5. Engineered Safety Features

5.1 Auxiliary Cooling System

The auxiliary cooling system (ACS) consists mainly of the AHX, auxiliary gas circulators and an air cooler as shown in Fig. II.4.1. The ACS has a heat transfer capacity of about 3.5MW. The ACS automatically starts up when the reactor is scrammed and the MCS is stopped in abnormal events. Core cooling by a forced circulation is possible with the ACS. The ACS consists of redundant dynamic components such as gas circulators, water pumps and valves that are also operated with emergency power supply.

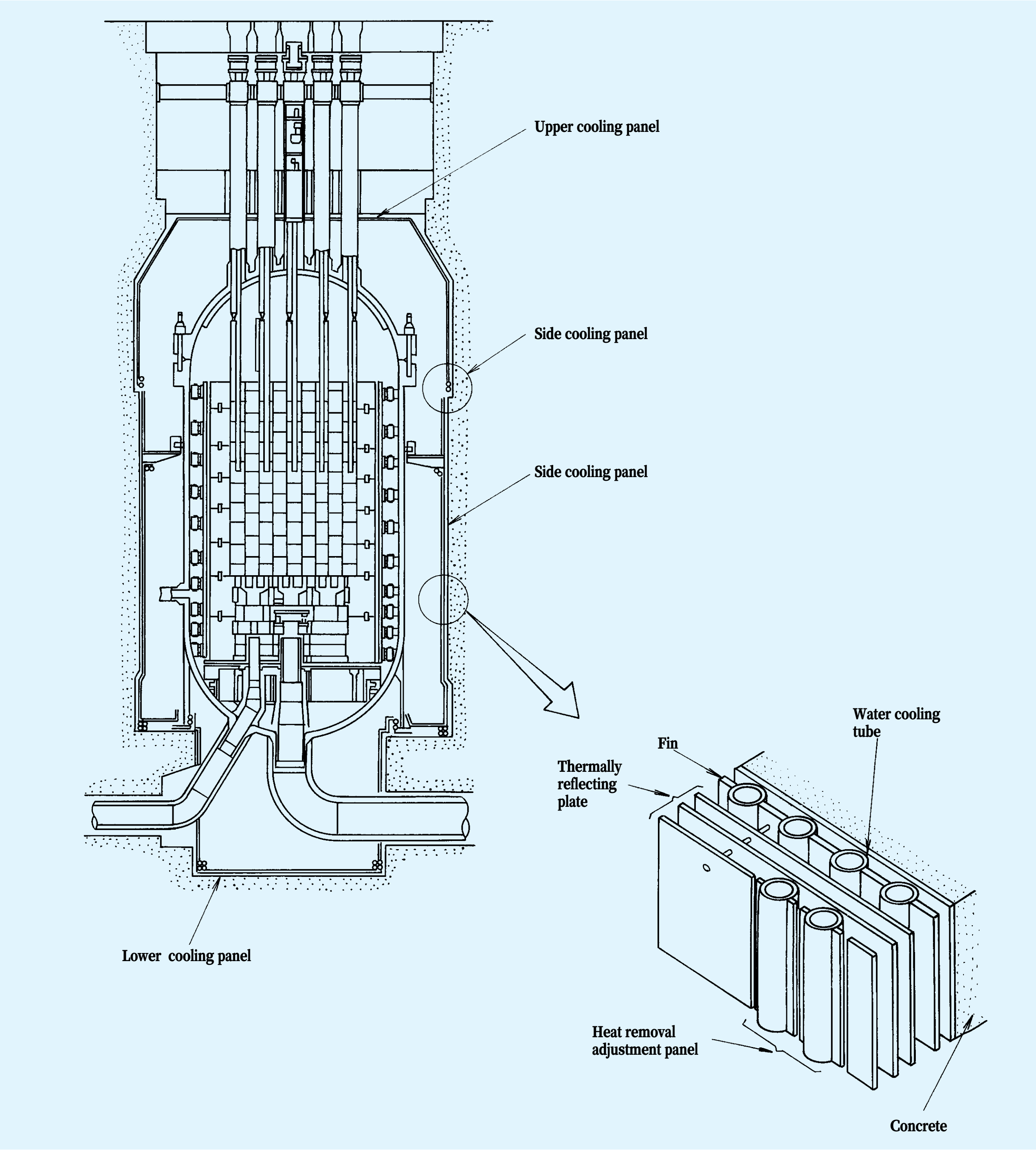

Fig. II.5.1 Cooling panels of the vessel cooling system around the reactor pressure vessel.

The residual heat of the core can be removed even by the vessel cooling system (VCS) without the ACS. The ACS, however, is needed from the viewpoint of operational flexibility, because it takes a very long time to cool down the core by the VCS.

5.2 Vessel Cooling System

The VCS consists of upper, lower, and side cooling panels and heat removal adjustment panels around the RPV, as shown in Fig. II.5.1, and cooling water circulation systems. The amount of heat removal should be adjusted to be less than 0.6MW during normal operation to accomplish the reactor outlet gas temperature of 950℃, and to be more than 0.3MW during accidents to cool down the reactor and not to exceed the limits of fuel and RPV temperature. The VCS is used as a residual heat removal system when the forced circulation by the MCS cannot be maintained due to the rupture of the inner pipe or both pipes in the concentric hot gas duct. The VCS is also an engineered safety feature composed of two independent complete sets that are backed up with emergency power supply. They are operated even in normal operation in order to cool the biological shielding concrete wall.

Each cooling panel consists of several parts. Pressure-proof and leakage tests were performed at each fabrication process. The installation of all cooing panels was completed in November 1995.

5.3 Containment Structure

The containment structure consists of a reactor containment vessel (CV), service area (SA) and an emergency air purification system which reduce the release of fission products (FPs) to the environment during the postulated accidents. The CV is designed to withstand the temperature and pressure transients and to be leak-tight within the specified limits in the case of concentric hot gas duct rupture.

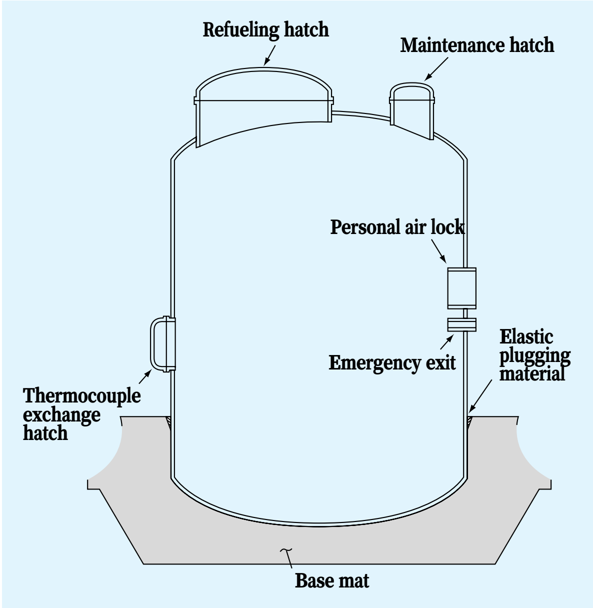

Fig. II.5.2 Reactor containment vessel.

(1) Reactor containment vessel

The CV made of steel is 30.3m in height, 18.5m in inner diameter and has 2800m^3 free volume. Its configuration is shown in Fig. II.5.2. The CV is comparatively small, to minimize the amount of air which may react with graphite components during the depressurization accident (rupture of the concentric hot gas duct).

The CV is designed to have a maximum leak rate of 0.1% of the total volume per day at room temperature and 0.9 times of 0.4MPa, which is the maximum service pressure.

The specification of the CV is shown in Table II.5.1.

The first pressure-proof and leakage tests of the CV were carried out in November 1992. Further pressure and leak rate tests were performed in 1996.

(2) Service area

The SA is the space surrounding the CV where the fuel handling and storage systems and the primary and the secondary helium purification systems are located. The pressure inside the SA is maintained slightly lower than that of the atmosphere by the ventilation system and the emergency air purification

Table II.5.1 Specification of reactor containment vessel.

Containment type	Steel containment
Maximum service pressure	0.4MPa
Maximum service temperature	150℃
Major size	
Inner diameter	18.5m
Overall height	30.3m
Body thickness	30mm
Top lid thickness	38mm
Refueling hatch diameter	8.5m
Maintenance hatch diameter	2.4m
Personal air lock diameter	2.5m
Free volume	2800m^3
Material	Carbon steel
Maximum leak rate	Less than 0.1% per day at room temperature and 0.9 times as high as maximum service pressure

system in normal and accident conditions, respectively.

The leak-tightness test of the SA was performed in 1996.

(3) Emergency air purification system

The emergency air purification system removes airborne radioactivity and maintains proper pressure in the SA during the accidents. The system consists of two lines as shown in Fig. II.5.3. Each line consists of an exhaust filtering unit, an exhaust blower and butterfly valves. The system filters and discharges the air to atmosphere through an exhaust duct at a volume flow of 56m^3/min/unit.

The specification of the emergency air purification system is shown in Table II.5.2.

After installation of the emergency air purification system, the filter efficiency test was carried out in 1996.

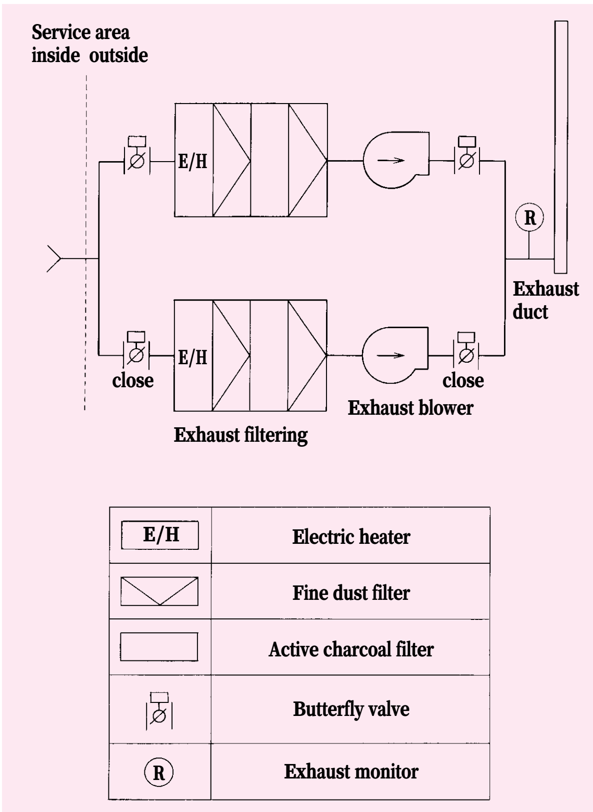

Fig. II.5.3 Emergency air purification system.

Table Ⅱ.5.2 Specification of emergency air purification system.

Exhaust filtering unit	
Type	Dust and iodine removal filter
Number	2
Volume velocity	56m^3/min/unit
Charcoal layer thickness	50mm
Removal efficiency	
Iodine	More than 95% at 50℃ and relative humidity of 80%
Metallic FP	More than 99% for 0.7 micron of particle