2.2 NEARBY INDUSTRIAL, TRANSPORTATION, AND MILITARY FACILITIES

2.2.1 Location and Routes

2.2.1.1 Industrial Facilities. There are presently three operating industrial facilities within 5 miles of the South Texas Project Electric Generating Station (STPEGS) and one more within 6-1/2 miles, as shown on Figure 2.2-1. Additionally, four plant sites are located within the 5-mile radius and one more site within 5.5 miles. These facilities are described in Section 2.2.2.

2.2.1.2 Extractive Industries. There are no known extractive industries within 5 miles of the proposed plant.

2.2.1.3 Nuclear Power Facilities. Other than the STPEGS, there are no nuclear facilities either operable or being built or planned (reactors ordered) within 50 miles of the plant site (Ref. 2.2-1).

2.2.1.4 Transportation.

2.2.1.4.1 Roads: As shown on Figure 2.1-2, there are four roadways within 5 miles of the plant. The road nearest the plant is Farm-to-Market Road (FM) 521, which has been relocated so that it is at least 0.89 miles (1,430 meters) from the Containment structures. Other information on this and other roads within 5 miles is given below:

Road	Direction	Distance (mi)	24-hr Traffic	Surface	Classification
FM 1095	W	4.2	1,260	Bituminous	B
FM 521	ENW*	0.89*	900	Bituminous	A
FM 3057	NNE	4.5	1,060	Bituminous	A
FM 2668	ENE	4.8	1,445	Bituminous	A
FM 1468	N	1.0	400	Bituminous	None

*Relocated

Classification: Class A - 80,000 lbs. load limit
Class B - 58,420 lbs. load limit

All roads are two-lane, 24-ft-travel-way, county-maintained roads.

The closest major highway is Texas State Highway 60, which is located approximately 7.2 miles east of the Containment structures. Highway 60 runs north-south.

* There are no statistics with respect to estimated future traffic along FM 521; however, the Texas State Highway Commission assumes a 5 percent per year increase in use as a standard rule of thumb.

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2.2.1.4.2 Railroads: There are presently three railroad systems in the area of the plant. They are listed below and shown on Figure 2.2-2 along with their proposed spur lines to the plant.

Railroad	Distance (mi) and Direction from Plant at Closest Point
Santa Fe - Main Line	7 E
- Spur to DuPont	6 E
- Industrial Spur	4.8 N
- Spur to Cities Service	5.6 NE
Missouri Pacific - Main Line	7 N
- Spur to Celanese	4.8 N
Southern Pacific	10 W

Other than the spur to the plant, the rail line nearest to the STPEGS is composed of industrial spurs from the Missouri Pacific and Santa Fe railroads, which join to form a single spur extending to the Celanese Chemical Company. The Southern Pacific Line is out of service.

2.2.1.4.3 Water: The principal waterway near the site is the Colorado River, shown on Figure 2.2-1 and discussed in Section 2.2.2.4.

2.2.1.4.4 Airways: Airways near the site are shown on Figure 2.2-2 and discussed in Section 2.2.2.5.

2.2.1.4.5 Military Facilities: There are no military facilities, missile bases, or operations within 5 miles of the plant (Ref. 2.2-1).

2.2.1.4.6 Pipelines: Pipelines in the vicinity of the site are shown on Figure 2.2-3 and discussed in Section 2.2.2.3.

2.2.1.4.7 Underground Gas Storage: There is no underground storage of liquid petroleum gas (LPG) within 5 miles of the plant site. The nearest LPG underground storage facility is in the Markham salt dome, 16 miles north-northwest of the plant site. Markham is used to store ethane and propane. Because there are no salt domes underlying or closer to the plant site than the Markham salt dome, any future storage of LPG need not be considered. See Figure 2.2-4 for location of salt domes and Table 2.2-4 for information on the salt domes.

2.2.1.4.8 Above-Ground Gas Storage: The Bulk Gas Storage Facility (BGSF) on-site will store up to 200,400 standard cubic feet (scf) of hydrogen in twenty-four pressurized tubes. The BGSF also stores liquified nitrogen and gaseous nitrogen. The storage parameters for these gases are given in Table 2.2-7. The BGSF is located approximately 525 feet North of the Unit 2 Diesel Generator Building (DGB) and serves both units. 2

2.2.2 Descriptions

2.2.2.1 Description of Facilities. The five offsite industrial facilities located within approximately 7 miles of the STPEGS are indicated on Figure 2.2-1. 2

The Celanese Chemical Company is the largest facility located near the STPEGS site (approximately 4.8 miles to the north-northeast) and employs approximately 500 workers. The Celanese Chemical Company produces a variety of chemical products. Potentially hazardous chemicals stored at and shipped from the Celanese plant are detailed in Reference 2.2-3.

DuPont owns and operates a high density polyethylene plant located approximately 7 miles east of the STPEGS site. The plant site covers 2,100 acres and employs approximately 150 persons. There is no hazard to STPEGS associated with the DuPont facility plant location and hazardous material transportation routes.

Five and one-half miles north-northeast of STPEGS is the K and K Compression site, which was purchased from the Big Three Industrial Gas and Equipment Co. All production equipment has been dismantled and there are no plans for further industrial production.

A public wharf located at the Port of Bay City, 4.8 miles to the north-northeast, is the terminal used by Crysen (formerly the Bay Tex terminal), a facility for unloading gasoline and diesel oil from barge transport on the Colorado River. After unloading and storage, the petroleum is shipped by truck to retail terminals. The Crysen Terminal, employing 6 persons, maintains a petroleum product storage capability of 120,000 barrels. The Crysen Terminal transports about 25,000 gallons of petroleum a month. The Celanese Chemical Company uses the public wharf and transit shed facilities at the Port of Bay City for the shipment of nylon salt. Six hundred tons of nylon salt have been bargeloaded from the Crysen facility for a single shipment. 2

Located in the area where FM 521 crosses the Colorado River (3.5 miles east) is the Parker Brothers facility, which was used for unloading oyster, clam and reef shells. The dock facility ceased operations in December 1982.

Table 2.2-1 summarizes the information presented above.

2.2.2.2 Description of Products and Materials. A description of the products and materials at the industrial facilities is presented in Section 2.2.2.1. A description of the products and materials in the Bulk Gas Storage Facility appears in Table 2.2-7. 2

2.2.2.3 Pipelines. Figure 2.2-3 shows the natural gas pipelines within 5 miles of the plant. There are no LPG or liquid natural gas lines within 5 miles of the site. Also shown on Figure 2.2-3 are the gas and oil production fields within the same distance from the plant. It should be noted that the area described by Figure 2.2-3 is crossed by many more pipelines and fields than those represented. For clarity, only those lines and fields which are within the above distance from the plant are shown. The transmission pipeline nearest the plant is a 16-in. natural gas pipeline of the Dow Chemical

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Company. At its closest approach to the plant, this pipeline is 2.1 miles to the northwest (Ref. 2.2-1). The Delhi 4-in. gathering line serves the South Duncan Slough field and is 1.6 miles from the STPEGS plant at the point of closest approach. Data on the pipelines are summarized in Table 2.2-2.

Two Big Three pipelines from the Freeport, Texas area carry oxygen and nitrogen to the Celanese Chemical Company. The closest approach of the pipelines to STPEGS is their termination point at the Celanese plant.

There is little or no potential for future expansion of the oil and gas production fields within 5 miles of the site because each field is surrounded by dry holes and the limits of the structure of each field are known from reflection geophysical data. As of August 1985, there has been a decline in production in each field. Production zones in all the fields are in the Frio Formation at depths ranging from 10,200 to 12,650 ft. Development of producing zones in Eocene Age sands is unlikely because of the great depth of such sands (estimated to be about 20,000 ft) in the vicinity of the site.

The four fields within 5 miles of the site are shown on Figure 2.2-3. An evaluation of the possibility of the development of oil and gas production fields closer to the site than those now indicated on Figure 2.2-3 is presented in Section 2.5.1.1.6.6.7.2.

The proposed La Salle liquified natural gas (LNG) terminal (Ref. 2.2-28) site is located about 35 miles southwest of the STPEGS site and five miles northwest of Port O'Connor. A 36-in. pipeline trends in a west-northwest direction, 463 miles to Pecos County, Texas. The La Salle terminal is the pipeline's closest point to the STPEGS (Ref. 2.2-20).

2.2.2.4 Waterways. The primary waterway in the vicinity of the site is the Colorado River, which is used primarily for barge traffic. From the Gulf Intracoastal Waterway, which is 125 ft wide and 12 ft deep, the river winds along a 15-mile stretch until it approaches the turning basin. The river channel is approximately 15 ft deep and 100 ft wide. The minimum depth of the Colorado River between the Gulf and the Crysen Terminal is 7-1/2 ft. During the 12-month period from July 1981 through June 1982, 1,186 barges and 934 tug boats used the river for the transportation of raw and finished materials to the Celanese, DuPont, Parker Brothers, and Crysen facilities. There are presently no plans by the U.S. Army Corps of Engineers (USACE) to enlarge the river for larger operations. However, the USACE has begun a diversion project at the mouth of the Colorado River.

The project is situated on the Texas Coastline approximately one mile south of Matagorda (Figure 2.2-6). The river diversion features are to be located in Matagorda Bay and the Colorado River adjacent to the Gulf Intracoastal Waterway near the town of Matagorda.

The project is expected to enhance the Bay's commercial productivity and take advantage of incidental opportunities to provide flood control and reduce navigation hazards and navigation maintenance dredging. Project details and impacts are discussed in an Environmental Impact Statement prepared by the USACE in March 1981.

2.2.2.5 Airports. The current aerial navigation charts (Houston sectional) show only two airports within 10 miles of the STPEGS. C-Level Farm, 9.5 miles to the west-northwest of the proposed plant, has a 3,700-ft turf runway. The facility is used primarily for crop-dusting operations and for the sale of agricultural aircraft. There are from 2 to 12 aircraft based at the airport, depending on sales stock and crop-dusting operational requirements. During the working seasons, the aerial applicators make approximately 25 to 30 take-offs and landings a day.

Collegeport Airfield, located approximately 8.5 miles to the southwest, is no longer in active use. However, a replacement airfield with a 2,800-ft runway has been constructed about 1/4 mile east of the old runway. The primary use of the airport will be agricultural aviation. During the peak growing season, there will be approximately 100 take-offs and landings per day.

There are, however, another 18 runways within 10 miles. The majority of these facilities are small grass strips used intermittently during aerial application (crop-dusting) operations. These strips are typically 1,800 to 2,600 ft long.

The predominant agricultural aircraft used in the area are the Grumman Ag Cat, the Cessna Ag Truck, and the Cessna Ag Wagon. The Ag Cat has an 80-gallon fuel capacity and can carry 2,000 pounds of chemicals. The Ag Truck and Ag Wagon each can carry 1,800 pounds of chemicals and have 56-gallon fuel capacities. The likelihood of significant plant damage from light aircraft of this type is considered to be remote even in the event of a crash.

The nearest airport with an associated control zone is at Palacios, 13 miles to the west-southwest. Approximately 11 aircraft are based at Palacios, the largest of which is a Twin Beech Bonanza D50. There are approximately 100 to 150 take-offs and landings a week at Palacios. Palacios Airport supports no commercial passenger operations (Figure 2.2-2 and Refs. 2.2-1, 2.2-7, and 2.2-8).

There are no airports within 10 miles of the plant with greater than 500 d^2 (d is the distance in miles from the site) operations annually or farther than 10 miles with greater than 1,000 d^2 operations annually, so no detailed evaluation of probability of an aircraft crash associated with nearby airports is required.

There are two low-level federal airways within 10 miles of the plant. The centerlines of V70 and V20 are approximately 5 and 9 miles, respectively, northwest of the plant. Formerly, low-level federal airway V20S coincided with V70, but V20S has been discontinued. Due to the extent, 4 nautical miles on either side of the centerline, V20 does not pass within 2 miles of the site. An evaluation of the hazard to STPEGS from air traffic on V70 (which does pass within 2 miles of the site) is described in Section 3.5.1.6. The U.S. Air Force and Navy had maintained a flight route designated OB-19 (Olive Branch 19) for the purpose of conducting low-level navigation and bombing training flights in jet aircraft. Use of this route, which passes over the STPEGS site, has been discontinued, effective January 30, 1975. In fact, this route had been inactive since 1972.

The 20 active runways and two low-level federal airways are shown on Figure 2.2-2.

2.2.2.6 Projections of Industrial Growth. The Bay City area, including the vicinity of the STPEGS site, has access to barge, rail, and road transportation and includes large undeveloped areas. It can be anticipated that there will be some industrial growth in the area during the operational life of STPEGS. A survey of the area has revealed the following plans for industrial growth in the area.

The Celanese plant is being modified to increase its production capacity, but these modifications will have no effect on the storage capacity of the toxic gases or chemicals previously discussed, nor will other toxic gases or chemicals that could constitute a hazard to STPEGS be stored there as a result of the modifications.

The Union Carbide Corporation owns a site near Bay City, as shown on Figure 2.2-1. It is anticipated that Chemicals & Plastics of Union Carbide Corporation will develop this site in the future. Due to economic conditions, however, firm plans for the development of the site have not yet been established.

In addition, an LNG terminal has been proposed for a site on Matagorda Bay approximately 35 miles from the STPEGS site. Because of the great distance from STPEGS, we have concluded that this facility does not pose a hazard to STPEGS. This conclusion is supported by safety analyses done by both the El Paso Marine Company and the Federal Power Commission (FPC). The more conservative of these analyses was done by the FPC and indicated the following two modes of risk (Refs. 2.2-18 and 2.2-20):

1. A pool fire from a spill, which could result in fatalities to unprotected individuals at a distance of about 3,830 ft

2. A flammable vapor cloud or plume which, assuming Pasquill stability class F and a wind speed of 1.5 m/sec, would be dispersed to its lower flammability limit within a distance of 26.6 km (16.6 miles)

2.2.2.7 On-Site Bulk Gas Storage. The BGSF contains bulk quantities of hydrogen and nitrogen (both liquified and low-pressure). The storage facilities for these gases are sized to accommodate the maximum expected usage for initial filling of user systems and for two weeks of operational use. The applicable guidance of Electric Power Research Institute (EPRI) Special Report NP-5283-SR-A (Reference 2.2-29) has been incorporated into the design of the BGSF.

The storage facilities are designed to withstand 125 mph sustained winds and a seismically-generated acceleration of 0.1 G both vertically and horizontally. 2
The BGSF is located outdoors and away from spaces that could confine a hydrogen gas cloud. The BGSF design includes excess flow control valves for the hydrogen supply station to prevent excess leakage.

Lighting is provided for the BGSF, and the facility is surrounded by an isolation fence. Vehicle barriers prevent direct access to the facility. The facility is posted as a flammable gas area. The nearest high voltage power lines are approximately 40 feet away from the distribution manifold and 50 feet away from the storage cylinders. The BGSF is located approximately 525 feet due North of the Unit 2 DGB, outside the Protected Area. Vehicle access and hydrogen deliver routes will be from the West side of the site and will utilize FM 521. 2

2.2.3 Evaluation of Potential Accidents

2.2.3.1 Determination of Design Basis Events.

2.2.3.1.1 Industrial Facilities: There are only four industrial facilities located within 5 miles of the plant.

The HVDC facility, located on site, is similar to an AC switchyard in terms of equipment and operation and poses no hazard to the STPEGS plant.

The Parker Brothers facility, which ceased operations in December 1982, was used for unloading oyster shell and presented no hazard to the plant.

The Crysen Terminal facility, which provides storage capacity for 120,000 barrels of gasoline, is located approximately 4.8 miles from the plant site. At this distance, the peak overpressure from an explosion of a 10-percent gasoline-air mixture (the most explosive mixture) is estimated to be less than 0.1 psi with a duration of 0.5 seconds. This will present no hazard to the plant. The peak acceleration due to ground shock is calculated using the data in Reference 2.2-10 as .005g. The velocity of missiles generated by the explosion was computed using an impulse-momentum technique. This was compared with the velocity required to reach the plant site considering aerodynamic drag effects, and it was found that no missiles can reach the plant site. It is concluded that there are no design basis events associated with the Crysen Terminal facility.

The Celanese Chemical Company facility is located almost 5 miles from the plant. Only six of the chemicals stored at and shipped to and from the Celanese Chemical Company pose a potential hazard to STPEGS: anhydrous ammonia, HCl, naphtha, acetic acid, acetaldehyde, and vinyl acetate. The amounts of potentially hazardous chemicals stored in the largest single vessel at the Celanese plant are presented in Table 2.2-5. An analysis (Ref. 2.2-3) was performed to determine the effects that a postulated release of these potentially hazardous chemicals would have on control room habitability. The methods and assumptions of the analysis are in agreement with the guidance given in Regulatory Guide (RG) 1.78 and methodology presented in NUREG-0570 and NUREG/CR-1741. The analysis considered the instantaneous puff release of anhydrous ammonia, while the remaining chemicals were analyzed on the basis of evaporative releases. The results of this analysis show that none of the chemicals stored at or shipped to and from the Celanese Chemical Company pose a hazard to the STPEGS plant.

1. Detection, alarm, and automatic isolation will be necessary for vinyl acetate and anhydrous ammonia.

2. Detection and alarm will be necessary for HCl, acetic acid, acetaldehyde, and naphtha. For each of these chemicals there is sufficient time (greater than 2 minutes) for the control room operators to respond.

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2.2.3.1.2 Transportation: There are no munitions manufacturers or munitions users located near the plant. Therefore, there will be no routine shipments of high explosives on FM 521, which passes near the plant. Analyses were performed assuming the explosion of either an 8,000-gallon gasoline truck or a truck carrying 5 tons of TNT. At 4,000 ft (the closest approach of FM 521 to safety-related structures), there would be no adverse effects due to explosions of gasoline or TNT-loaded trucks due either to overpressure from the blast or missiles generated by the explosion.

The nearest approach of a railway is the industrial spur serving the Celanese Chemical Company. Shipments to and from the Celanese facility will always involve lesser amounts of any hazardous chemicals than the amount stored at the facility. The closest approach of road, rail, and shipping routes is such that STPEGS is in compliance with RG 1.91.

The Colorado River passes approximately 2.75 miles east of the plant. As discussed above for road traffic, there will be no routine shipments of high explosives on this stretch of the river. The largest shipments of petroleum products to the Crysen Terminal will be two 15,000-barrel-capacity barges. At the nearest distance from the plant to the river (2.75 miles), the ground shock acceleration will be less than .01g, and the peak overpressure from the explosion will be less than 0.1 psi. These values are based on the explosion of a 10 percent gasoline/9 percent air mixture in each of the two barges. At 2.75 miles, no missiles generated by this explosion can reach the plant site.

The major shipper of hazardous chemicals on the river is the Celanese Chemical Company. ~~The amounts of potentially hazardous chemicals shipped from the Celanese Chemical Company via FM 521 or the Colorado River are presented in Table 2.2-6.~~ An analysis was performed to evaluate the effects that a postulated release of these chemicals would have on control room habitability. The results of this evaluation show that none of the chemicals transported on the Colorado River pose a credible hazard to STPEGS.

Plant cooling water is supplied from an onsite reservoir. Makeup water is taken from the Colorado River. There would be no safety-related consequences of vessels impacting the river intake structure or from liquid spills of corrosive chemicals in the Colorado River.

2.2.3.1.3 Brush or Forest Fires: The land around the STPEGS site is almost entirely cleared agriculture land. The only wooded area which could support a fire is along the Colorado River. Except for isolated trees, there are no wooded areas within 1 mile of safety-related structures. Underbrush is limited to locations along sloughs or between fields; hence, brush fires would be limited in extent. In addition, the safety-related structures are surrounded on the east, north and west by relocated FM 521 and on the south by the Cooling Reservoir. The plant structures themselves are all surrounded by service roads. Considering the above, forest or brush fires do not represent a credible hazard to STPEGS.

2.2.3.1.4 Pipelines: Table 2.2-2 lists natural gas pipelines in the plant vicinity. The 16-inch-diameter Dow Chemical Company pipeline located 2.1 miles from STPEGS Category I structures and the 30-in. Texas Eastern Transmission Corporation pipeline located 4.5 miles from STPEGS Category I structures have the greatest potential for adverse effect on STPEGS in the event of a pipeline rupture. The effects of a break in each of these pipelines has been evaluated for two cases:

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1. The release and detonation at the break location of the entire amount of gas which could escape from the ruptured pipeline over the course of the accident.

2. The delayed detonation of the gas-air mixture in the plume as the wind blows in the direction of the STPEGS site.

Potential hazard to STPEGS from the oxygen, nitrogen, and hydrocarbon pipelines terminating at the Celanese plant is discussed in Appendix 2.2.B.

The use of existing natural gas pipelines for transport of LNG is not feasible because of the reduced temperatures required (-140 to -300°F). The use of existing gas pipelines for transport of other products could be technically feasible depending on the nature of the products. There is no gaseous product other than natural gas shipped by pipeline in large enough quantities to be a potential hazard to the plant.

Only highly volatile liquids could pose a realistic hazard to the plant. LPG is the major product of concern. A large supply of LPG would have to be developed to economically justify converting and operating the 30-in. Texas Eastern Transmission Corporation pipeline for LPG service. Since the development of such a supply is extremely unlikely in this area, this possible LPG conversion is not considered to be a hazard to STPEGS.

The two Dow Chemical Company pipelines in the plant vicinity carry gas from two gas fields to Dow's plant in Freeport, Texas. There are no existing or potential sources of LPG for transmission through these lines to Freeport and there are no potential markets which would justify reversing flow in these lines.

The other pipelines in the area are part of gathering systems that move natural gas from the producing fields to a central collection point. No potential LPG sources or markets exist to justify conversion of these pipelines.

2.2.3.1.4.1 Detonation of Entire Amount of Gas Released - The assumptions and parameters used in the analysis of this hypothetical occurrence are as follows:

1. Double-ended rupture occurs at point of closest approach to Category I structures (2.1 miles and 4.5 miles).

2. Total quantity of gas released is the sum of that in the pipeline between compressor stations and that released at maximum normal flow during time required to isolate.

   a. Distance between compressor stations: 60 miles for the 16-in. line and 116 miles for the 30-in. line.

   b. Quantity of gas between stations: 1.3×10^6 lb for the 16-in. line and 1.1×10^7 lb for the 30-in. line.

c. Time to isolate: for the 16-in. line, cloud travel time to the plant at 0.71 m/sec plus 1 hour; for the 30-in. line, 1 hour (compressor station is manned 24 hours a day and rupture would be sensed at compressor station immediately).

d. Quantity of gas released in above time at normal flows of 81 lb/sec for the 16-in. line and 163 lb/sec for the 30-in. line: 7.2×10^5 lb for the 16-in. line and 6.2×10^5 lb for the 30-in. line.

3. Explosive equivalent of 10-percent gas-air mixture based on 1,225 Btu/lb mixture and 2,000 Btu/lb TNT: 1.8×10^7 lb TNT for the 16-in. line and 1.1×10^8 lb TNT for the 30-in. line.

4. The resultant overpressures are based on the work of Kinney (Ref. 2.2-11) and are given in Table 2.2-8.

Under the physically impossible conditions described above, the resulting loads on Category I structures are less than those due to the wind loads associated with 290-mph rotational and 70-mph transnational tornadoes (Section 3.3). The occurrence of the above hypothetical event will not affect the ability to safely shut down the plant.

The postulated conditions are considered impossible since it is assumed that all of the gas released over the period of an hour or more will be diluted to within the flammable range without further dispersion. No consideration is given to the upward momentum or buoyancy of the gas. These effects will tend to disperse the gas so that only a small portion of the released gas will be within the flammable range at any given time.

2.2.3.1.4.2 Delayed Detonation of Moving Plume - The assumptions and parameters used in the analysis of this hypothetical occurrence are as follows:

1. Double-ended rupture occurs at point of closest approach to Category I structures (2.1 miles and 4.5 miles).

2. Gas escapes continuously at the rate of 81 lb/sec for the 16-in. line and 163 lb/sec for the 30-in. line.

3. Five-percentile meteorological conditions based on the data given in Section 2.3 without building wake correction.

4. Distance downwind from break using the χ/Q's where the centerline concentrations reach the lower flammability limit of 5 volume percent (2.5×10^{-3} lb/ft^3) and reach the upper flammability limit of 15 volume percent (75×10^{-3} lb/ft^3): 1,020 meters and 540 meters respectively for the 16-in. line and 1,550 meters and 800 meters respectively for the 30-in. line.

5. The amount of gas within the flammability limits based on the amount of gas released in the time for plume to travel between the above points: 5.5×10^4 lb for the 16-in. line and 1.7×10^5 lb for the 30-in. line.

6. The equivalent amount of TNT using the method of item 3 in Section 2.2.3.1.4.1: 5.3×10^5 lb TNT for the 16-in. line and 1.6×10^6 lb TNT for the 30-in. line.

7. The resultant overpressure for a detonation centered at the midpoint of the flammable mixture using the same methods as item 4 in Section 2.2.3.1.4 is given in Table 2.2-8.

Since the overpressure is less than that due to tornado winds, the occurrence of this improbable event will not affect the ability to safely shut down the plant.

The above analysis is conservative since the amount of gas considered in the detonation includes gas off the centerline of the plume which is below the lower flammability limit. This will be particularly significant for the portion of the plume nearest the plant and will not only reduce the equivalent yield but will also increase the effective distance from the plant. The analysis is also conservative because the effects of buoyancy were neglected. Methane has a density of approximately 50 percent of air, which causes the gas to rise and leads to additional dispersion.

2.2.3.1.5 Gas and Oil Production Fields: The gas and oil production fields within 5 miles of the STPEGS site are identified in Section 2.2.2.3 and shown on Figure 2.2-3. (Gas and oil production fields are discussed in more detail in Section 2.5.1.1.6.6.7.2.) The closest well to the STPEGS site is a single well in the South Duncan Slough gas field, approximately 1.6 miles from the nearest STPEGS safety-related structure.

As stated in Section 2.2.1.4.6, it is assessed that there is very little potential for future expansion of the oil and gas fields within 5 miles of the STPEGS site. This conclusion was based on production data from the existing fields and the geological data for the site vicinity. Nevertheless, the likelihood and potential consequences of accidents which might occur during gas or oil well drilling operations or production operations adjacent to the STPEGS site were evaluated. This analysis, summarized in Appendix 2.2.A, shows that even if a gas well is drilled at the worst location immediately adjacent to the STPEGS site there would be no adverse effect on STPEGS safety-related structures. The fields within Matagorda County do not produce hydrogen sulfide gas, and the potential for an accidental release of toxic gas within 15 miles of the STPEGS site is therefore nil. This analysis also shows that the existing gas well located 1.6 miles from the plant poses no credible hazard to the STPEGS plant.

2.2.3.1.6 Plant Site Chemical Storage Protection: The circulating cooling water, the essential cooling water, the potable water, and the auxiliary cooling water will be chemically treated for control of biological growth with a 0.8-percent solution of sodium hypochlorite. Small amounts of liquid chlorine will be stored in the potable water chlorinator at the Nuclear Training Facility. The sodium hypochlorite solution will be generated at the plant site by an electrolytic process which uses sodium chloride and water as raw materials. The diluted sodium hypochlorite solution will present no threat to the control room. The sodium hypochlorite solution, for the essential cooling water system, will be enhanced with a sodium bromide salt 3
and biodispersant.

An analysis of the remaining on-site gases was performed using the guidance from RG 1.78 and the methodology in NUREG-0570 and NUREG/CR-1741. The results of this analysis show that detection, alarm, and automatic isolation will be required for anhydrous ammonia and ammonium hydroxide. none of the remaining chemicals pose a credible hazard to the STPEGS plant. The data for these chemicals can be found in Table 2.2-5.

2.2.3.1.7 Plant Lightning Protection: Measures will be taken on the above-ground outdoor STPEGS appurtenances to prevent damage to either energized or nonenergized structures which could be subject to a direct lightning stroke where receipt of such a stroke could damage critical plant components, including:

1. Lightning arresters will be installed on the generator transformers and other similar energized equipment to provide a direct coupling to ground for lightning stroke-incurred surge current and any followup 60-Hz current.

   At the location of each lightning arrester, an array of buried vertical ground rods or the equivalent will be installed to provide a deep earth coupling with the shortest required length of interconnecting ground cable.

2. Air terminals and downcomers will be provided, as required, for critical nonmetallic plant structures not effectively shielded from a direct lightning stroke by an adjacent structure.

   Air terminals, as required, will be provided on metallic plant structures which are not otherwise effectively shielded where a direct lightning stroke could damage a structure to the detriment of proper plant operation.

3. Ground rods or the equivalent will be installed as part of the overall plant grounding system and also specifically as stated in item 2.

4. All measures, devices and considerations of lightning protection requirements shall be in accordance with the National Fire Protection Association's (NFPA's) "Lightning Protection Code - NFPA No. 78", (Ref. 2.2-10).

2.2.3.1.8 Hydrogen Gas Explosions: An analysis has been performed of the effects of a detonation involving the hydrogen gas stored in bulk in the on-site BGSF. Per the guidance of Reference 2.2-29, this analysis assumes that one of the hydrogen cylinders in the BGSF ruptures and its contents are instantaneously released. The hydrogen fully forms a "puff," and the gas immediately detonates. The "puff" cloud of the gas was assumed to have a Gaussian concentration distribution (per the model described in Regulatory Guide 1.78). Dispersion of the hydrogen due to winds and the buoyancy of the hydrogen is conservatively neglected. 2

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The analysis assumes that the release becomes well mixed with air. The detonation concentration range for the gas-air mixtures is assumed in the analysis to be from 4% to 74.2% hydrogen by volume. This range is much larger than the detonation concentration range for hydrogen which is normally 18% to 59% hydrogen by volume in air. This assumption conservatively over-estimates the amount of hydrogen that detonates.

The results of the analysis show that the radius of the maximum acceptable over-pressure circle for the explosion of hydrogen (as defined in RG 1.91, Revision 0) is 163 feet. The nearest safety-related structure to the BGSF is the Unit 2 DGB, which is approximately 525 feet away. Therefore, detonation of the hydrogen in the BGSF does not pose a threat to safety-related structures. 2

Analyses for the nitrogen pressure vessels at the BGSF have been performed to determine the burst energies of the vessels. The resulting energies were converted to equivalent amounts of TNT, and the radii of the maximum acceptable over-pressure circles (per RG 1.91, Revision 0) are shown in Table 2.2-7. The peak reflected over-pressures for the DGB North wall due to ruptures/explosions of the BGSF tanks are given in Table 2.2-7 as well.

The results of these analyses show that the BGSF vessels do not present a threat to safety-related structures.

2.2.3.2 Effects of Design Basis Events. Plant design features incorporated as a result of the design basis events identified in Section 2.2.3.1 are:

1. Detection and alarm for HCl, acetic acid, acetaldehyde, and naphtha will be necessary to allow ample time for control room personnel to don protective breathing apparatus.

2. Detection, alarm and automatic isolation for anhydrous ammonia, ammonium hydroxide, and vinyl acetate will be necessary to allow ample time for control room personnel to don protective breathing apparatus.

A description of the instrumentation and automatic isolation features is provided in Section 9.4.1.3.

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2.2-2 Not Used.

2.2-3 Onsite Toxic Gas Analysis (NC9006); Offsite Toxic Gas Analysis (NC9015).

2.2-4 Not Used.

2.2-5 Not Used.

2.2-6 Not Used.

2.2-7 U.S. Department of Commerce, "Sectional Aeronautical Chart-Houston-11th Edition", Atmospheric Administration, National Ocean Survey, Washington, D.C. (March 29, 1973).

2.2-8 U.S. Department of Transportation, "Airman's Information Manual, Pt. 4-Graphic Notices and Supplemental Data", Federal Aviation Administration (July 1973).

2.2-9 Not Used.

2.2-10 Iotti, R. C., W. J. Krotiuk, and D. R. DeBoisblanc, "Hazards to Nuclear Plants From On (Or Near) Site Gaseous Explosions", in Topical Meeting on Water Reactor Safety, G. A. Freund compiler, CONF-730304 (March 1973), pp. 641-661.

2.2-11 Kinney, G. R., "Engineering Elements of Explosions", AD844917 (November 1968).

2.2-12 Not Used.

2.2-13 Not Used.

2.2-14 National Fire Protection Association, "Lightning Protection Code - NFPA No. 78".

2.2-15 Not Used.

2.2-16 Not Used.

2.2-17 Not Used.

2.2-18 "Analysis of the Risk to the Public Due to the Marine Transportation of Liquified Natural Gas in the Matagorda Ship Channel, Texas", draft environmental impact statement for the Matagorda Bay Project, Attachment A, Federal Power Commission Docket No. CP77-330 et al., July 1977.

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REFERENCES (Continued)

Section 2.2:

2.2-19 Not Used.

2.2-20 Joint LNG Safety Study of El Paso Atlantic Company, El Paso Eastern Company, and El Paso LNG Terminal Company in support of applications for import authorizations and certificates of public convenience and necessity respecting the proposed Algeria II Project, Docket No. CP73-258 et al., April 1, 1977.

2.2-21 Not Used.

2.2-22 Not Used.

2.2-23 Not Used.

2.2-24 Not Used.

2.2-25 Not Used.

2.2-26 Not Used.

2.2-27 Not Used.

2.2-28 FPC Draft Environmental Impact Statement, Matagorda Bay Project, July 1977, page 25.

2.2-29 "Guidelines for Permanent BWR Hydrogen Water Chemistry Installations - 1987 Revision," EPRI NP-5283-SR-A (September 1987). 2

TABLE 2.2-1

DESCRIPTION OF INDUSTRIAL FACILITIES

Facility	Location Relative to STPEGS	Hazardous Products/Function	No. of Employees
Celanese Chemical Co.	4.8 mi NNE	acetic acid anhydrous ammonia hydrochloric acid naphtha vinyl acetate acetaldehyde	400-500
K and K Compression Co.	5.5 mi NNE	none	0
Crysen Terminal	4.8 mi NNE	loading dock	6
Parker Brothers Facility	3.5 mi E	none	0
Dupont Facility (HDPE Plant)*	7 mi E	sulfuric acid sodium hydroxide hexane fuel oil (no. 2) toluene gasoline diesel fuel 1-butene propylene hydrogen	150

*Due to their location outside the 5-mile radius, the listed hazardous materials are not to be included in the hazardous chemical analysis.

TABLE 2.2-2

NATURAL GAS PIPELINES

Operator	TETCO	Valley	Amoco	Delhi	Dow	
Line Size (in.)	30	8	4	4	16	12
Age (yrs)	17	10	11	5	20	26
Design Pressure (psig)	1,100	(1)	(2)	(3)	1,000	700
Depth of Cover (in.)	30	24-36	36	36	30	24
Distance from Site (mi)	4.5	2.9	3.4	1.6	2.1	2.1

1. Test pressure 1,800 psig, operating pressure 500-600 psig.
2. Test pressure 1,800 psig; operating pressure 700 psig.
3. Test pressure 2,000 psig; operating pressure 500-600 psig.

Table 2.2-3 is not used.

TABLE 2.2-4

CONFIGURATION AND EXPLOITATION OF SALT DOMES IN MATAGORDA COUNTY AND ADJACENT GULF COAST REGION

Name	County	Top of Caprock (ft)	Top of Salt (ft)	Vol** of Salt (mi^3)	Sulfur Prod.	Brine Prod.
Barbers Hill	Chambers	350	1,000	5.1		X
Big Hill	Jefferson	200	1,300	2.6		
Blue Ridge	Ft. Bend	143	230	1.3		X
Clemens	Brazoria	530	1,380	1.9		
*Day	Madison	2,780	3,167	-		
Fannett	Jefferson	741	2,080	1.0	X	
Hull	Liberty	260	595	2.6		
Markham	Matagorda	1,380	1,417	1.9		X
Pierce Junction	Harris	630	860	1.3		X
Sour Lake	Hardin	660	719	1.8		
Stratton Ridge	Brazoria	850	1,250	9.6		X

*Not shown on Figure 2.2-4: 150 miles north of site
**Salt volume estimated from top of salt to a depth of 10,560 ft

TABLE 2.2-5

POTENTIALLY HAZARDOUS CHEMICALS STORED AT CELANESE CHEMICAL COMPANY AND ON THE STPEGS SITE

Chemical	Amount (lbs)	Distance (ft)	Toxicity (ppm) Limit	χ/Q (sec/m^3)
Acetic Acid	7.9×10^6	2.5×10^4	10	2.77×10^{-5}
Vinyl Acetate	4.1×10^6	2.5×10^4	10	2.92×10^{-5}
Naphtha	2.1×10^6	2.5×10^4	500	8.54×10^{-6}
Anhydrous Ammonia	9.9×10^3	398	25	3.26×10^{-3}
Ammonium Hydroxide	1.03×10^5	406	25	1.36×10^{-3}
Acetaldehyde	7.5×10^5	2.5×10^4	100	3.15×10^{-5}
Hydrogen (BGSF)	1.05×10^3	525	163	N/A

The ambient temperature was assumed to be 100°F. The control room was taken to be a type C per RG 1.78 for the initial screening of chemicals, with a flow pattern as presented in Figure 2.2-5.

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TABLE 2.2-6

POTENTIALLY HAZARDOUS CHEMICALS SHIPPED FROM THE CELANESE CHEMICAL COMPANY

Chemical	Truck Quantity (lbs)	Barge Quantity (lbs)	χ/Q (sec/m^3)
Acetic Acid	4.8×10^4	2.85×10^6	3.25×10^{-4}**/5.96×10^{-5}
Vinyl Acetate	--	2.54×10^6	5.95×10^{-5}
Anhydrous Ammonia	4.3×10^4	--	2.35×10^{-4}
Hydrochloric Acid*	4.8×10^4	--	2.35×10^{-4}
Acetaldehyde	4.8×10^4	--	3.23×10^{-4}

* A hydrochloric acid toxicity limit of 5 ppm was used.
** Truck route χ/Q value.

The ambient temperature was assumed to be 100°F. The control room was taken to be a type C per RG 1.78 for the initial screening of chemicals, with a flow pattern as presented in Figure 2.2-5.

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TABLE 2.2-7

EFFECTS OF TANK RUPTURES/EXPLOSIONS FOR GASES STORED IN BULK ON-SITE

Stored Gas	Number of Vessels	Volume/ Vessel (FT^3)	Pressure (PSIG)	Temp. (°F)	RG 1.91 Rev. 0 Radius	Peak Reflected Pressure @ DGB
Hydrogen	24	56	2400	70	163 ft	0.396 psi
LP N_2	1	1471	185	-305	136 ft	0.302 psi
HP N_2	12	56	2400	70	121 ft	0.253 psi

TABLE 2.2-8

EFFECTS OF BREAKS IN NATURAL GAS PIPELINES

	Detonation of Entire Amount of Gas Released		Delayed Detonation of Moving Plume	
Line	16" Dow	30" TETCO	16" Dow	30" TETCO
Amount of gas (lb)	2.02×10^6	1.16×10^7	5.5×10^4	1.7×10^5
TNT equivalent (lb)	1.8×10^7	1.1×10^8	5.3×10^3	1.6×10^6
Distance from plant (mi)	2.1	4.5	1.6	3.4
Peak side on overpressure (psi)	0.7	0.6	0.21	0.15
Peak reflected overpressure (psi)	1.5	1.3	0.42	0.31
Positive phase duration (sec)	0.8	1.4	0.27	0.41

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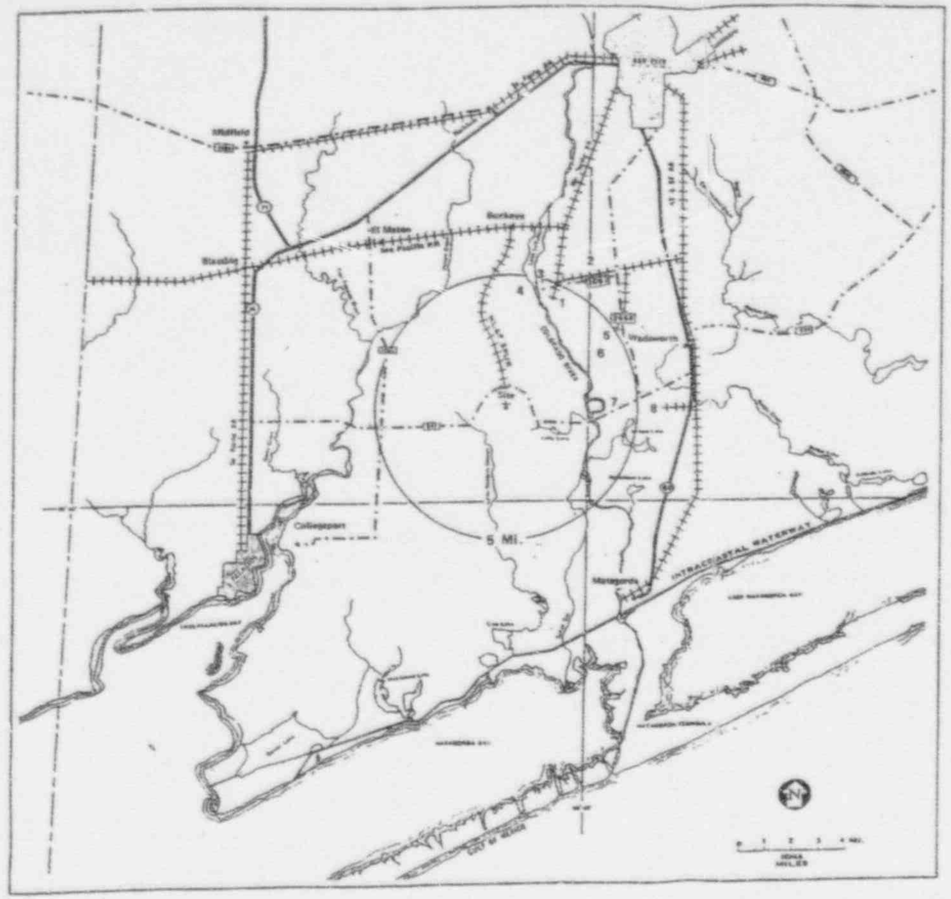

LEGEND:

Highways	
Local	
State	
Railroads	
County Line	
Incorporated Towns	
Unincorporated Towns	
Celanese Chemical Co.	1
K&K Compression Site	2
Cryzen Terminal	3
Union Carbide Site	4
Cities Service Site	5
Dow Chemical Site	6
Parker Bros. Facility	7
DUPONT FACILITY	8

SOUTH TEXAS PROJECT
UNITS 1 & 2

INDUSTRIAL FACILITIES IN THE IMMEDIATE ENVIRONS OF THE SOUTH TEXAS PROJECT

Figure 2.2-1 0198 Revision 0

UFSAR SECTION 6.4

Habitability Systems

Affected Sections:	6.4.1.6	Noxious Gas Protection
	6.4.4.2	Toxic Gas Protection

6.4 HABITABILITY SYSTEMS

The habitability systems for the control room envelope are designed in accordance with the design bases described in Section 6.4.1 so that habitability of the control room envelope can be maintained under normal and accident conditions. The habitability systems and provisions include:

1. Shielding

2. Control room air purification and pressurization (includes makeup and cleanup filtration units)

3. Kitchen and sanitary facilities

The general guidance contained in General Design Criterion (GDC) 19 of 10CFR50, Appendix A, is reflected throughout this section.

6.4.1 Design Bases

The functional design of the habitability systems and their features are established by the following design bases:

6.4.1.1 Control Room Envelope. The control room envelope is located at El. 35 ft and in two heating, ventilating, and air conditioning (HVAC) rooms at El. 10 ft and 60 ft. in the Electrical Auxiliary Building (EAB) as shown in Figure 6.4-1.

The control room envelope is provided with HVAC equipment, fire protection equipment, adequate lighting, communication equipment, kitchen, sanitary, administrative and storage facilities, and spaces required for normal plant operation and for maintaining the plant in a safe condition following an accident.

6.4.1.2 Habitability. The control room envelope is equipped to maintain the control room atmosphere at environmental conditions suitable for occupancy per GDC 19.

6.4.1.3 Capacity. The normal occupancy level of the control room envelope is 10 persons.

6.4.1.4 Food, Water, Medical Supplies, and Sanitary Facilities. Food, water, basic medical supplies, and first-aid equipment are provided by the Emergency Response Organization in the event of an emergency. Kitchen and sanitary facilities including toilets, washrooms, and lockers are provided within the control room envelope. If emergency conditions require confinement, food is brought onsite in protected containers. Site accessibility is determined by the Radiological Services. Potable water required for toilet, kitchen, and lavatory is provided by a storage tank during plant emergency. One gallon of water per person per day is provided for drinking, food preparation, and medical needs. The Potable and Sanitary Water System is described in Section 9.2.4. Should this system become unavailable during an emergency period, bottled water could be brought into the control room envelope if required.

Normal sanitation facilities are available as described in Section 9.2.4.

6.4.1.5 Radiation Protection. Radiation protection as required by GDC 19 of 10CFR50, Appendix A, is provided by shield walls, shield slabs at floor and ceiling, radiation monitoring equipment, and emergency filtering units. Assumptions and analyses regarding sources and amounts of radioactivity which may surround or leak into the control room envelope are discussed in Sections 6.4.4.1 and 15.6.5. Related shielding requirements are discussed in Section 12.3.2. The Radiation Monitoring System (RMS) is discussed in Sections 11.5 and 12.3.4.

6.4.1.6 Noxious Gas Protection. Smoke detectors located in the control room envelope return air duct actuate alarms and display them to the operators in the control room to indicate the presence of smoke in the control room envelope. Additionally, the control room envelope can be purged of smoke by outside air if required as described in Section 9.4.1.

Redundant chemical detectors and smoke detectors located in the outside air intake provide the control room envelope with automatic isolation from potentially hazardous chemicals in the event of an onsite or offsite chemical spill accident. This isolation capability is discussed in Section 9.4.1.3. These same redundant detectors also provide for detection and alarm for specific chemicals. Refer to Section 2.2.3 for an evaluation of Hazardous Chemicals located on- and off-site.

6.4.1.7 Respiratory Apparatus for Emergencies. A 6-hour supply of breathing air and self-contained breathing apparatus (including required redundant apparatus) will be provided for the emergency team with provision for obtaining additional air beyond the 6-hour limit. A minimum of 1-hour supply with redundancy will be provided within the control room envelope. A portion of the total 6-hour supply may be stored elsewhere in the EAB in locations easily accessible to the emergency team, if required due to storage limitations within the envelope.

6.4.1.8 Habitability Systems Operation During Emergencies. Operation of the habitability systems during emergencies is discussed in Section 9.4.1. Fire protection for the control room envelope is discussed in Section 9.5.1.

6.4.1.9 Radiation Monitors. Radiation monitors are discussed in Sections 11.5 and 12.3.4.

6.4.2 System Design

6.4.2.1 Definition of Control Room Envelope. The areas included in the control room envelope to which the control room operator could require access during an emergency are the following:

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1. Control room main control board and monitoring panel area - Continuous occupancy required.

2. Computer room - Infrequent access required.

3. Shift supervisor's office - Infrequent access required.

4. Shift engineer's office - Infrequent access required.

5. Men's toilets and bunks - Infrequent access required.

6. Women's toilets and bunks - Infrequent access required.

7. Kitchen - Infrequent access required.

8. Relay Room - Infrequent access required.

9. Lobby - Infrequent access required.

10. Results Engineer's Office - Infrequent access required.

11. Control Room HVAC equipment rooms other than makeup filter unit rooms - clean surrounding required because of inleakage and infrequent access required.

The equipment to which control room operators could require access during an emergency is listed in Table 6.4-1 and the layout of the control room envelope is given in Figures 6.4-1 and 6.4-2.

6.4.2.2 Ventilation System Design. The control room envelope HVAC system is designed to maintain the control room envelope area at room design temperature and relative humidity conditions given in Table 9.4-1. The HVAC system is also designed to maintain the control room envelope at a minimum of 0.125-inch water gauge (wg) positive pressure relative to the surrounding area, following postulated accidents other than hazardous chemical/smoke releases and/or Loss-of-Offsite Power (LOOP), by introducing makeup air equivalent to the expected exfiltration air during plant emergency conditions (Engineered Safety Features [ESF] signal and/or high radition in outside air). The design outside makeup air is 2,000 ft^3/min and drawn from a single intake on the east side of the EAB at El. 80 ft-0 in. (Figure 9.4.1-2). This arrangement minimizes any possibility of contaminants infiltrating the control room envelope from the surrounding areas. Additionally, during postulated accident conditions, on detection of high radiation in the outside air or safety injection (SI) signal, outside makeup air for the control room envelope is automatically routed through makeup air units and cleanup units containing charcoal filters. The control room air is also automatically recirculated partially (i.e., 10,000 ft^3/min) through control room air cleanup units containing charcoal filters. This arrangement provides cleanup of the control room air. A LOOP event by itself does not start the makeup air units, but it does isolate the control room envelope and start cleanup units.

The design features, fission product removal capability, and protection capability of the control room envelope HVAC system are as follows:

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1. Normal and emergency ventilation of the control room envelope area are discussed in Section 9.4.1. The system configuration is shown on Figure 9.4.1-2. Principal components, ducts, dampers, instrumentation, and airflows for normal and emergency modes are indicated in the above-mentioned figure.

2. Design parameters and data for major system components are listed and described in Table 9.4-2.1.

3. Control room envelope HVAC system components, essential instrumentation, ducting, and outside air intake are designed in accordance with seismic Category I requirements. The components are not subject to the effects of floods, hurricane, tornado, internal or external missiles, pipe whip, or jet impingement. Tornado damper and missile shielding is provided at the outside air intake to protect the system components from tornado and external missiles.

Figures 1.2-28, 12.3.1-9, and 12.3.1-18 present layout drawings of the control room envelope showing doors, corridors, stairwells, shielded walls, and the placement and type of equipment within the control room envelope. The location of control room air inlets is shown on Figure 1.2-30.

A description of the emergency filter trains, their filtration capability, and the extent of their compliance with Regulatory Guide (RG) 1.52 are presented in Section 6.5.1.

6.4.2.3 Leaktightness. The HVAC system is designed to maintain the control room envelope at 0.125-in. wg positive pressure relative to the surrounding area during emergency conditions. The control room envelope HVAC system operates on a continuous basis. During the plant emergency operation mode, the following potential paths of air infiltration to the control room envelope exist.

1. Outside air normal intake isolation dampers, return air smoke relief dampers and exhaust air dampers in the control room envelope HVAC system. These dampers are used for isolating the control room envelope.

2. Penetration space around supply air, return air and exhaust air ducts in the control room envelope and chase walls and floors.

3. Penetration space around electrical conduits and cables in the control room envelope and chase walls and floors.

4. Penetration space around piping in the control room envelope and chase walls and floors.

5. Space around doors.

6. Makeup filter units and associated ductwork outside the envelope.

A review of these leak paths, as summarized below, indicates that infiltration through these paths during the plant emergency mode is minimal.

1. In the control room envelope HVAC system, the outside air normal intake dampers, return air smoke relief dampers, and exhaust air dampers are designed leak-tight with a 5-second closure time.

2. Supply air, return, air and exhaust air duct penetrations in the control room envelope walls and floors are sealed airtight (seal-welded).

3. Penetration space around electrical and control conduits and cables in the control room envelope and chase walls and floors are sealed airtight.

4. Penetration spaces around chilled water piping for HVAC equipment, piping to plumbing fixtures, drains, and potable water piping in the control room envelope and chase walls and floors are sealed airtight.

5. Doors leading from the control room envelope at El. 35 ft to the EAB and the Mechanical Auxiliary Building (MAB) are 3-hour-fire rated automatic closures. The doors leading from the control room envelope to the electrical penetration area, the MAB, and the Diesel Generator Building (DGB) are provided with air locks. None of the control room envelope doors leads directly to the outside. All doors lead to closed chase spaces, closed stairwells, or closed corridors and are designed for low leakage. Thus, the effect of outside wind or other adjoining building ventilation systems on infiltration or leakage into the control room envelope is insignificant. The elevator door at elevation 35 ft is a potential leak path and therefore is provided with an air lock.

6. Makeup filter units and associated ductwork downstream of the unit are pressurized to prevent inleakage and are designed for low leakage.

6.4.2.4 Interaction with Other Zones and Pressure-Containing Equipment. The control room envelope HVAC system is not connected to other areas or HVAC systems where the potential for radioactivity exists, except for sharing common air intake and exhaust with the remaining EAB. The computer and relay rooms are provided with fire protection by a total flooding halon system. In the event of fire in these areas, these rooms are flooded with Halon 1301. The supply and return air ducts of the ventilation system for these areas are automatically sealed with isolation dampers preventing the escape of Halon 1301 to the remaining control room envelope. Any leakage of halon around the 3-hour-rated fire doors of the computer room and the relay room is diluted by the volume of control room envelope. The other rooms in the control room envelope are provided with portable fire extinguishers or deluge water spray fire protection. All HVAC ducts penetrating fire walls in the control room envelope are provided with quick-acting fire dampers which isolate the fire affected room from adjoining rooms.

As described in Section 6.4.2.3 above, the control room envelope is maintained at 0.125-in. wg positive pressure relative to the surroundings during emergency conditions. Additionally, as described in Section 6.4.2.2, above, upon detection of an unacceptable level of airborne radioactivity in the outside makeup air of the control room envelope HVAC system or receipt of an SI signal, the makeup air and part of control room envelope recirculation air are filtered by makeup air units and control room air cleanup units containing charcoal filters.

There are no pressure-containing tanks, pipes, or equipment containing hazardous materials in the control room envelope. In the event of an inadvertent release of hazardous materials from outside of the control room, the low-leakage fire-rated doors of the control room envelope will prevent a significant transfer of such materials into the control room envelope.

6.4.2.5 Shielding Design. The control room envelope radiation shielding design is discussed in Section 12.3.2.

6.4.3 System Operational Procedures

The method of operation of the control room envelope HVAC system during normal plant and emergency conditions is described in Section 9.4.1.

6.4.4 Design Evaluation

Each of the operating systems which ensures control room envelope habitability is discussed in detail in other sections. These systems and the sections in which they are discussed are:

Electrical Auxiliary Building HVAC Systems	9.4.1
Fire Protection System	9.5.1
Communication System	9.5.2
Lighting System	9.5.3
Offsite Power System	8.2
Onsite Power System	8.3
Radiation Monitoring System	11.5, 12.3.4

6.4.4.1 Radiological Protection. The control room envelope HVAC system has been designed to limit the dose equivalent to the plant operators from airborn radioactivity after a Design Basis Accident (DBA).

The postulated Loss-of-Coolant Accident (LOCA) has been qualitatively determined to be the DBA resulting in the highest control room operator doses. The radioactive transport model is described in Section 15B. Refer to Section 15.6.5 for a discussion of the offsite environmental consequences of a postulated LOCA, using the assumptions of RG 1.4. These assumptions have also been used for the control room dose analysis. Due to the close proximity of the charcoal filters to the control room envelope, the filter units dose contributions were considered in the control room envelope dose analysis.

The emergency HVAC for the control room envelope is discussed in Section 9.4.1. The system configuration is shown on Figure 9.4.1-2. The mathematical model used to represent the system uses a single outside air intake and a filtered pressurization inflow which mixes with part of the return air, and then the mixed air is filtered again before being supplied to the air-handling unit along with the remaining return air. If one train of control room HVAC is inoperable, for example due to diesel generator failure, not all of the makeup air would be filtered twice before it is introduced into the control room envelope. In the worst case, 235 cfm of the makeup air is filtered by the makeup units, but not by the recirculation units, before it is introduced into the control room envelope. The air-handling unit supplies the conditioned air to the control room envelope. A summary of these parameters is presented in Table 6.4-2. An unfiltered inleakage of 10 scfm to the control room envelope has also been assumed (Ref. 6.4-4). 2

The atmospheric releases from the Containment purge valves prior to closure, the Refueling Water Storage Tank (ESF leakage) and from the Fuel Handling Building (FHB) (ESF leakage) are assumed to be transported to the control room envelope air intake by the atmospheric (meteorological) conditions existing at the time. These conditions are estimated using the methods of Reference 6.4-4. The atmosphere dispersion factors for each case can be found in Table 6.4-2. 3

The inhalation thyroid dose and the semi-infinite cloud gamma and beta doses are calculated using the time-integrated concentrations in each area and the occupancy factors noted in Table 6.4-2. The semi-infinite cloud model remains appropriate only for the beta dose, due to the short range of beta particles. The semi-infinite cloud gamma dose calculated is divided by a geometric factor which converts the semi-infinite gamma dose to a finite dose (Ref. 6.4-4). This factor is given as:

$$GF = \frac{1173}{V_{0.338}}$$

where:

V = volume of region of interest, ft3

The resulting doses to control room personnel are given in Table 6.4-2.

The calculated thyroid dose total is less than the design limit of 30 roentgen equivalent man (rem), as is the skin beta dose total. The total whole-body gamma dose is less than the design limit of 5 rem. Thus the control room envelope HVAC System design meets the dose requirements of GDC 19 of 10CFR50, Appendix A.

6.4.4.2 Toxic Gas Protection. The general guidance contained in RG 1.78, has been considered in the design of the control room envelope HVAC ~~system, as described in Section 9.4.1.~~

The habitability of the control room was evaluated using the procedures described in Regulatory Guide 1.78. As indicated in Section 2.2, no offsite storage or transport of chemicals is considered a hazard to the plant based on the Offsite Toxic Gas Analysis (Ref. 2.2-3). There are no onsite chemicals that pose a credible hazard based on the Onsite Toxic Gas Analysis (Ref. 2.2-3). Therefore, special provisions for protection against toxic gases are not required In accordance with the plant emergency plans and procedures, self contained breathing apparatus is provided for assurance of control room habitability.

6.4.5 Testing and Inspection

Systems and their components, listed in Section 6.4.4 above, which maintain control room envelope habitability are subjected to documented preoperational testing and inservice surveillance to ensure continued integrity. The tests conducted verify the following for both normal and emergency conditions.

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1. System integrity and leaktightness

2. Inplace testing of emergency filter plenums to establish leaktightness of plenums and design parameters of the high-efficiency particulate air and charcoal filters

3. Proper functioning of system components and control devices

4. Proper electrical and control wiring

5. System balance for design airflow, water flow and operational pressures

6.4.5.1 Control Room Envelope HVAC System Integrity and Leaktightness Test. The control room envelope is leak tested prior to plant startup and subsequently in accordance with the Technical Specifications.

6.4.5.1.1 Considerations Leading to the Selected Test Frequency: The frequency of performing this test is determined by the following considerations:

1. Preoperational test data

2. Normal control room envelope HVAC system performance data, as correlated to the cleanup cycle performance data

3. Periodic monitoring of the control room envelope HVAC system, which gives an indication of building tightness and system performance

6.4.5.1.2 Test Methods: The test is conducted by closing all the access points to the control room envelope including doors, temporary openings, etc.

Control room envelope pressure is established by setting the return air volume to less than the supply air volume such that the design pressure is achieved. Tests are repeated as often as necessary until the acceptance criteria are met. Control room envelope pressure and outside makeup airflow rate are measured by the portable pressure gauges and/or permanently installed flow monitors in the ductwork.

6.4.5.1.3 Acceptability Requirements: The result of the final leak test is accepted if the control room envelope makeup airflow does not exceed 2,000 ft^3/min at a positive envelope pressure of $\geq$0.125-in. wg. This criterion is based on a measuring accuracy of $\pm$1 percent of full scale on pressure reading and $\pm$5 percent of full scale on airflow reading.

6.4.5.2 In-Place Testing of Emergency Filter Units. In-place testing of control room envelope HVAC system emergency filter units is performed prior to system startup and thereafter in accordance with the guidelines contained in RG 1.52. This testing is described in Section 9.4.1.4.

6.4.5.3 Other Tests. Tests to verify proper functioning of control room envelope HVAC system components and control devices, proper electrical and control wiring, and system design air and water flow are described in Section 9.4.1.4.

6.4.5.4 Inspection. After control room envelope HVAC system testing, balancing, and startup procedures have been completed, the system is periodically and routinely inspected as per the Technical Specifications.

6.4.6 Instrumentation Requirement

The control logic and the instrumentation required to actuate the control room envelope HVAC system are described in Section 7.3. Instruments for monitoring the makeup and cleanup air filter units are described in Section 6.5.1.5. The instrumentation and controls provided to ensure the habitability of the control room envelope are discussed in Section 9.4.1.

Control room envelope radiation monitoring instruments are discussed in Sections 11.5 and 12.3.4.

REFERENCES

Section 6.4:

6.4-1 Not Used

6.4-2 Not Used

6.4-3 Department of Defense, Office of Civil Defense, Shelter Design and Analysis, Vol. 3, Chapter 9.

6.4-4 Murphy, K. G., and K. M. Campe, "Nuclear Power Plant Control Room Ventilation System Design for Meeting General Criterion 19", 13th AEC Air Cleaning Conference, August 1974.

TABLE 6.4-1

EQUIPMENT TO WHICH THE CONTROL ROOM OPERATORS COULD REQUIRE ACCESS DURING AN EMERGENCY

Item or Equipment	Location Within Control Room Area
Control and monitoring panels	See Figure 6.4-2
Portable radiation measuring instruments	Storeroom
Emergency procedures, manuals, and drawings	Storage space
Self-contained breathing apparatus	See Section 6.4.1.7
Communications equipment	Operator's desk
Fire-extinguishing equipment	All rooms
Control room cleanup filter units	Control Room Envelope HVAC Equipment Rooms

TABLE 6.4-2

CONTROL ROOM DOSE ANALYSIS

Assumptions

Containment leakage assumptions (Based on a containment free volume of 3.41 x 10^6 ft^3)	0.3% (0-24 hrs) 0.15% (1-30 days)
ESF system leakage into the FHB assumptions	8,280 cm3/hr
ESF system leakage into the RWST assumptions	1,740 cm^3/hr
Pressurization makeup air inflow parameters:	
flow rate	2,000 ft3/min
filter efficiency *	98.5% inorganic, 98.5% organic, 99% particulate
Control room envelope clean-up air (recirculation) parameters:	
filtered flow rate (recirculation air)	10,000 ft3/min
filter efficiency	95% inorganic, 95% organic, 99% particulate
envelope free volume	274,080 ft3
envelope unfiltered inleakage	10 ft3/min

Meteorological dispersion factors (including wind speed and direction allowances):

	Containment Leakage Case	ESF Leakage and Purge Case
0-8 hours	1.06×10^{-3} sec/m3	1.29×10^{-2} sec/m3
8-24 hours	7.03×10^{-4} sec/m3	8.55×10^{-3} sec/m3
1-4 days	4.45×10^{-4} sec/m3	5.42×10^{-3} sec/m3
4-30 days	1.91×10^{-4} sec/m3	2.32×10^{-3} sec/m3

* 1765 cfm is filtered through makeup and recirculation filters; 235 cfm is filtered through makeup filters only. Effective filter efficiency for 2000 cfm is given above.

TABLE 6.4-2 (Continued)

CONTROL ROOM DOSE ANALYSIS

Assumptions (Cont'd)

Occupancy assumptions:

24 hours, control room	100%
1-4 days, control room envelope	60%
4-30 days, control room envelope	40%

Breathing rate of operator 3.47×10^{-4} m^3/sec

Results

Operator dose, 0-30 day period (rem):	Thyroid	Whole-Body Gamma	Skin Beta
Containment leakage	21.03	1.69	21.52
ESF leakage into the FHB	1.58	6.59×10^{-5}	3.94×10^{-4}
ESF leakage into the RWST	0.62	3.8×10^{-5}	6.1×10^{-6}
Containment purging	0.058	6.14×10^{-5}	9.86×10^{-4}
Direct dose from Containment	---	0.07	---
Direct dose from cloud of released fission products	---	0.67	---
Iodine filter loading	---	2.72×10^{-3}	---
Total	23.29	2.43	21.52

3

TABLE 6.5-3

INPUT PARAMETERS TO DETERMINE MINIMUM pH FOR SUMP SOLUTION

RWST deliverable volume, ft^3	70,533
RWST boron concentration, ppm	3,000
Accumulator water volume, each of 3, ft^3	1,229
Accumulator boron concentration, ppm	3,000
Reactor coolant system water mass, lb	626,000
Reactor coolant boron concentration, ppm[1]	1,800
Trisodium Phosphate, lb[2]	11,500
Resultant Solution pH	7.0

1. Based upon current fuel management, the maximum RCS Boron Concentration is 1550 ppm. 1800 ppm is the projected value of 18 month or longer future fuel cycles.

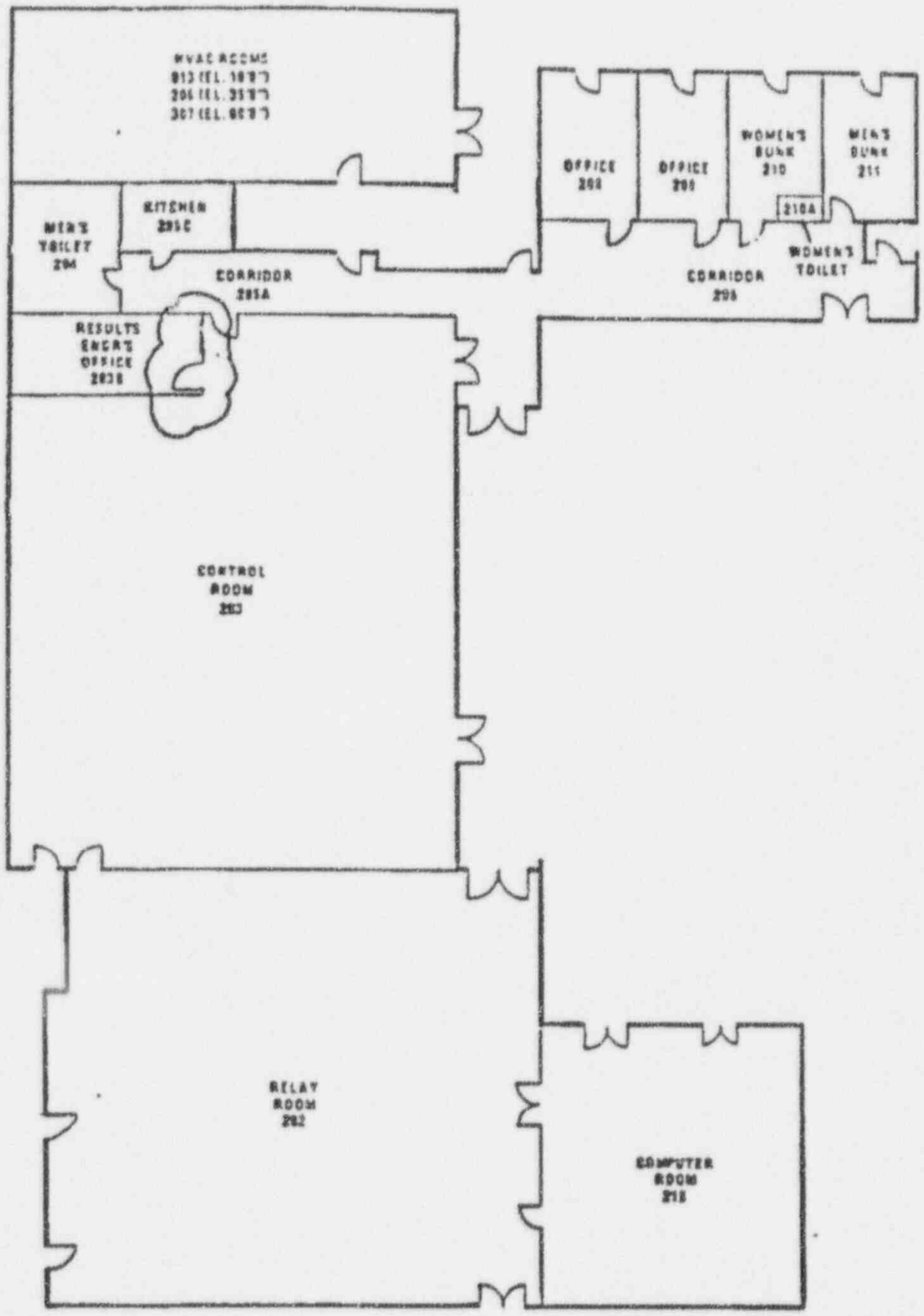
2. $Na_3PO_4 \bullet 12\ H_2O$ which contains a minimum of 43% Na_3PO_4.

TABLE 6.5-4

INPUT PARAMETERS TO DETERMINE MAXIMUM pH FOR SUMP SOLUTION

RWST deliverable volume, ft^3	47,256
RWST boron concentration, ppm	2,800
Accumulator water volume, each of 3, ft^3	1,172
Accumulator boron concentration, ppm	2,700
Reactor coolant system water mass, lb	626,000
Reactor coolant boron concentration, ppm	0
Trisodium Phosphate, lb[1]	15,100
Resulting Solution pH	7.5

1. Assumes that each of 6 Trisodium Phosphate baskets (~42 ft^3) is filled with TSP to the maximum level. The maximum TSP density is 60 lb/ft^3. The specified mass of TSP is based upon $Na_3 \bullet PO_4 \bullet 12H_2O$ which contains a minimum of 43% Na_3PO_4.

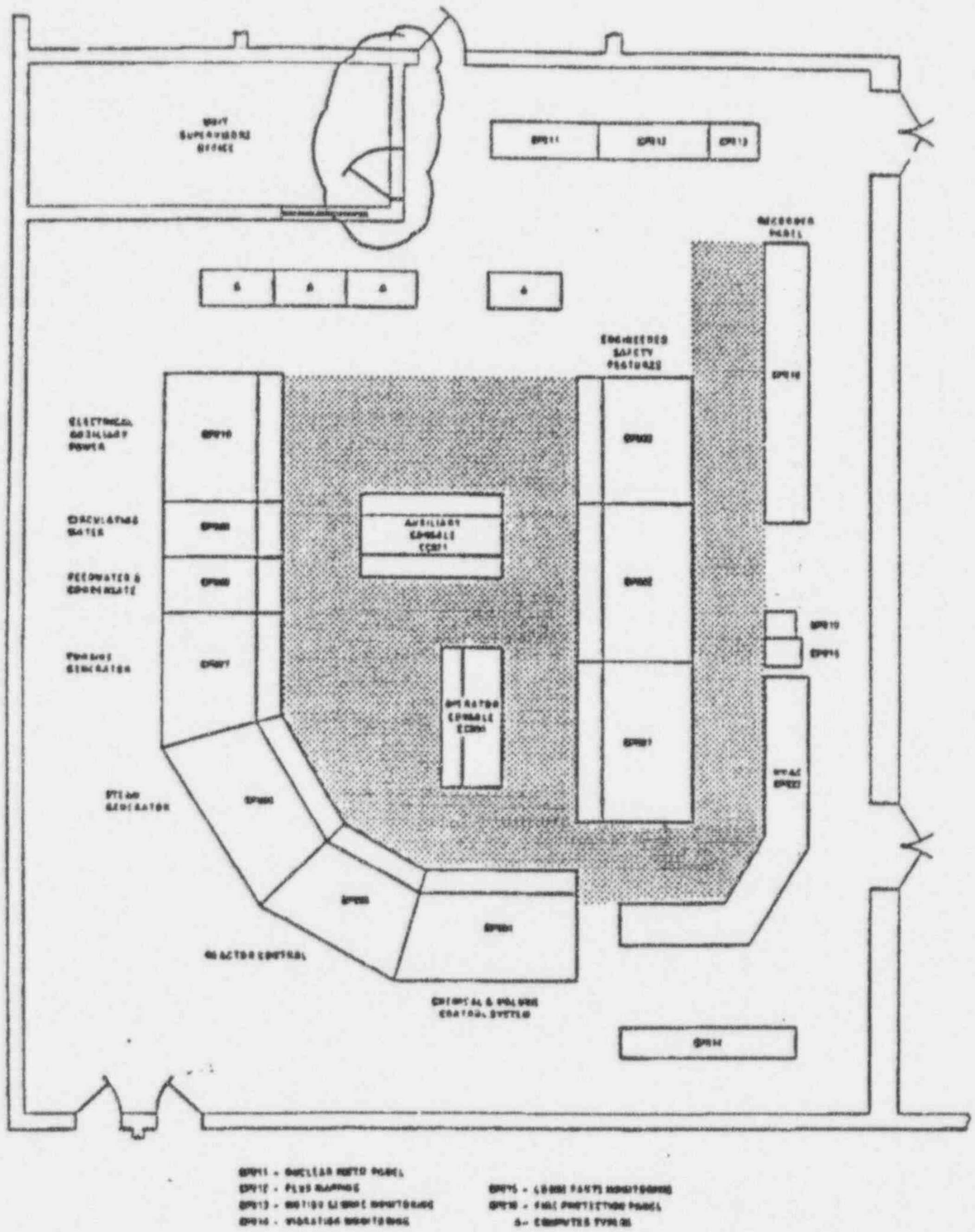


SOUTH TEXAS PROJECT
UNITS 1 & 2

CONTROL ROOM ENVELOPE

Figure 6.4-1 Revision 2

STP D-0749A



SOUTH TEXAS PROJECT
UNITS 1 & 2

CONTROL ROOM LAYOUT

Figure 6.4-2 Revision 2

STP D-0749A

UFSAR SECTION 7A

Responses to NUREG-0737 Clarification of TMI Action Plan Requirements
Section III.D.3.4 Control Room Habitability Requirements

Affected Sections: S.8 Emergency Response Facilities

III.D.3.4 CONTROL ROOM HABITABILITY REQUIREMENTS

Position

In accordance with Task Action Plan Item III.D.3.4 and control room habitability, licensees shall assure that control room operators will be adequately protected against the effects of accidental release of toxic and radioactive gases, and that the nuclear power plant can be safely operated or shut down under design basis accident conditions (Criterion 19, "Control Room", of Appendix A, General Design Criteria for Nuclear Power Plants", to 10CFR50).

Clarification

(1) All licensees must make a submittal to the NRC regardless of whether or not they met the criteria of the referenced SRP sections. The new clarification specifies that licensees that meet the criteria of the SRPs should provide the basis for their conclusion that SRP 6.4 requirements are met. Licensees may establish this basis by referencing past submittals to the NRC and/or providing new or additional information to supplement past submittals.

(2) All licensees with control rooms that meet the criteria of SRP sections 2.2.1 through 2.2.2 Identification of Potential Hazards in Site Vicinity, 2.2.3 Evaluation of Potential Accidents, and 6.4 Habitability of Systems, shall report their findings regarding the specific SRP sections, as explained below. The following documents should be used for guidance:

(a) RG 1.78, "Assumptions for Evaluating the Habitability of Regulatory Power Plant Control Room During a Postulated Hazardous Chemical Release";

(b) RG 1.95, "Protection of Nuclear Power Plant Control Room Operators Against an Accident Chlorine Release"; and,

(c) K. G. Murphy and K. M. Campe, "Nuclear Power Plant Control Room Ventilation System Design for Meeting General Design Criterion 19", 13th AEC Air Cleaning Conference, August 1974.

Licensees shall submit the results of their findings, as well as the basis for those findings, by January 1, 1981. In providing the basis for the habitability finding, licensees may reference their past submittals. Licensees should, however, ensure that these submittals reflect the current facility design and that the information requested in Attachment 1 is provided.

(3) All licensees with control rooms that do not meet the criteria of the above-listed references, SRPs, RGs, and other references shall perform the necessary evaluations and identify appropriate modifications.

Each licensee submittal shall include the results of the analyses of control room concentrations from postulated accidental release of toxic gases, control room operator radiation exposures from airborne radioactive material, and direct radiation resulting from design basis accidents. The toxic gas accident analysis should be performed for all potential hazardous chemical releases occurring either on the site or within 5 miles of the plant-site boundary. RG 1.78 lists the chemicals most commonly encountered in the evaluation of control room habitability, but is not all inclusive.

The design basis accident (DBA) radiation source term should be for the LOCA Containment leakage and ESF leakage contribution outside Containment, as described in Appendices A and B of SRP Chapter 15.6.5. In addition, BWR facility evaluations should add any leakage from the main steam isolation valves (MSIV) (i.e., valve-stem leakage, valve seat leakage, MSIV leakage control system release) to the Containment leakage and ESF leakage following a LOCA. This should not be construed as altering the staff recommendations in Section D of RG 1.96, Rev. 2 regarding MSIV leakage-control systems. Other DBAs should be reviewed to determine whether they might constitute a more severe control room hazard than the LOCA.

In addition to the accident analysis results, which should either identify the possible need for control room modifications or provide assurance that the habitability systems will operate under all postulated conditions, permitting the control room operators to remain in the control room to take appropriate actions required by GDC 19, the licensee should submit sufficient information needed for an independent evaluation of the adequacy of the habitability systems. Attachment 1 lists the information that should be provided along with the licensee's evaluation.

III.D.3.4 ATTACHMENT 1, INFORMATION REQUIRED FOR CONTROL-ROOM HABITABILITY EVALUATION

(1) Control-room mode of operation, i.e., pressurization and filter recirculation for radiological accident isolation or chlorine release

(2) Control-room characteristics

(a) air volume control room

(b) control-room emergency zone (control room, critical files, kitchen, washroom, computer room, etc.)

(c) control-room ventilation system schematic with normal and emergency air-flow rates

(d) infiltration leakage rate

(e) HEPA filter and charcoal absorber efficiencies

(f) closest distance between Containment and air intake

(g) layout of control room, air intakes, Containment building, and chlorine, or other chemical storage facility with dimensions

(h) control-room shielding including radiation streaming from penetrations, doors, ducts, stairways, etc.

(i) automatic isolation capability-damper closing time, damper leakage, and area

(j) chlorine detectors or toxic gas (local or remote)

(k) self-contained breathing apparatus availability (number)

(l) bottled air supply (hours supply)

(m) emergency food and potable water supply (how many days and how many people)

(n) control-room personnel capacity (normal and emergency)

(o) potassium iodide drug supply

(3) Onsite storage of chlorine and other hazardous chemicals

(a) total amount and size of container

(b) closest distance from control-room air intake

(4) Offsite manufacturing, storage, or transportation facilities of hazardous chemicals

(a) identify facilities within a 5-mile radius

(b) distance from control room

(c) quantity of hazardous chemicals in one container

(d) frequency of hazardous chemical transportation traffic (truck, rail, and barge)

(5) Technical specifications (refer to standard technical specifications)

(a) chlorine detection system

(b) control-room emergency filtration system including the capability to maintain the control-room pressurization at 1/8-inch water gauge, verification of isolation by test signals and damper closure times, and filter testing requirements.

STPEGS Response

The safety design basis for the habitability system for the control room is defined in Section 6.4. The design of the habitability system meets the appropriate recommendations of RGs 1.78 and 1.95 and the requirements of GDC 19.

The results of dose calculations for a DBA LOCA release are presented in Section 6.4.

The information requested by Item III.D.3.4, Attachment 1, is provided as indicated below:

Attachment 1 Item No.	STPEGS UFSAR Section
(1),(2)(a)(b), (d),(e),(k)-(o)	6.4
(2)(c)	2.2
(2)(h)	1.2.3, 12.3
(2)(i)	9.4
(2)(j)	2.2, 6.4
(3)(a),(b)	2.2, 9.3
(4)(a)-(d)	2.2
(5)	Technical Specifications

S.8 (Continued)

S.8.4 Emergency Operations Facility (EOF)

S.8.4.1 Requirements

a. The EOF is a licensee-controlled and operated facility. The EOF provides for management of overall licensee emergency response, coordination of radiological and environmental assessment, development of recommendations for public protective actions, and coordination of emergency response activities with Federal, State, and local agencies.

When the EOF is activated, it will be staffed by predesignated emergency personnel identified in the emergency plan. A designated senior licensee official will manage licensee activities in the EOF.

Facilities shall be provided in the EOF for the acquisition, display, and evaluation of radiological and meteorological data and Containment conditions necessary to determine protective measures. These facilities will be used to evaluate the magnitude and effects of actual or potential radioactive releases from the plant and to determine dose projections.

The EOF will be:

b. Located and provided with radiation protection features as described in Table 1 (previous guidance approved by the Commission) and with appropriate radiological monitoring systems.

c. Sufficient to accommodate and support Federal, State, local, and licensee predesignated personnel, equipment and documentation in the EOF.

d. Structurally built in accordance with the Uniform Building Code.

e. Environmentally controlled to provide room air temperature, humidity, and cleanliness appropriate for personnel and equipment.

f. Provided with reliable voice and data communications facilities to the TSC and control room, and reliable voice communication facilities to OSC and to NRC, State, and local emergency operations centers.

S.8 (Continued)

g. Capable of reliable collection, storage, analysis, display, and communication of information on Containment conditions, radiological releases and meteorology sufficient to determine site and regional status, forecast status, and take appropriate actions. Variables from the following categories that are essential to EOF functions shall be available in the EOF:

(i) variables from the appropriate Table 1 or 2 of RG 1.97, Rev. 2, and

(ii) the meteorological variables in RG 1.97, Rev. 2 for site vicinity and regional data available via communication from the National Weather Service.

h. Provided with up-to-date plant records (drawings, schematic diagrams, etc.), procedures, emergency plans, and environmental information (such as geophysical data) needed to perform EOF functions.

i. Staffed using Table 2 (previous guidance approved by the Commission) as a goal. Reasonable exceptions to goals for the number of additional staff personnel and response times for their arrival should be justified and will be considered by NRC staff.

j. Provided with industrial security when it is activated to exclude unauthorized personnel and when it is idle to maintain its readiness.

k. Designed taking into account good human factors engineering principles.

S.8.4.2 Documentation and NRC Review

The conceptual designs for emergency response facilities (TSC, OSC, and EOF) have been submitted to NRC for review. In many cases, the lack of detail in these submittals has precluded an NRC decision of acceptability. Some designs have been disapproved because they clearly did not meet the intent of the applicable regulations. NRC does not intend to approve each design prior to implementation, but rather has provided in this document those requirements which should be satisfied. These requirements provide a degree of flexibility within which licensees can exercise management prerogatives in designing and building emergency response

S.8 (Continued)

facilities (ERF) that satisfy specific needs of each licensee. The foremost consideration regarding ERFs is that they provide adequate capabilities of licensees to respond to emergencies. NUREG guidance on ERFs has been intended to address specific issues which the Commission believes should be considered in achieving improved capabilities.

Licensees should assure that the design of ERFs satisfies these requirements. Exemptions from or alternative methods of implementing these requirements should be discussed with NRC staff and in some cases could require Commission approval. Licensees should continue work on ERFs to complete them according to schedules that will be negotiated on a plant-specific basis. NRC will conduct appraisals of completed facilities to verify that these requirements have been satisfied and that ERFs are capable of performing their intended functions. Licensees need not document their actions on each specific item contained in NUREG-0696 or 0814.

S.8.4.3 Reference Documents (Emergency Response Facilities)

10 CFR 50.47(b) - Requirements for Emergency Facilities and Equipment for OLs.

10 CFR 50.54(q) and Appendix E, Paragraph IV.E - Requirements for Emergency Facilities and Equipment for ORs.

NUREG-0660 - Description of and Implementation Schedule for TSC, OSC, and EOF.

Eisenhut letter to power reactor licensees September 13, 1979 - Request for commitment to meet requirements.

Denton letter to power reactor licensees October 30, 1979 - Clarification of requirements.

NUREG-0654 - Radiological Emergency Response Plans

NUREG-0696 - Functional Criteria for Emergency Response Facilities.

NUREG-0737 - Guidance on Meteorological Monitoring and Dose Assessment.

S.8 (Continued)

Eisenhut letter to power reactor license February 18, 1981 - Commission approved guidance on location, habitability, and staff for emergency facilities. Request and deadline for submittal of conceptual design of facilities.

NUREG-0814 (Draft Report for Comment) - Methodology for Evaluation of Emergency Response Facilities.

NUREG-0818 (Draft Report for Comment) - Emergency Action Levels

RG 1.97, Rev. 2 - Guidance for Variables to be Used in Selected Emergency Response Facilities.

COMJA-80-37, January 21, 1981 - Commission approval guidance on EOF location and habitability.

Secretary memorandum S81-19, February 19, 1981 - Commission approval of NUREG-0696 as general guidance only.

STPEGS Response

TECHNICAL SUPPORT CENTER (TSC)

The TSC is the onsite technical support facility for emergency response. When activated, the TSC is staffed by predesignated technical, engineering, senior management, and other licensee personnel, and predesignated NRC personnel. During periods of activation, the TSC is staffed continuously to provide plant management and technical support to plant operations personnel, and to relieve the reactor operators of peripheral duties and communications not directly related to reactor system manipulations. The TSC performs the EOF functions for the Alert Emergency class and for the Site Area Emergency class and General Emergency class if activation of the EOF is delayed.

Further discussion of the TSC and the TSC staffing requirements is provided in the STPEGS Emergency Management Plan (EMP).

Safety Design Bases

The equipment and facilities comprising the TSC perform no safety-related functions. The design ensures that any fault or malfunction of the TSC equipment does not compromise any safety-related equipment, components, or structures.

S.8 (Continued)

Power Generation Design Bases

1. Location and Structural Integrity

   A. The TSC is located in the Electrical Auxiliary Building (EAB), at elevation 72 feet, within a 2-minute walking distance of the Control Room (CR) (see Figures 7A.S.8-1 to 7A.S.8-4).

   B. The TSC is structurally designed in accordance with the Uniform Building Code (UBC).

   C. Personnel access to the TSC is controlled.

2. Size and Space Allocation

   A working space of approximately 75 ft^2 per person is provided in the TSC. Human factors engineering standards are considered in the TSC design. Areas other than those specifically designated work area may be used to contribute to the working space.

3. Habitability

   A. The TSC is provided with sufficient radiological protection and monitoring equipment to assure that radiation exposure to any person working in the TSC will not exceed 5 rem whole body, or its equivalent to any part of the body, for the duration of an accident.

   B. The HVAC for the TSC is designed to provide a suitable environment during normal and post-accident operation, including protection from post-accident radiological releases. For further discussion of the TSC HVAC design see Section 9.4.1.

      The TSC HVAC system is normally powered from a non-Class 1E MCC which provides power at 480 V +110 percent. When normal power is lost, a backup power supply from a non-Class 1E diesel generator is provided.

   C. Radiation monitoring, ~~toxic gas detection~~, and smoke detection capability are provided in the HVAC supply duct to the TSC. Alarm and indication are provided.

   D. High airborne radiation level in the intake to the TSC HVAC system switches the system to the filtration/recirculation mode of operation. Detection of high ~~toxic gas/or~~ smoke level in the intake to the TSC HVAC system causes automatic isolation of the system.

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S.8 (Continued)

E. The following emergency items are provided:

1. Portable air breathing apparatus: 18 individual units

2. Anticontamination clothing: 18 individual sets

4. Communications

A. The TSC is provided with continuous communication with the following areas:

1. Control Room

2. Operational Support Center

3. Emergency Operations Center

4. Auxiliary Shutdown Panel area

5. NRC "Hot Line" connected to the NRC Emergency Notification System

6. NRC Health Physics Network telephone system

7. State and Local Emergency Operations Centers

5. Plant Records Storage

Plant records necessary to perform the TSC functions are available in the TSC. The records available include:

A. Plant design documents such as piping and instrumentation diagrams, control logic diagrams, and electrical elementary diagrams.

B. Radiation Zone drawings

C. UFSAR

D. Emergency Operating Procedures

E. Emergency Plan

F. Maps of the Emergency Planning Zone

6. Data Acquisition and Display

The ERFDADS, which is capable of reliable data collection, storage, analysis, display, and communications sufficient to determine plant status, determine changes in status, forecast status, and take appropriate actions, is provided (Section S.4 of this Appendix). The SPDS, required by NUREG-0737, is implemented by the ERFDADS.

S.8 (Continued)

The Dose Assessment System provides reliable data collection, storage, analysis, display, and communications sufficient to determine site and regional status, determine changes in status, forecast status, and take appropriate actions in accordance with the STPEGS Emergency Plan.

The ERFDADS and Dose Assessment System equipment located in the TSC are powered from a non-Class 1E, uninterruptable power supply (UPS) capable of maintaining system operation for 2 hours and system memory for 8 hours. Normal AC power to the UPS is supplied from a non-Class 1E diesel generator-backed bus.

7. TSC Operational Requirements

The TSC is designed to be fully functional within one hour of activation. The TSC is designed with an availability goal of 99 percent during all plant pressure and temperature conditions exceeding cold shutdown conditions. Activation of the TSC is required as shown below:

Plant Status	Activation
Notification of Unusual Event	Optional
Alert	Required
Plant Status	**Activation**
Site Area Emergency	Required
General Emergency	Required
Other	As directed by plant management

OPERATIONAL SUPPORT CENTER (OSC)

When activated, the OSC is the onsite area separate from the control room where predesignated operations support personnel assemble.

The OSC is located in the MEAB (see Figures 7A.S.8-1 and 7A.S.8-5) to facilitate support functions and tasks. |

The OSC is provided with continuous voice communications with the control room, TSC, and EOF.

Adequate staffing is provided by STPEGS and is identified in the Emergency Plan.

EMERGENCY OPERATIONS FACILITY

The EOF is a licensee-controlled and operated facility. The EOF provides for management of overall licensee emergency response, coordination of radiological and environmental assessment, determination of recommended public protective actions, and coordination of emergency response activities with federal, State, and local agencies.

UFSAR SECTION 9.4

Air Conditioning, Heating, Cooling, and Ventilating Systems

Affected Sections:	9.4.1	Electrical Auxiliary Building HVAC Systems
	9.4.1.1	Design Bases
	9.4.1.3	Safety Evaluation

9.4 AIR-CONDITIONING, HEATING, COOLING, AND VENTILATING SYSTEMS

The objective of the plant Heating, Ventilating, and Air-Conditioning (HVAC) Systems is to provide ambient air conditions for personnel comfort, health and safety, and efficient equipment operation and integrity by controlling the thermal environment and airborne radioactivity in the plant. The HVAC systems are described in detail in Sections 9.4.1 through 9.4.8. Parameters of plant HVAC Systems are summarized in Table 9.4-1. HVAC Systems components design data are summarized in Tables 9.4-2.1 through 9.4-2.8. The HVAC Systems single-failure analyses are summarized in Tables 9.4-5.1 through 9.4-5.8. Space temperature, pressure, and humidities in the plant during different modes of operation are indicated in Table 3.11-1. HVAC equipment safety classification is summarized in Section 3.2. Plant main exhaust air ductwork data are summarized in Table 9.4-3. The general flow characteristics and system configuration of HVAC Systems are shown on all the figures between 9.4-1 and 9.4.8-1.

9.4.1 Electrical Auxiliary Building HVAC Systems

The following systems are included within the Electrical Auxiliary Building (EAB) HVAC Systems:

1. Control Room (CR) Envelope HVAC System
2. EAB Main Area HVAC System
3. Technical Support Center (TSC) HVAC System
4. Essential Chilled Water System

9.4.1.1 <u>Design Bases</u>. The systems which comprise the EAB HVAC Systems are designed as follows:

1. CR Envelope HVAC System is designed to:

   a. Assure habitability of the CR envelope and permit safe shutdown of the plant as may be required under any normal or emergency conditions.

   b. Maintain ambient temperature conditions to provide operator comfort and to satisfy environmental requirements of equipment. The design bases of ambient conditions, safety class, and seismic category are listed in Table 9.4-1 and Section 3.2.

   c. Maintain the CR envelope at positive pressure to minimize any inleakage of possible contamination from the outside.

   d. Satisfy the design requirements of limiting dose to CR operators following the Design Basis Accident (DBA) in accordance with General Design Criterion (GDC) 19 of 10CFR50 Appendix A.

Instrumentation and controls are provided to detect abnormal conditions such as smoke, toxic gases, and high radioactive concentrations in the makeup air. Two leak tight isolation dampers in series are provided in the outside air ductwork for each main air handling unit (AHU) to

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isolate the CR envelope and stop outside air makeup in the event of smoke or toxic gas detection at the outside air intake. Operation, monitoring, and control of these systems are provided in the CR.

Equipment, motors, and controls with safety functions (except for outside air, smoke, and toxic gas monitors) are supplied from Class 1E power sources and are separated and redundant to meet the single failure criterion. The smoke and toxic gas monitors are served by a non-Class 1E uninterruptible power source (UPS) and are redundant.

Surveillance of airborne radioactivity levels of the outside makeup air to the supply system is provided by the CR ventilation inlet air radiation monitors. On a high gaseous radioactivity or safety injection (SI) signal, CR makeup is automatically diverted through CR air makeup filter units. These units contain high-efficiency particulate air (HEPA) and charcoal filters.

Surveillance of airborne toxic gaseous levels of the makeup air entering the outside air intake is provided by toxic gas monitors, as described in Section 9.4.1.3.

This safety-related system consists of three 50-percent-capacity redundant trains, powered by three redundant, independent, Engineered Safety Features (ESF) busses and provided with chilled water for the AHU from a separate essential chilled water train corresponding to the same division. Thus the single active failure criterion is met.

The physical separation criteria applicable to the CR Envelope HVAC System are specified in Section 3.5 for separation and missile protection and in Section 3.6 for protection against the dynamic effects associated with postulated rupture of piping. Common supply and return air ductwork is used with a crosstie between the three trains and is provided with necessary isolation dampers to isolate the nonoperating train.

In case of fire within this area, provision is made for smoke purge as described in Section 9.4.1.3. The design of this system also complies with GDCs 2, 3, and 4.

A high temperature switch is located in the main CR to annunciate an alarm should the space temperature exceed the predetermined setpoint of the temperature switch. Inadvertent closure of a fire damper serving this area would initiate the alarm. The alarm alerts the CR operator and appropriate measures can be taken to manually reopen the failed fire damper to restore the design air flow. Temperature excursions in spaces contiguous to the main CR, yet within the envelope, can be identified by CR personnel or by high temperature alarms located in the rooms (i.e., Relay Room, Computer Room). Should this condition occur, suitable measures can be taken to manually reopen the damper.

Environmental design considerations relating to CR habitability following an accident are discussed in Section 6.4.

Regulatory Guide (RG) 1.52 and Oak Ridge National Laboratory (ORNL) publication ERDA 76-21, "Design, Construction and Testing of High-

Efficiency Air Filtration Systems for Nuclear Application", are used as guides in the detail design of the CR envelope HVAC.

2. EAB Main Area HVAC System is designed to maintain ambient temperature conditions to provide operator comfort and to satisfy environmental requirements of equipment. The design bases of ambient conditions, safety class, and seismic categories are listed in Table 9.4-1 and Section 3.2.

   Equipment, motors, and controls with safety functions are supplied from Class 1E power sources and are separated and redundant to meet the single failure criterion.

   This safety-related system consists of three 50-percent-capacity redundant trains, powered by three redundant independent, ESF busses and provided with chilled water for the AHU from a separate essential chilled water train corresponding to the same division. Thus the single active failure criterion is met.

   The physical separation criteria applicable to the EAB Main Area HVAC system are specified in Section 3.5 for separation and missile protection and in Section 3.6 for protection against the dynamic effects associated with postulated rupture of piping. Supply and return air ductwork is separated by trains, with the exception of common supply/return risers between the three trains which are provided with necessary isolation dampers to isolate the nonoperating train.

   In case of fire within this area, provision is made for smoke purge as described in Section 9.4.1.3. The design of this system also complies with GDCs 2, 3, and 4.

   High temperature switches have been placed in critical areas on each level. These switches are provided with CR annunciation should the ventilation air be interrupted by the inadvertent closure of a fire damper and the resulting space temperature exceeds the temperature switch alarm setpoint. The annunciation alerts the CR operator and appropriate investigative measures can be implemented to reopen the failed fire damper to restore the design air flow. The fire dampers can only effect one train of the HVAC system and the remaining two safety-related trains are available to perform the system's safety function.

   American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 52 and ORNL publication ERDA 76-21, "Design, Construction and Testing of High-Efficiency Air Filtration Systems for Nuclear Application" are used as guides in the detail design of the EAB main area HVAC.

3. Technical Support Center HVAC System is designed to:

   a. Maintain the TSC in a habitable condition as may be required under any normal or emergency condition. (For the TSC habitability requirements see Appendix 7A, item S.8).

   b. Maintain ambient temperature conditions to provide personnel comfort and to satisfy environmental requirements of equipment.

The design bases of ambient conditions, safety classes, and seismic categories are listed in Table 9.4-1 and Section 3.2.

c. Maintain the TSC at positive pressure to minimize any inleakage of possible contamination from the outside.

d. Satisfy the design requirements of limiting dose to the occupants following the DBA in accordance with GDC 19 of 10CFR50 Appendix A.

Instrumentation and controls are provided to detect abnormal conditions such as smoke, toxic gases, and high radioactive concentrations in the makeup air. Makeup air for the TSC, EAB main area, and CR envelope is provided from the same outside air intake and monitoring is provided at that point. A leaktight isolation damper is provided to isolate the TSC and stop outside air makeup in the event of smoke or toxic gas detection at the outside air intake. Operation, monitoring, and control of these systems are provided at a local panel in the TSC HVAC Room.

Equipment, motors, and controls with essential functions are supplied from a reliable source of power backed up by the TSC diesel generator (DG).

In case of fire within this area, provision is made for smoke purge similar to CR and EAB HVAC Subsystems above.

RG 1.140 and ORNL publication ERDA 76-21, "Design, Construction and Testing of High-Efficiency Air Filtration Systems for Nuclear Application" are used as guides in the detail design of the TSC HVAC.

4. Essential Chilled Water System is designed to provide chilled water to certain supply AHUs under any normal or emergency condition. For the AHUs being supplied, see Section 9.4.1.2, Item (4).

The safety class (SC) and seismic category are listed in Section 3.2.

This safety-related system consists of three 50-percent-capacity redundant trains, powered by three redundant, independent, ESF busses. Thus the single active failure criterion is met.

The physical separation criteria applicable to the Essential Chilled Water System are specified in Section 3.5 for separation and missile protection and in Section 3.6 for protection against the dynamic effects associated with postulated rupture of piping.

9.4.1.2 <u>System Description</u>. The EAB HVAC System consists of the following four major systems. The areas served by these HVAC Systems are shown on Figures 1.2-26 through 1.2-30.

1. <u>CR Envelope HVAC System</u> serves the CR envelope areas described in Section 6.4.

2. <u>EAB Main Area HVAC System</u> serves all the following major areas in EAB.

   a. Battery and distribution panel rooms

b. Electrical switchgear rooms

c. Cable spreading rooms

d. Distribution panel rooms

e. Power cable vaults

f. Motor generator set room

g. Storage rooms

h. HVAC system equipment rooms

i. Miscellaneous electric equipment room

j. Miscellaneous offices

k. Radiation monitoring room

l. Electrical penetration areas

m. Auxiliary Shutdown Panel (ASP) area

n. Central Alarm Station (Unit 1 only)

3. Technical Support Center (TSC) HVAC System serves the following TSC areas within the EAB.

   a. Computer room

   b. Communication room

   c. Nuclear Regulatory Commission (NRC) room

   d. Operations room

   e. TSC HVAC equipment room

   f. Storage rooms

   g. Toilets

   h. Conference and break rooms

The above three systems are independent of each other with the exception of common outside air intake. The system configuration is shown on Figures 9.4.1-1 to 9.4.1-3 and principal system components are listed and described in Table 9.4-2.1.

4. Essential Chilled Water System provides chilled water to the following safety-related AHUs.

   a. EAB main supply AHUs in EAB

b. CR envelope AHUs in EAB

c. Electrical penetration space emergency AHUs in EAB

d. Reactor makeup water (RMW) pump cubicle AHUs in Mechanical Auxiliary Building (MAB)

e. Boric acid transfer pump cubicle AHUs in MAB

f. Essential chiller area AHUs in MAB

g. Chemical and Volume Control System (CVCS) valve cubicles AHUs in MAB

h. Radiation monitor room AHUs in MAB

i. Spent fuel pool (SFP) pump cubicle AHUs in Fuel Handling Building (FHB)

j. Containment sump isolation valve cubicle AHUs in FHB

k. ESF pump cubicles AHUs in FHB

9.4.1.2.1 Description:

1. Control Room Envelope HVAC System is safety-related and consists of three 50-percent-capacity redundant equipment trains except for the toilet/kitchen exhaust, heating, and computer room HVAC Subsystem which are nonsafety-related. Two of the three trains are required to function during the following modes of operation: shutdown, hot standby, normal operation, postulated accident condition, and loss of offsite power (LOOP). The system is shown on Figure 9.4.1-2. The following is a description of the components and their function.

   a. Main Air Handling Unit

      Each of the three units consists of:

      1) Prefilters

         The prefilters are provided to protect the high-efficiency filters located downstream from coarse particles carried by the airstream. These filters have a 30 percent efficiency, based on the ASHRAE Standard 52 efficiency test.

      2) High-Efficiency Filters

         The high-efficiency filters used downstream of the prefilters are provided to supply clean air to the CR envelope. These filters have a 95 percent efficiency based on the ASHRAE Standard 52 efficiency test.

3) Cooling Coils

Finned-tube coils cool supply air to the required cooling temperature. Drain troughs are provided to collect and remove condensate. The coil is cooled by chilled water from the Essential Chilled Water System. The cooling coils are designed for adequate heat removal capacity to maintain the area at the design ambient temperatures.

4) Supply Fan

The supply fans are centrifugal type with direct-drive, single-speed motors. Fan motors are totally enclosed, fan-cooled, and statically and dynamically balanced.

Redundant leaktight isolation dampers are provided in the outside air ductwork to each AHU. During emergency operation (initiated by the SI and loss of offsite power (LOOP) signal, outside air high radiation, toxic gas or smoke signal) these isolation dampers are closed automatically. In case of outside air high radiation or an SI signal, makeup air is provided automatically via the makeup and cleanup filter units. Each AHU is designed to supply the CR envelope areas with a continuous source of conditioned and filtered air.

b. Return Air Fan

The return air fans draw air from the required rooms via the return air ducts and then deliver it to the corresponding main AHU. The return air is mixed with the makeup air to form the total air flow through the main AHU. During smoke purge these fans exhaust the return air to the outside with 100 percent supply air makeup to the main AHU. The return fans are vaneaxial type with direct-drive, single-speed motors. Fan motors are totally enclosed, air-cooled, and statically and dynamically balanced.

c. Makeup Air Filter Unit

Each of the three units consists of the following:

1) Electric Heater

An electric heater is provided to reduce the moisture in the airstream to 70 percent relative humidity in order to protect and maintain the efficiency of the carbon filters.

2) Prefilters

The prefilters are provided to increase the life of the HEPA filters. The prefilters are designed for 85 percent efficiency based on the ASHRAE Standard 52 efficiency test.

3) HEPA Filters

HEPA filters are provided to remove radioactive particles from the airstream. HEPA filters are designed to meet performance requirements in accordance with the "Standards for HEPA Filters" issued by the Institute of Environmental Sciences (IES) (formerly American Association for Contamination Control [AACC]), CS-1-1968.

4) Carbon Filters

The carbon filters are used to adsorb airborne radioiodine from the airstream.

5) HEPA Filters

A bank of HEPA filters is also provided downstream of the carbon filters to prevent carryover of charcoal particles from the carbon filters into the airstream.

6) Centrifugal Fan

Makeup air unit fans are direct-drive, centrifugal type with single-speed motors. Fan motors are totally enclosed, fan-cooled, and statically and dynamically balanced.

Normally, makeup air which is required to pressurize the CR envelope areas and provide a source of fresh air is supplied by the main AHU supply fan. During emergency operation (initiated by an SI or outside air high radiation signal) the makeup unit is used to filter outside air for makeup. The makeup unit fan delivers filtered air to the cleanup unit.

Makeup air to the makeup units is drawn from a common plenum where outside air is introduced through one of two physically separated air intakes. Only one intake (located in the EAB) is used for makeup air during an emergency. The other intake, which also serves the MAB, is used for 100 percent outside air during smoke purge. The emergency air intake is located on the east side of the EAB at El. 80 ft (Figure 1.2-29). The air intakes are designed to withstand the effect of missiles and tornadoes.

d. Control Room Air Cleanup Filter Unit

Each of the three units consists of the following:

1) Prefilters

The prefilters are provided to increase the life of the HEPA filters. The prefilters are designed for 85 percent efficiency based on the ASHRAE Standard 52 efficiency test.

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2) HEPA Filters

HEPA filters are provided to remove radioactive particles from the airstream. HEPA filters are designed to meet performance requirements in accordance with the IES Standard CS-1-1968.

3) Carbon Filters

The carbon filters are used to adsorb airborne radioiodine from the airstream.

4) HEPA Filters

A bank of HEPA filters is provided downstream of the carbon filters to prevent carryover of charcoal particles from the carbon filters into the airstream.

5) Centrifugal Fan

Cleanup unit fans are direct-drive, centrifugal type with single-speed motors. Fan motors are totally enclosed, fan-cooled, and statically and dynamically balanced.

During emergency conditions (SI or high radiation signal) the cleanup air filter units are utilized to filter both outside air from the makeup filter units and part of the return air from the CR envelope. The cleanup units also operate during LOOP, although there is no outside air supply from the makeup filter units. The filtered air from the cleanup units is supplied to the main AHUs.

e. Ductwork and Duct Reheat Coils

The ductwork and duct reheat coils are common to the three equipment trains. Reheat coils are provided in the supply ducts to areas served to control temperature during normal operation, temper outside air supply during smoke purge in winter (common for CR envelope and EAB main area), and provide heating during plant shutdown in winter. The reheat coils are electric type with temperature controls located in the areas served. The reheat coils are nonsafety-related and tripped by an isolated SI signal during an emergency condition to prevent inadvertent operation and possible degradation of safety cooling function.

f. Exhaust Air Fan

A single exhaust fan is provided to exhaust air from toilets and kitchen. The fan is an inline centrifugal type with a belt-drive, single-speed, open drip-proof motor.

The exhaust system operates only during normal operation and has no safety function. Two leaktight isolation dampers are provided in the exhaust duct and automatically closes during the CR envelope emergency mode.

g. Computer Room Air Handling Units

The computer room is pressurized by air supplied from the CR envelope main AHU. Heating and cooling is provided by separate nonsafety-related AHUs located in the room.

Two 100-percent-capacity AHUs are provided to condition and recirculate room air. Each AHU consists of the following:

1) Filters

These filters are provided to maintain a dirt-free room environment. They are 65 percent efficient, based on ASHRAE Standard 52.

2) Cooling Coil

Finned-tube coils cool supply air to the design temperature. Drain troughs are provided to collect and remove condensate. The coil is served by the TSC chilled water system which is described in Section 9.4.1.2.1, Item 3. The cooling coil is designed with adequate heat removal capacity to maintain the room at the design ambient temperature.

3) Electric Heating Coils

An electric heating coil provides heating during winter shutdown conditions.

4) Humidifier

An electric type humidifier is provided to prevent relative humidity from dropping below 40 percent.

5) Circulating Fan

A centrifugal fan is provided to supply and return conditioned room air.

The computer room AHUs are nonsafety-related and are served by a reliable source of power backed up by the TSC DC power.

2. EAB Main Area HVAC System is safety-related except for the heating system (other than ESF battery room heating coils), elevator machine room HVAC system, and electrical penetration area normal HVAC system. It consists of three 50-percent-capacity equipment trains. Two of three EAB supply fans are required to function during normal plant operation. 2
Two of three EAB equipment trains (supply and return fans) are required to function for design basis accident conditions. The system is shown on Figure 9.4.1-1. The following is a description of the EAB Main Area HVAC System components and their function.

a. Main Air Handling Unit

Each AHU is designed to supply the EAB main areas with a continuous source of conditioned and filtered air, and consists of the following:

1) Prefilters, high-efficiency filters, and cooling coils are provided as described for the CR envelope main AHUs. Refer to Table 9.4-2.1 for performance data.

2) Supply Fans

The supply fans are vaneaxial type with direct-drive, single-speed motors. Fan motors are totally enclosed, air-cooled, and statically and dynamically balanced.

3) Electric Heating Coils

Electric heating coils are provided to temper the supply air during winter operation and during smoke purge. The heating coils are nonsafety-related and are tripped by an isolated SI signal to prevent inadvertent operation and possible degradation of safety cooling function during emergency conditions.

b. Return Air Fans

During DBA conditions the return air fans draw air from the required rooms via the return air ducts and then deliver it to the corresponding main AHU. The return air is mixed with the makeup air to form the total air flow through the main AHU. During smoke purge these fans exhaust the return air to outside with 100 percent supply air makeup to the main AHU. The return fans are vaneaxial type with direct-drive, single-speed motors. Fan motors are totally enclosed, air-cooled, and statically and dynamically balanced.

c. Exhaust Air Fans

Exhaust fans are provided to exhaust air from the battery rooms. They are vaneaxial type with direct-drive, single-speed, spark-proof, totally enclosed motors.

During all modes of operation the battery rooms are exhausted to the outdoors with an air change rate sufficient to maintain a hydrogen concentration level below 2 percent by volume.

d. Ductwork and Duct Reheat Coils

The ductwork and duct reheat coils are common to the three equipment trains. The reheat coils are provided for the occupied areas to maintain room temperature within comfort limits during normal operation. Reheat coils are also provided for battery rooms to maintain room temperature suitable for the battery operation during normal and emergency operations. The reheat coils are of the electric type with temperature controls located in the areas being served. The reheat coils are nonsafety-related except those for the ESF battery rooms which are safety-related. The nonsafety-related reheat coils are tripped during emergency condition by an isolated SI signal to prevent inadvertent operation and possible degradation of safety cooling function.

e. Electrical Penetration Area HVAC Subsystem consists of the following:

1) Ventilation System

The electrical penetration areas are supplied with ventilation air from the MAB main supply system. The air is exhausted to the outside by two 100 percent exhaust fans. The supply and exhaust systems are nonsafety-related and serve no safety function. The exhaust fans are of the centrifugal type with direct-drive, single-speed, and have totally enclosed motors.

2) Air Handling Units

Two AHUs, one safety-related and the other nonsafety-related, are located in each train-related electrical penetration area to recirculate room air and provide cooling during emergency and normal conditions, respectively. Each AHU consists of a fin tube chilled water cooling coil and circulating fan (centrifugal type).

f. Chilled Water System

The EAB Main Area HVAC System, except for nonsafety-related AHUs in electrical penetration areas, is served by the Essential Chilled Water System (Section 9.4.1.2, Item 4). The nonsafety-related AHUs are served by the TSC Chilled Water System.

3. Technical Support Center HVAC System is nonsafety-related but complies with the habitability requirements of GDC 19. The system consists of one 100 percent equipment train except for supply and return fans, computer room AHUs, and chilled water system which have 100 percent redundancy. The system is shown on Figure 9.4.1-3. The following is a description of system components and their functions:

a. Main Air Handling Unit:

1) Prefilters, High-Efficiency Filters, and Cooling Coils

Same as for the CR Envelope HVAC supply unit, except the cooling coil is served by a separate nonsafety-related TSC Chilled Water System described below.

2) Supply Fan

Two 100-percent-capacity fans are provided. The supply fans are of the centrifugal type with direct-drive, single-speed motors. Fan motors are totally enclosed, fan-cooled, and statically and dynamically balanced.

3) Electric Heating Coil

An electric heating coil is provided to temper the supply air in winter during smoke purge or plant shutdown.

An isolation damper is provided to shut off the normal outside air makeup to the main AHU on detection of high radiation, toxic gas, or smoke at the outside air intake.

b. Computer Room Air Handling Units

The TSC computer room is pressurized by air supplied from the TSC main AHU. Heating and cooling is provided by separate nonsafety-related AHUs located in the room. Two 100 percent capacity AHUs are provided to condition and circulate room air. These units are the same as those for the CR computer room (Section 9.4.1.2.1, Item 1.g).

c. Return Air Fans

Two 100 percent return fans are provided to return the room air to the main AHUs during normal operation and exhaust to the outside during smoke purge operations. The return fans are centrifugal type with direct-drive, single-speed, and a totally enclosed motor.

d. Makeup Air Filter Unit

The makeup air filter unit consists of the same components as CR Envelope Makeup units.

Normally, makeup air is supplied by the supply AHU. Upon detection of high airborne radiation at the outside air intake, the makeup filter unit is utilized to filter the outside air makeup and part of the return air. The makeup unit fan delivers makeup air to the supply AHU.

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e. Exhaust Air Fan

An exhaust fan is provided to exhaust air from the toilets and break room during normal operation. During the isolation mode (high radiation, toxic gas, or smoke at the outside air intake) the exhaust fan is shut down and the isolation damper closes.

The fan is of the centrifugal type, with a direct-drive, single-speed, totally enclosed motor.

f. TSC Chilled Water Subsystem

The TSC Chilled Water Subsystem supplies chilled water to the TSC AHU cooling coil as well as cooling coils for the main computer room, TSC computer room, electrical penetration area (normal only), FHB Post-Accident Sampling System (PASS) area, and MAB radwaste counting room.

This subsystem is shown on Figure 9.4.1-5 and consists of two 100-percent-capacity equipment trains with common piping as follows:

1) Water Chiller

The two water chillers are the air-cooled condenser type and are provided with all necessary accessories for automatic operation. The chiller cools the chilled water to the design temperature listed in Table 9.4-2.1.

2) Chilled Water Pump

The two chilled water pumps are of the centrifugal type and are used to circulate chilled water through the cooling coils.

3) Expansion Tank

The expansion tank is common to the two trains and is provided to allow expansion due to temperature variations in the chilled water system.

4) Chemical Addition Tank

The chemical addition tank is common to the two trains and is provided to maintain water chemistry in the chilled water system.

5) Air Separator

An air separator is utilized to remove air from the system. Air released by the air separator is channeled into the expansion tank.

6) Chilled Water Piping and Valves

The chilled water piping is common to the two trains and is provided with necessary valves for isolating and regulating the chilled water flow.

The above TSC HVAC System components are nonsafety-related with the exception of the exhaust fan, duct heat coils, and AHU heating coils, all components are served by a non-Class 1E reliable power source backed up by the TSC DG.

4. Essential Chilled Water System is provided to supply chilled water to the chilled water cooling coils in the AHUs given in Section 9.4.1.2, Item 4.

The system is shown on Figure 9.4.1-4 and consists of three 50 percent capacity equipment trains. Each train is composed of:

a. Water Chillers

There are two water chillers in each train. Each water chiller is a centrifugal type with a water-cooled condenser and is provided with necessary accessories for automatic operation. The chillers cool the chilled water to the design temperature listed in Table 9.4-2.1.

The alignment of the two chillers in each train varies with ECW temperature and/or the status of the Unit. With the Unit in normal operation (modes 1-4) with normal ECW temperatures, both chillers in each train will normally be aligned for operation. Typically only one of these chillers (in each operating chilled water train) will be operating. However, the larger chiller (300 ton) in each train has sufficient capacity to meet normal and post-accident loads, provided the 150 ton chiller is realigned to prevent convective heat transfer into the chilled water train via the idle chiller and the EAB HVAC alignment modified to reduce the transient heat load.

In normal operation with "cold ECW" conditions (below 60°F, with entry and exit allowed between 60 and 69°F), only the 300 ton chiller is aligned for operation in each chilled water train. The 300 ton chiller has sufficient capacity to meet normal and post-accident loads. The 150 ton chiller is intentionally rendered inoperable to ensure the available load under the worst case assumptions is adequate for 300 ton chiller operation.

In cold shutdown or refueling operation, with normal ECW temperature, either of the chillers in a train can meet the required normal or post-addident load.

In cold shutdown or refueling operation, with "cold ECW" conditions, either one (but only one) of the chillers is aligned for operation in a train. Rendering one of the chillers inoperable ensures the required minimum load for the operable chiller is available.

In the unlikely event of ECW temperatures below 42°F with a unit in normal operation, the single set chiller condenser flowrate may not support the full range of loads from minimum to maximum. Therefore, a dedicated human operator will be stationed to control ECW flow. The existing analysis supports operation down to 37°F ECW temperature.

b. Chilled Water Pump

The chilled water pump is a centrifugal type and is used to circulate chilled water through the cooling coils.

c. Expansion Tank

The expansion tank is provided to allow normal expansion due to temperature variation in the chilled water system.

d. Chemical Addition Tank

The chemical addition tank is provided to maintain the water chemistry in the chilled water system.

e. Chilled Water Piping and Valves

The chilled water piping is provided with necessary valves for isolating and regulating the chilled water flow.

9.4.1.2.2 Instrumentation Application:

1. Control Room Envelope HVAC System:

All fans are operable from the main CR. Temperature control is provided inside the CR envelope to control space temperatures by controlling reheat coils. Indication of the amount of filter loading for filters associated with the air handlers is provided locally for each of the air handlers. In addition, a pressure differential recorder is provided in the main CR for the upstream HEPA filters associated with both the cleanup and the makeup units.

The following instrumentation is provided in addition to that shown on Figure 9.4.1-2.

- Alarms for CR fan trouble
- Position indication for isolation dampers
- Indication for the operational status of the fans

2. EAB Main Area HVAC System:

Fans are operable from the main CR and the transfer switch panel in the ESF switchgear room, with the exception of the elevator machine room exhaust fan.

Room temperatures are controlled by temperature controls located in the various rooms of the EAB. Indication of the amount of filter loading for particulate filters associated with the EAB AHUs is provided at each of the AHUs.

The following instrumentation is provided in addition to that shown on Figure 9.4.1-1.

- Position indication for dampers

- Indication for the operational status of the fans
- Alarm for fan trouble

3. TSC HVAC System:

The fans are operable from the TSC local panel. The indication of the amount of filter loading for the AHU and makeup air filter unit is provided locally.

The following information is provided at the TSC local panel in addition to that shown on Figure 9.4.1-3.

- Position indication for dampers
- Indication for the operational status of the fans

4. Essential Chilled Water System:

The water chillers and the chilled water pumps are operable at auxiliary shutdown stations and from the main CR.

Each chiller is provided with all necessary accessories for automatic operation. A local panel is provided with each chiller to monitor and control the water chiller. This monitoring includes indications of temperature and pressure.

All chilled water system trains (three) are placed in operation automatically upon receipt of an SI signal or a LOOP. Bypass flow around the cooling coils is isolated upon receipt of an SI signal. The status of the affected equipment is not changed when the actuation signal is reset.

The following instrumentation is provided in addition to that shown on Figure 9.4.1-4.

- Pump status lights
- Chiller status
- Pumps status on computer
- Chiller trouble alarms
- Valves position indicating lights on main control board

9.4.1.3 Safety Evaluation. Continued operation of the safety-related portion of the CR Envelope HVAC System and EAB Main Area HVAC system during all modes of operation is ensured by the following design features in addition to the general features described in Section 9.4.1.1.

1. Design of system components, except the smoke and toxic gas detectors, meets seismic Category I requirements.

2. During LOOP, active components such as motors, damper operators, controls, and instrumentation with safety functions (except outside air toxic gas and smoke detectors) are served by their respective independent ESF power train. The pneumatic dampers are designed to fail in the

safe position (as shown on Figures 9.4.1-1 through 9.4.1-5) during a LOOP. The toxic gas and smoke detectors are served by UPS.

Following a LOOP, the CR envelope HVAC equipment operates in the filtered recirculation mode. No makeup air is supplied. In this way, should smoke or toxic gas be present at the outside air intake, no change in system operation would be required.

3. Redundancy of components ensures that the system meets the single active failure criterion. The system failure modes and effects analysis (FMEA) is presented in Table 9.4-5.1.

4. The system is adequate to meet the CR envelope habitability requirements as discussed in Section 6.4.

5. The system conforms to GDC 19 as it provides adequate radiation protection to permit occupancy of the CR envelope during or following postulated accident conditions, without the personnel receiving radiation exposures in excess of 5 rem whole body (see Section 6.4 for CR Habitability System).

   The makeup air filter unit and CR air cleanup filter unit are capable of removing airborne radioactive iodine from the incoming air and the CR air and limiting it to acceptable levels. A detailed description of the radioactivity filtration capability of these filter unit is provided in Section 6.5.1.

   Detection of radioactivity in the CR ventilation inlet is provided by radiation monitors, as described in Section 11.5. Upon detection of high airborne radioactivity at the outside air intake, the makeup air is filtered by means of carbon filter units. A portion of the recirculation air is also filtered.

6. The CR envelope is maintained at a minimum of 0.125 in. wg positive pressure relative to the surrounding area following receipt of an outside air high radiation or SI signal with a maximum makeup air design value of 2,000 ft^3/min. The penetrations into the CR envelope are sealed or gasketed.

7. Two redundant radiation monitors are provided to monitor the makeup air; upon high radiation, they alarm and automatically place the makeup units and CR cleanup filter units into operation in order to meet GDC 19.

8. In the event of a postulated fire causing smoke in areas confined within the CR envelope boundary EAB Main Area, redundant smoke detectors located within the common return duct will alarm in the CR upon detection of smoke. The operator may then place the appropriate system into the smoke purge mode of operation (i.e., 100 percent outside air) to purge the smoke from the inside the building as necessary. The return air carrying smoke is exhausted outside by the return air fans by way of isolation and relief dampers. However, this is only a secondary means of smoke purge. The primary means of smoke purge is by portable fans as described in the Fire Hazard Analysis Report (FHAR).

   In the event of smoke reaching the outside air intake, two redundant smoke detectors are provided in the common outside makeup air duct. The smoke detectors are located near the junction between the two air intakes and the common duct to minimize transit time of smoke to the detectors. The smoke detectors alarm the condition in the CR and automatically isolate the CR by closing the redundant outside air isolation dampers.

The HVAC equipment areas and the rooms in the CR envelope and EAB are separated by fire walls. Ductwork from equipment areas to the CR, computer room, relay room, and switchgear room are protected by fire dampers. Fire in any area is isolated by fire walls and fire dampers.

9. The Essential Chilled Water System, including the water chillers, chiller pumps, and chilled water piping and supports, is designed to meet the seismic Category I requirements. Each train is completely isolated from the other trains, and no common piping is provided in the Essential Chilled Water System. The system conforms to the codes and standards outlined in Section 3.2.

~~10. Redundant monitors are provided to monitor toxic gas concentrations at the outside air makeup to the CR. (Refer to Section 2.2.3 for the toxic gas evaluation.) The redundant toxic gas monitors are located at the common makeup air duct (Figure 9.4.1-2).~~

(10.) ~~11.~~ The HVAC ductwork is designed to seismic Category I requirements and a normal operating pressure based on the fan shutoff pressure.

(11.) ~~12.~~ The failure of nonessential systems, structures, or components located close to essential portions of the system will not preclude operation of the CR envelope and the EAB Main Area HVAC System.

(12.) ~~13.~~ The system is located in a seismic Category I structure that is tornado-missile-, and flood-protected.

9.4.1.4 Inspection and Testing Requirements. To assure and demonstrate the capability of the EAB HVAC System to perform the assigned function, tests are performed to verify proper wiring and control hookup, proper function of system components and control devices, and to perform final air balance of the system. A preoperational test is conducted with equipment and controls operational to verify that the system operation meets design requirements. To ensure a continued state of readiness of the EAB HVAC System after completion of the preoperational tests, RG 1.52 and the Plant Technical Specifications, where applicable, will be followed in the performance of periodic inspection, maintenance, and testing. Table 9.4-4 describes the testing requirements for the HEPA and carbon filters.

9.4.2 Fuel Handling Building Heating, Ventilating, and Air Conditioning System

9.4.2.1 Design Basis. The FHB HVAC System is designed in accordance with the following:

1. The system is designed to:

   a. Provide continuous air flow across the water surface of the SFP and controlled ventilation air flow in other FHB spaces. Ventilation air flow is from areas of low to progressively higher radioactivity levels. The system is capable of maintaining a negative pressure in the FHB relative to the outside during normal operation and will maintain a negative pressure during accident conditions (except when the railway door is open).

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b. Provide ambient conditions in the FHB, as listed in Table 9.4-1, to ensure a suitable environment for personnel and equipment in the building. The system also purges the moisture and radioactive gases that evaporate from the spent fuel pool.

c. Mitigate the consequences of a fuel handling accident as well as a Loss-of-Coolant Accident (LOCA) by limiting plant site boundary dose to within the guidelines of 10CFR100. This is accomplished by routing exhaust air from the spent fuel pool and the remainder of the FHB through ESF filter units containing HEPA filters and iodine removal carbon filters if high levels of airborne radioactivity are detected in the exhaust air (automatically upon an SI signal).

d. The system meets/complies with GDCs 2, 5, 60, and 61.

2. Equipment motors and controls in the safety class portions of the system are supplied with power from Class 1E electric power sources and have sufficient redundancy to satisfy the single failure criterion.

3. The SC and seismic category of the system components are listed in Section 3.2.

4. System components and ductwork are protected against outside missiles and dynamic effects of tornado and wind pressure since they are located within a seismic Category I structure and protected by a tornado isolation damper at both the air intake and main exhaust vent.

9.4.2.2 System Description. The FHB HVAC consists of the following subsystems:

1. Supply Air Subsystem

2. Supplementary Coolers Subsystem

3. Exhaust Air Subsystem

The configuration of these subsystems is shown on Figures 9.4.2-1 and 9.4.2-2, and design data of principal system components are listed in Table 9.4-2.2. Figures 1.2-39 through 1.2-46 show the location of systems, structures, and cubicles in the FHB.

The system serves the following safety-related areas within the FHB in addition to the various other areas.

1. Room containing SFP pumps and heat exchangers (HXs)

2. Rooms containing valves

3. Rooms containing HVAC equipment

4. Rooms containing high-head safety injection (HHSI) pumps, low-head safety injection (LHSI) pumps, and Containment spray pumps (Emergency Core Cooling System [ECCS]).

The ventilation subsystems listed above, and their functions during different modes of plant operation, are described as follows.

SECTION 7

TRM Revision

The following pages include the TRM sections which delineate the Toxic Gas Monitoring requirements for STPEGS. The existing requirements are deleted by this Licensing Document Change Request as noted on the included mark-up.

INSTRUMENTATION

CHEMICAL DETECTION SYSTEMS

LIMITING CONDITION FOR OPERATION

3.3.3.7 Three independent Chemical Detection Systems of each Unit shall be OPERABLE with their Alarm/Trip Setpoints adjusted to actuate at the following concentrations:

a. Vinyl Acetate $\leq$ 10 ppm

b. Anhydrous Ammonia/ Ammonium hydroxide/ $\leq$ 25 ppm

APPLICABILITY: All MODES.*

ACTION:

a. With one Chemical Detection System inoperable, restore the inoperable system to OPERABLE status within 7 days or place the affected channel in its tripped condition.**

b. With two or more Chemical Detection Systems inoperable, within 1 hour initiate and maintain operation of the Control Room Emergency Ventilation System in the recirculation mode of operation.

SURVEILLANCE REQUIREMENTS

4.3.3.7 Each Chemical Detection System shall de demonstrated OPERABLE by performance of a CHANNEL CHECK at least once per 12 hours, an ANALOG and/or DIGITAL CHANNEL OPERATIONAL TEST at least once per 31 days and CHANNEL CALIBRATION at least once per 18 months.

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* In MODES 5 and 6, if it becomes necessary to place the Control Room Emergency Ventilation System in the recirculation mode of operation and if other Technical Specifications (3.7.7 "Control Room Makeup and Cleanup Filtration System" and/or Table 3.3-3, Item 10 "Control Room Ventilation") require placing the system in the recirculation and makeup filtration mode, then in this situation, place the system in the filtered recirculation mode only.

**The inoperable system may be bypassed for up to 4 hours for surveillance testing of the other systems per Specification 4.3.3.7.

★ **Delete this page in it's entirety** ★

SECTION 8

References

1. Onsite Toxic Gas Analysis, NC9015 Revisions 5 & 6.

2. Offsite Toxic Gas Analysis, NC9006 Revisions 5 & 6.

3. UFSAR Sections:

2.2.3	Evaluation Of Potential Accidents
2.2.3.1	Determining of Design Basis Events
2.2.3.1.1.	Industrial Facilities
2.2.3.1.2	Transportation
2.2.3.1.6	Plant Site Chemical Storage Protection
2.2.3.2	Effects of Design Basis Events
Table 2.2-5	Potentially Hazardous Chemicals Stored at Celanese Chemical Company and on the STPEGS Site
Table 2.2-6	Potentially Hazardous Chemicals Shipped from the Celanese Chemical Company.
6.4.1.6	Noxious Gas Protection
6.4.4.2	Toxic Gas Protection
7A III.D.3.4	Supp. 8 Emergency Response Facilities
9.4.1	Electrical Auxiliary Building HVAC Systems
9.4.1.1	Design Bases
9.4.1.3	Safety Evaluation

4. Technical Requirements Manual (TRM)

5. Design Base Document (DBD) 5V119VB1022
   Sections: 3.1.1.2, 3.2.1.5, 4.27.1 - 4.27.6

6. Design Criteria 5V119VD0106

7. Regulatory Guide (RG) 1.78 Rev. 0 (exception to Seismic Cat. I instruments)

8. NUREG-0570 Toxic Gas Concentrations in CR Following an Accident

9. NUREG-0800, Section 6.4, Control Room Habitability

10. Safety Evaluation by the NRC related to Amendment 7 to operation License NPF-76.

11. Correspondence ST-HL-AE-2545 Proposed Modification to Toxic Gas Monitoring

An analysis of the remaining on-site gases was performed using the guidance from RG 1.78 and the methodology in NUREG-0570 and NUREG/CR-1741. The result of this analysis show that ~~detection, alarm, and automatic isolation will be required for anhydrous ammonia and ammonium hydroxide.~~ none of the remaining chemicals pose a credible hazard to the STPEGS plant. ~~The data for these chemicals can be found in Table 2.2-5.~~

2.2.3.1.7 Plant Lightning Protection: Measures will be taken on the above-ground outdoor STPEGS appurtenances to prevent damage to either energized or nonenergized structures which could be subject to a direct lightning stroke where receipt of such a stroke could damage critical plant components, including:

1. Lightning arresters will be installed on the generator transformers and other similar energized equipment to provide a direct coupling to ground for lightning stroke-incurred surge current and any followup 60-Hz current.

   At the location of each lightning arrester, an array of buried vertical ground rods or the equivalent will be installed to provide a deep earth coupling with the shortest required length of interconnecting ground cable.

2. Air terminals and dow[illegible]ers will be provided, as required, for critical nonmetallic plant structures not effectively shielded from a direct lightning stroke by an adjacent structure.

   Air terminals, as required, will be provided on metallic plant structures which are not otherwise effectively shielded where a direct lightning stroke could damage a structure to the detriment of proper plant operation.

3. Ground rods or the equivalent will be installed as part of the overall plant grounding system and also specifically as stated in item 2.

4. All measures, devices and considerations of lightning protection requirements shall be in accordance with the National Fire Protection Association's (NFPA's) "Lightning Protection Code - NFPA No. 78", (Ref. 2.2-10).

2.2.3.1.8 Hydrogen Gas Explosions: An analysis has been performed of the effects of a detonation involving the hydrogen gas stored in bulk in the on-site BGSF. Per the guidance of Reference 2.2-29, this analysis assumes that one of the hydrogen cylinders in the BGSF ruptures and its contents are instantaneously released. The hydrogen fully forms a "puff," and the gas immediately detonates. The "puff" cloud of the gas was assumed to have a Gaussian concentration distribution (per the model described in Regulatory Guide 1.78). Dispersion of the hydrogen due to winds and the buoyancy of the hydrogen is conservatively neglected. 2

★ This Page Requires Revision ★