6.6 CONTAINMENT PENETRATION ROOM VENTILATION SYSTEM

6.6.1 DESIGN BASIS

The Containment Penetration Room Ventilation System is designed to collect and process containment penetration leakage, so as to reduce to a minimum the environmental radioactivity levels from post-accident containment leaks. See Section 14.24.3 for a discussion of the assumed operation of the system post-LOCA.

6.6.2 SYSTEM DESCRIPTION

The Containment Penetration Room Ventilation System is shown schematically in Figure 9-20A. Since experience has shown that containment leakage is more likely at penetrations such as electrical cables and air purging valves, rather than through the liner plates or weld joints (Reference 1), penetration rooms are built adjacent to the outside surface of each containment and enclose the areas around the majority of the penetrations. The only penetrations which do not pass through these areas are:

a. Two main steam lines;

b. Two main feedwater lines;

c. Equipment hatch;

d. Normal personnel access lock;

e. Emergency personnel access lock; and,

f. Refueling tube.

The main steam and feedwater lines are welded to the liner plate and, therefore, are not considered as a source of leakage. The equipment hatch and access lock openings can be tested during normal operation and are not considered sources of significant leakage. There are double seals at each of these three access openings. The refueling tube is valved on one end and blind flanged on the other end.

The principal function of this system is to control and minimize the release of radioactive materials from the containment to the environment during a post-accident period. Following a LOCA, a Containment Isolation Signal (CIS) will start both of the two full-size blowers. The penetration room exhaust ventilation system design basis is the Maximum Hypothetical Accident. The system is credited in the dose calculations with filtering the radioactive material released through the 4” containment vent line at the onset of a Maximum Hypothetical Accident as well as leakage through the penetrations. A gravity damper, which opens when the blower starts, is provided at the discharge of each blower to prevent recirculation through a failed or idle unit. The entire system is designed to operate under negative pressure up to the fan discharge.

To minimize the release of radioactive material to the environment, penetration room ventilation is continuously routed through a prefilter, an absolute high efficiency particulate air (HEPA) filter, and an activated charcoal filter, positioned in series. The use of these filters post-accident is described in Section 14.24.3.

In all cases, the flow rate from the penetration room will exceed the total maximum containment leakage rate. The containment purge equipment, if running, will be shut down by a containment radiation signal (CRS), and the valve in each purge line penetration will be closed. Refer to Section 14.24.3 for a discussion of relevant accident analysis assumptions.

6.6.3 SYSTEM COMPONENTS

The Containment Penetration Room Ventilation System is provided with two blowers and two filter assemblies. Both blowers, each of which is aligned with a filter assembly, discharge through a single line to the unit vent. (Table 6-10) Power-operated dampers are provided for isolating each filter assembly from the penetration rooms. The filter assembly consists of a prefilter, a HEPA filter and an activated charcoal filter in series. The prefilter removes coarse airborne material and water droplets using pads of glass fiber, placed between perforated metal grids, as the filtering media.

The HEPA filter, which removes small airborne particles that pass through the prefilter, consists of two cells of fiber glass media mounted in a metal frame.

The activated charcoal filter removes methyl as well as elemental iodine contaminants resulting from a LOCA. It consists of six cells of activated charcoal having approximately 5 wt% impregnation of iodine compounds, and an ignition temperature of ≥ 680°F, held in place by stainless steel channel clamps and galvanized bolts.

As a means of checking the condition of the charcoal in each filter bank, one or more charcoal test trays, filled from the same principal batch of charcoal as the other trays, may be installed in lieu of regular trays in each filter bank. Since the test tray is a substitute for a regular tray, it experiences air flows at the same rate and angle as the other trays. This ensures that the samples taken from the test trays are representative of the charcoal in the entire bank. Trays of this type may be installed in any charcoal filter bank that is part of the iodine removal system in this power plant. For operator information, temperature and pressure monitoring is provided for all penetration rooms and an area radiation monitor is provided for the West Penetration Room. Differential pressure indicators are provided across the filters.

6.6.4 SYSTEM OPERATION

During normal operation, the system is held on standby with both blowers aligned with their respective filter assemblies. A CIS will start both of the blowers. The containment purge equipment, if running, will be shut down by a CRS, and the valve in each purge line will be closed.

All of the system components can be controlled from the Control Room.

6.6.5 DESIGN EVALUATION

The blower capacity of 2000 ± 200 cfm exceeds, in all cases, the total maximum Containment Building leakage rate. The blowers and the respective filters are aligned in a redundant manner to assure operation of one blower and its respective filter assembly, independent of a failure or malfunction of any of the active system components.

When the system is in operation, a negative pressure may be maintained in the penetration rooms and in the ducting up to the discharge of the blower. All components are designed to Seismic Category I requirements.

6.6.6 AVAILABILITY AND RELIABILITY

Redundancy of components, monitoring operation of the system from the Control Room and provision of proper instrumentation, assure proper response of the system when a LOCA does occur. Upon failure of the normal electrical power supply to the blowers, power is supplied from the emergency power source.

The system components and equipment are fully accessible during normal plant operation.

A single failure analysis for the main components of the system is given in Table 6-11.

6.6.7 TESTS AND INSPECTIONS

All equipment and associated components are arranged so that they can be inspected at any time the containment is accessible.

Testing of charcoal/HEPA filter units is established based on Technical Specification requirements. The Technical Specification specifies testing conditions based on the application of the particular filter unit.

6.6.8 REFERENCE

1. W.B. Cottrell and A.W. Savolainen, Editors, U. S. Reactor Containment Technology, ORNL-NSIC-5, Volume II, August 1965

TABLE 6-10

PENETRATION ROOM BLOWER DESCRIPTION

Type	Centrifugal
Quantity	2 in each unit
Capacity (cfm)	2000 at 8 1/2" w.g. (inch H_20)
Motor	5 hp, 460 Volt, 3 phase, 60 cycle
Codes	NEMA

TABLE 6-11

SINGLE FAILURE CHARACTERISTICS FOR CONTAINMENT PENETRATION ROOM VENTILATION SYSTEM

	COMPONENT	MALFUNCTION	COMMENTS AND CONSEQUENCES
1.	Blower	Fails to start	Spare blower is already operating.
2.	Blower	Fails during service	Alarm in Control Room will indicate loss of negative pressure, and spare blower is already in service.
3.	Blower valve	Fails to open	Spare blower is already operating.
4.	Filter valve	Fails to open	Failure not considered credible since one filter will always be lined up to operate when needed.
5.	Ductwork	Leakage	Leakage of unfiltered air may be inward since ductwork may be maintained at negative pressure.