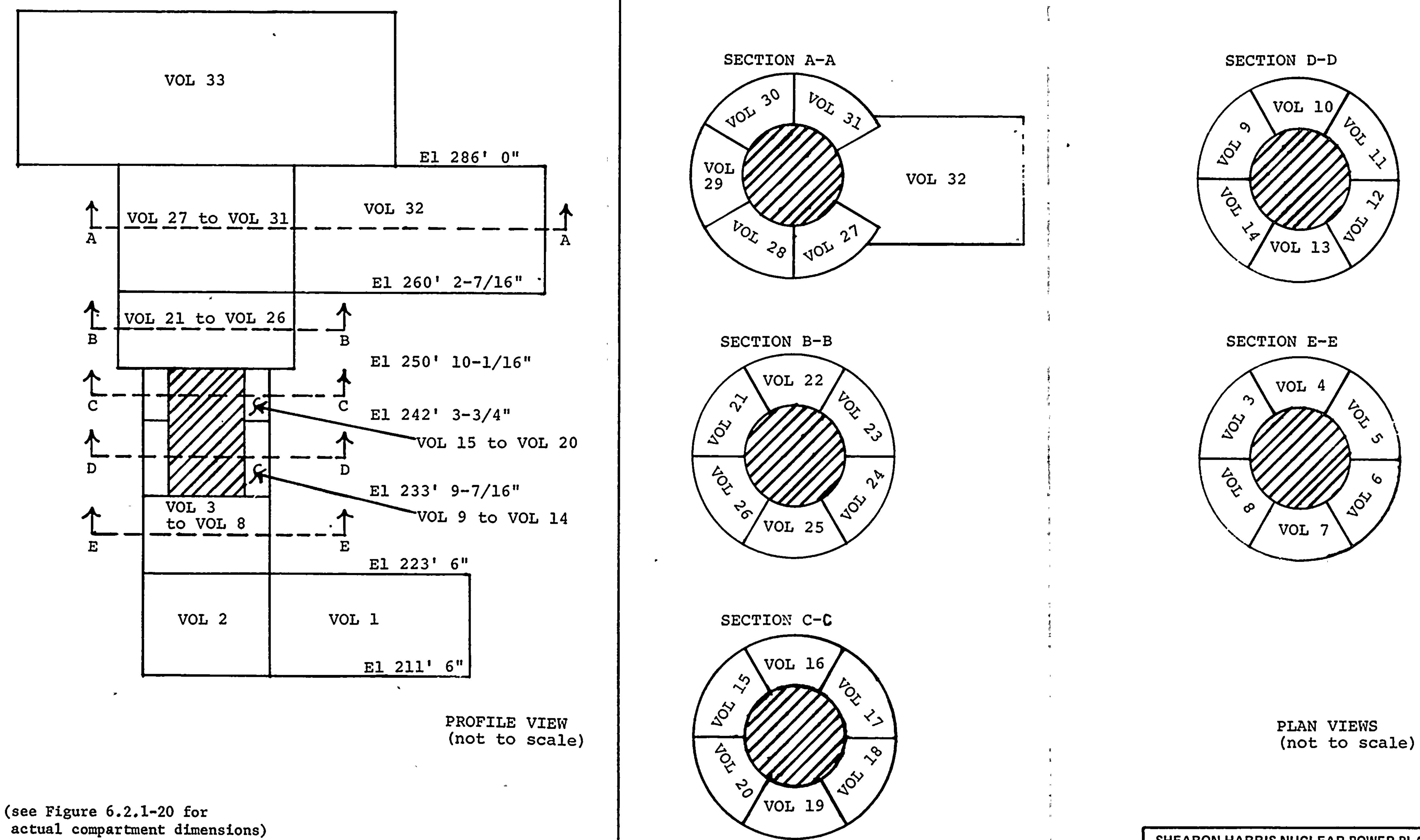



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FIGURE 6.2.1-21

for the instrument logic and schematic diagrams. This system is to protect the Containment Building from internal negative pressures that exceed its design.

Initiating Circuits and Logic

There are two redundant vacuum relief trains. Each of the redundant containment vacuum relief trains has a butterfly valve that can be remotely operated by a control switch in the Control Room. Each of these butterfly valves have a slave damper at a RAB air intake which functions at the same time as with its associated valve as long as instrument air is available. Each butterfly valve has an air accumulator which will allow extended operating duty after loss of the plant air system. Each train is automatically controlled based on containment building pressure between a negative 0.25 in. water gage and negative 2.5 in. water gage.

Bypass, Interlocks and Sequencing

In the event there is a containment ventilation isolation signal (CVI), the butterfly valve and damper of each train will close or be prevented from opening until this signal is reset. Once this signal has been reset for a particular safety train, the associated vacuum relief train will operate automatically.

Redundancy and Diversity

The instrumentation and controls of the redundant trains are physically and electrically separated. The controls for these systems are not connected to other containment ventilation systems. In addition, the pressure transmitters used for control and monitoring are of different manufacture to minimize common mode failures between manual and automatic operation. The redundancy and independence provided are adequate to maintain functional capabilities following the design basis shown in Table 7.3.1-1.

Display Instrumentation

The safety related display instrumentation, which provides the operator with sufficient information to monitor performance of the Containment Vacuum Relief System and to perform the required safety functions, is described in Section 7.5.

7.3.1.5.13 Fuel Oil Transfer Pump House Ventilation System

Refer to Section 9.4.5.2.4 for a description of the Fuel Oil Transfer Pump House Ventilation System, to Figure 9.4.5-2 for the system flow diagram, and to Figure 7.3.1-24 for the instrument logic and schematic diagrams. The system is used to maintain the pump room temperature below 104 F, and remove fuel oil fumes both under normal and accident conditions.

Initiating Circuits and Logic

There are four pump rooms (two rooms associated with each Unit), each having two redundant exhaust fans. Each of the fans can be remotely operated by its control switch in its associated Control Room. 2

Bypass, Interlocks and Sequencing

Under normal conditions one of the two fans is running. In the event there is a low flow condition due to loss of the operating fan, the second fan will automatically start after a time delay. In the event there is a loss of offsite power or an "S" signal actuation condition, the lead exhaust fan will be started automatically.

Redundancy and Diversity

The instrumentation and controls of the components of each pump house ventilation system are physically and electrically separate from each other. The redundancy and independence provided are adequate to maintain functional capabilities following the design basis events shown in Table 7.3.1-1.

Display Instrumentation

The safety related display instrumentation, which provides the operator with sufficient information to monitor performance of the Fuel Oil Transfer Pump House Ventilation System and to perform the required safety functions, is described in Section 7.5.

7.3.1.5.14 Emergency Service Water Intake Structure Ventilation System

Refer to Section 9.4.5.2.6 for a description of the Emergency Service Water Intake Structure Ventilation System, to Figure 9.4.5-2 for the system flow diagram, and to Figure 7.3.1-25 for the logic and schematic diagrams. This system is to insure the maximum temperatures of the electrical and pump rooms of 104 F and 120 F respectively are not exceeded.

Initiating Circuits and Logic

Each electrical equipment and pump room has its own distinct ventilation system. The electrical equipment room system includes a supply fan, cooling coil, electric heater, filter and associated supply and return dampers. Exhaust fans are provided for the pump room ventilation. Each fan associated with the ventilation system is remotely operated by its control switch in the Control Room.

Bypass, Interlocks, and Sequencing

Under normal operation, the electrical room supply fan is automatically cycled by a 24 hour clock. In addition, the electrical supply fan will be automatically started when the room temperature exceeds 104 F. The pump room exhaust fan will automatically start when either the outside air temperature exceeds 70 F or the room temperature exceeds 90 F and its associated emergency service pump is running.

The display instrumentation for this system is listed in Table 7.5.1-8.

7.5.1.5 Auxiliary Control Panel Instrumentation

For a description of this instrumentation, refer to Section 7.4.

7.5.1.6 RCCA Position Indication System

The display instrumentation for this system is listed in Table 7.5.1-15.

7.5.1.7 Safe Shutdown System

For a description of this system, refer to Section 7.4.

7.5.1.8 Post-Accident Monitoring Instrumentation

The Post-Accident Monitoring System is designed to monitor plant variables during and following an accident.

Instrumentation provided for the remote monitoring of post-accident parameters is qualified for operation in post-accident environmental and seismic conditions.

The post-accident display instrumentation is provided for the operator to enable him to perform manual safety functions and to determine the effect of manual actions taken following a reactor trip due to ANS Condition II, III or IV events as defined in Chapter 15.0. Tables 7.5.1-1 through 7.5.1-13 list the information readouts required to maintain the plant in a hot shutdown condition or to proceed to cold shutdown within the limits of the Technical Specifications. Reactivity control after ANS Condition II and III events will be maintained by administrative sampling of the reactor coolant for boron concentration to ensure that it is sufficient to maintain the reactor sub-critical. Each parameter is monitored by the redundant channels, SA or SB. Both channels are indicated in the Control Room with at least one channel recorded by a safety related recorder that is operational immediately following, but not during a seismic event. The post-accident monitoring instrumentation is powered from the 120V AC instrument bus normally energized from the onsite emergency busses. Each channel is powered from a separate power supply. These instruments are identified by the yellow color bezel on the board. The following systems parameters are listed in Tables 7.5.1-1 through 7.5.1-13.

a) Reactor coolant COLD LEG and HOT LEG temperature (loops 1 and 2 only)

b) Pressurizer water level

c) Reactor coolant pressure (wide range)

d) Containment pressure

e) Steam line pressure

f) Steam generator water level (wide range)

g) Steam generator water level (narrow range)

h) Component cooling water heat exchanger discharge pressure

i) Component cooling water surge tank level

j) Component cooling water heat exchanger discharge temperature

k) Refueling water storage tank level

l) Containment spray pump A and B discharge header pressure

m) Auxiliary feed water flow to steam generator

n) Auxiliary feed water pumps A and B discharge pressure

o) Turbine auxiliary feed water pumps discharge pressure

p) Emergency service water pumps A and B discharge pressure

q) Service water pumps A and B header flow

r) Service water booster pumps A and B pressure

s) Service water booster pumps A and B flow

t) Diesel generators A and B voltage

u) Diesel generators A and B field voltage

v) Diesel generators A and B current

w) Batteries A and B voltage

x) Containment sump level

### 7.5.1.9 Bypassed and Inoperable Status Indication (IEEE 279 Section 4.13 and RG 1.47)

A pressure, flow, and temperature typical process loop diagram is shown on Figure 7.5.1-1. Bypassed and inoperable conditions are indicated on the main control board (MCB) on a system and train basis.

The MCB has two nonsafety bypass and inoperable status panels for the ESF and ESF Support Systems. Each panel shows inoperable conditions of respective channels.

The function of these bypass panels is to show inoperable conditions of the ESF and ESF Support Systems to the control room operator. Bypassed or inoperable conditions are automatically indicated on the ESF bypass panel for loads powered from MCCs (for example loss of voltage, blown fuse or overload). Bypassed or inoperable conditions for loads powered from high or low voltage switchgear are indicated when the breaker is partially or fully racked out

TABLE 7.5.1-10

CONTROL ROOM INDICATORS AND/OR RECORDERS AVAILABLE TO THE OPERATOR TO MONITOR SIGNIFICANT PLANT PARAMETERS DURING NORMAL OPERATION AND CONDITION II, III AND IV EVENTS

CONTAINMENT SYSTEM

| MONITORED PARAMETER | FUNCTION | INST TAG NO | TRAIN | INSTRUMENT RANGE | INSTRUMENT ACCURACY | REQUIRED FOR ESF | REQUIRED FOR ESF SUPPORT | PPDI | PAMI | LOCATION | CWD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | INDICATION | | | | | | | | | | |
| CONTAINMENT PRESSURE | SET-1 | PI-950 | SA | -5-0-65 PSIG | ±3% | | | X | X | MCB | 185[1] |
| | SET-2 | PI-951 | SB | " | " | | | X | X | MCB | 185 |
| | SET-3 | PI-952 | SA | " | " | | | X | X | MCB | 185 |
| | SET-4 | PI-953 | SB | " | " | | | X | X | MCB | 185 |
| | RECORDING | PR-950 | NNS | " | - | | | X | | RCDR PNL | 185 |
| | SET-1 | PEN-1 | | | | | | | | | |
| | SET-2 | PEN-2 | | | | | | | | | |

NOTES:

(1) Monitor containment conditions following primary or secondary system break inside Containment.

3

### 9.5.4.4 Instrumentation Application

The control of each subsystem is identical. It maintains the proper supply of diesel oil in each day tank by means of interlocks between the high and low-level switches in the day tank, the corresponding fuel oil transfer pump motor starters, and supply valves at each day tank inlet. The Main Control Room is provided with high and low level annunciators for all day tanks and fuel oil storage tanks in the system, and control switches for remote control of each complete transfer system train.

Each diesel fuel oil storage tank is provided with a level transmitter which gives high level alarm, low level alarm and level indication on the fuel oil storage tank panel which is located near the fuel oil unloading pumps. Control switches are provided on the fuel oil storage tank panel for control of the fuel oil unloading pumps.

Each day tank is provided with alarms and indication on its respective diesel engine control panel and on the main control room panel on the Unit it serves, to:

a) Open supply valve on low-level, if necessary, and start transfer pump

b) Stop the fuel oil transfer pump on high level

c) Energize a control room and a local annunciator on low-low level

d) Close supply valve and energize a control room and a local annunciator on high-high level

e) Monitor oil level by a level indicator

Each of the fuel oil transfer pump strainers is equipped with discharge flow switches which cause an alarm in the Control Room and local engine control panel whenever the low flow setpoint is reached. Each fuel oil transfer pump discharge line is provided with a pressure indicator.

Each fuel oil transfer pump and its associated day tank inlet valve is provided with control on its respective diesel engine panel and on the main control panel of the Unit it serves. Primary control is provided from the Main Control Room. However, control can be transferred to the corresponding diesel engine panel via a selector switch on the diesel engine panel. If the Main Control Room is evacuated and plant control is transferred to the auxiliary control panel, then control of the DGFOSTS will automatically be transferred to its respective diesel engine panel.

Instrumentation and Control Design Criteria are discussed in Sections 7.1 and 7.6.

### 9.5.4.5 Inspection and Testing Requirements

The system is tested in conjunction with the periodic diesel generator test (Refer to Chapter 16 for details). The system is subject to the in-service inspection requirements of ASME XI in accordance with 10CFR50.55a(g) (refer to Section 6.6). Isolation valve bypass piping, and pressure test connections

are provided to allow pressure testing of that portion of the piping which is buried in the yard. Manways are provided to allow inspection of the buried fuel oil storage tanks and their instrumentation, and allows access for tank 5
cleaning if required. The access hatch to the tank manways is shown in Figure 3.8.4-22 (intersected by Section A-A on elevation 263.00 ft.). The system components are inspected and cleaned prior to installation. Instruments are calibrated during periodic testing and automatic controls are tested for actuation at the proper setpoints. Alarm functions are checked for operability and limits during plant preoperational testing and during every periodic diesel test. At the end of each diesel test period, the fuel oil transfer pump is automatically started to raise the fuel oil day tank level to full. Fuel oil transfer pumps are operated and tested during plant preoperational testing. Fuel oil transfer pumps are operated and tested initially to check factory test curves and to determine the initial pump characteristic as installed. Periodically during normal Unit operation, fuel oil storage tank and day tank levels are checked with a hand gage; fuel oil 5
transfer pump and motor availability is checked by conducting a flow test from the storage system to the fuel oil day tank.

Surveillance of the quality of the fuel oil is accomplished by periodic sampling for water and other contaminants in the storage system, and sampling of new fuel oil prior to transfer to the storage system. Sampling procedures shall be in accordance with ASTM Standard D270-65. Fuel oil samples shall be tested per ASTM Standard D975-74 and shall meet the specifications listed in Table 1 of ASTM D975-74.

#### 9.5.4.6 Diesel Fuel Distribution Sources

The primary supplier of diesel fuel is located in Greensboro, North 5
Carolina. Deliveries are made from:

Selma, North Carolina, approximately 45 miles
Greensboro, North Carolina, approximately 75 miles
Charlotte, North Carolina, approximately 140 miles
Spartanburg, South Carolina, approximately 200 miles
Wilmington, North Carolina, approximately 120 miles

Deliveries are routinely made under unfavorable environmental conditions such as storms, snow, ice, etc. With the amount of time that deliveries can be scheduled, no problems are anticipated.

4) Technical Specifications

5) Transient, instrument failure, and accident analysis

6) Normal and emergency operating procedures

7) Heat transfer, fluid flow and thermodynamics

The audit phase of this portion of the Cold License Training Program will consist of written and oral examinations administered and graded by Westinghouse personnel. The purpose of this audit will be to identify any areas requiring additional training effort. Individual or group weak areas identified by this audit will be corrected by intensive training efforts for those involved and training program modifications to minimize recurrence in future classes.

g) Management Training for Licensed Supervisors - Personnel requiring Senior Reactor Operator licenses will receive instruction in the following supervisory skills:

1) Leadership

2) Interpersonnel communication

3) Command responsibilities and limits

4) Motivation of personnel

5) Problem analysis

6) Decisional analysis

7) Administration requirements for the particular supervisory positions.

h) Training on Special Low Power Testing - Each licensed reactor operator and senior reactor operator will participate in the initiation, maintenance and recovery from natural circulation. 2

13.2.1.3 Shift Engineer (Shift Technical Advisor) Training

Shift Engineers will be provided with training in the following areas, as a minimum:

1) Duties and responsibilities of the Shift Engineer

2) Plant design and layout

3) Accidents analyzed in this FSAR and their consequences

4) Thermodynamics and fluid flow

5) Integrated plant response

6) Capabilities and limitations of plant instruments and controls

Additionally, Shift Engineers will receive a minimum of two weeks of training on the SHNPP simulator to include asterisked [*] items in Section 13.2.2.1.2a.

13.2.1.1.4 Technical Personnel Training

Technical personnel who require specialized training to properly perform in their areas of responsibility will attend formal training courses in their particular specialities as well as receive on-the-job training at the plant site prior to start-up. This training is described below:

a) Radiation Control and Test (RC&T) Technician Training - RC&T Technicians not having the qualifications shown in Section 13.1.3.1 will be required to complete the applicable training programs described below prior to appointment to their respective positions.

1) Basic RC&T Course Series - RC&T Technician III

| | | |
|---|---|---|
| Basic Chemistry | - | 2 weeks |
| Basic Health Physics | - | 2 weeks |
| Basic Counting Room | - | 1 week |
| Basic Environmental | - | 1 week |

2) Intermediate RC&T Course Series - RC&T Technician II

| | | |
|---|---|---|
| Intermediate Chemistry | - | 1 week |
| Intermediate Health Physics | - | 1 week |
| Intermediate Counting Room | - | 1 week |
| Intermediate Environmental | - | 1 week |

These coures are presented by CP&L personnel. At and above the RC&T Technician I level, specialized training will be provided as necessary by CP&L or by vendors. RC&T personnel will also receive on-the-job training by participating in systems checkout and start-up, preparing the laboratories for service, participating in initial radiation surveys, and participating in the writing, review and study of radiological and chemical procedure manuals.

b) Instrumentation and Control (I&C) Technician Training - I & C Technicians not having the qualifications shown in Section 13.1.3.1 will be required to complete the applicable training programs described below prior to appointment to their respective positions.

1) Basic I&C Course series - I&C Technician III

| | | |
|---|---|---|
| Basic Electronic | - | 1 week |
| Basic Pneumatic Instumentatiion | - | 2 weeks |
| Basic Electrical | - | 1 week |