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Generic PCSR Sub-chapter 16.2 : Process Auxiliary Systems

Hitachi-GE Nuclear Energy, Ltd.

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16.2.1 Compressed Air System

16.2.1.1 Instrument Air System

16.2.1.1.1 System Summary Description

This section is a general introduction to the Instrument Air System (IA) where the system roles, system functions, system configuration and modes of operation are briefly described. The IA is described in detail in the system specifications [Ref-1] and the Piping and Instrumentation Diagram (P&ID) [Ref-2]

16.2.1.1.1.1 System Roles

The IA is designed to supply clean, dry and oil-free compressed air to the plant instrumentation, control components and air operated valves.

16.2.1.1.1.2 Functions Delivered

The IA supplies compressed air to satisfy the requirements of plant instruments, controllers, pneumatic valves, etc. The main users of compressed air are shown in Table 16.2-1. The list of systems consuming air from the IA is included in [Ref-1].

Table 16.2-1 : Main users of Instrument Air

Facility	Main users
Reactor Building	Instrumentation
	Control valves
	Air-operated valves
Turbine Building	Instrumentation
	Control valves
	Air-operated valves
Radwaste Building	Instrumentation
	Control valves
	Air-operated valves
Control Building	Instrumentation
	Control valves
	Air-operated valves
Heat Exchanger Building	Instrumentation
	Control valves
	Air-operated valves

16.2.1.1.1.3 Basic Configuration

(1) The supply of compressed air for plant instrumentation and controls is provided by a compressed air system with two parallel trains. The system has two compressors arranged in parallel (one duty, one stand-by). Compressed air from the compressors is transferred to the air reservoir, then through one of two parallel dryer trains (one unit as backup), and finally is supplied to the respective pneumatic components.

(2) Normal operation of the IA is independent from the Station Service Air System (SA). However, in case of failure or abnormal pressure drop, the SA is capable of automatic operation to back up the IA through the piping and the valve connecting the two systems.

(3) Piping connecting to the High Pressure Nitrogen Gas Supply System (HPIN) is provided upstream of the valve isolating the IA since the instrumentation, controllers and devices for driving pneumatic valves inside the Primary Containment Vessel (PCV) are normally operated by nitrogen gas during normal plant operation.

(4) The IA consists of the following equipment. The outline of IA configuration is shown in Figure 16.2-1.

(a)	IA Compressor	2 units (1 as a backup)
(b)	IA Air Reservoir	1 unit
(c)	IA Dryer Pre Filter	2 units (1 as a backup)
(d)	IA Dryer Tower	2 sets/unit x 2units (1 as a backup)
(e)	IA Dryer After Filter	2 units (1 as a backup)

16.2.1.1.1.4 Modes of Operation

The IA can deliver the following operation modes by switching the position of the valves.

16.2.1.1.1.4.1 Normal Operation Mode

Compressed air is supplied by one of the IA Compressors which is selected as the driving unit to operate during normal operation.
Nitrogen gas is supplied from the Atmospheric Control System (AC) after pressure reduction through the HPIN.

16.2.1.1.1.4.2 Backup Operation Mode

The stand-by compressor automatically starts if a pressure drop is detected in the IA Air Reservoir due to a failure of the driving compressor or insufficient air supply to satisfy an increase in air consumption with just one unit.
Furthermore, in the event the gas pressure decreases further, the isolation valve on the tie-line connecting with the SA automatically opens to receive compressed air from the SA.
In addition, the IA can supply air to the pneumatic components inside the PCV in the event that nitrogen supply system failure occurs.

16.2.1.1.1.4.3 Plant Periodic Inspection Mode

During the periodic inspections, operators manually switch the supply to the pneumatic components inside the PCV so that the IA provides compressed air instead of nitrogen gas supplied via AC and HPIN .

16.2.1.1.2 Design Bases

This section describes the design bases for the IA.

16.2.1.1.2.1 Safety Functions

The IA has been designed to meet the following SFCs. The relation between the SFCs put on this system and the high level claims is shown in Appendix-1.

Normal Operations

(1) The IA continuously supplies compressed air to prevent inoperability of the pneumatic components within systems required for plant continuous operation, which are:
  (a) Turbine Building: Feedwater System (FDW), Off-Gas System (OG)
  (b) Reactor Building: Control Rod Drive System (CRD), Main Steam System (MS)
  (c) Heat exchanger Building: Reactor Building Cooling Water System (RCW) [IA_SFC_5-13.1]

  (This function is categorised as Category C and the components to deliver it are designed to meet Class 3 requirements)

(2) The IA in plant normal operation supplies the air required to maintain the normal operation of safety class 3 systems that contribute to reducing radiation exposure from radioactive material. [IA_SFC_5-13.2]
  (This function is categorised as Category C and the components to deliver it are designed to meet Class 3 requirements)

Fault Conditions

(3) The IA backs up the HPIN by automatically supplying compressed air to drive the instruments, controllers and pneumatics valves that are normally supplied with nitrogen gas by the HPIN, in the event that the HPIN supply is interrupted. [IA_SFC_5-13.3]
  (This function is categorised as Category C and the components to deliver it are designed to meet Class 3 requirements)

(4) The IA components within the PCVB are completely isolated by the PCIS in order to form barrier to confine the radioactive material within the containment boundary and prevent its dispersion to the environment in the event of faults. [PCIS_SFC_4-7.12]
  (This function is categorised as Category A and the components to deliver it are designed to meet Class 1 requirements.This safety function is developed and justified in Generic PCSR Chapter 13 “Engineered Safety Features” (GA91-9101-0101-13000) section 13.2.3.1.2 related to the Primary Containment Facility)

16.2.1.1.3 System Design Description

This section describes the design of the IA to support and justify the delivery of IA_SFC_5-13.1, IA_SFC_5-13.2 and IA_SFC_5-13.3. The IA is described in detail [Ref-1] and [Ref-2].

16.2.1.1.3.1 Overall System Design and Operation

The IA provides a reliable supply of dry, clean, oil-free compressed air for plant instrumentation and controls. Compressed air from two compressors arranged in parallel (one as backup) is transferred to the air reservoir, then through one of two parallel dryer trains (one train as backup), which each have a dryer pre-filter, two parallel dryer towers (one in service and one stand-by) and a dryer post-filter. Finally compressed air is directed to the respective pneumatic components.

16.2.1.1.3.1.1 Normal Operation Mode

Compressed air is supplied by one of the IA Compressors which is selected as the driving unit to operate during normal operation.
Nitrogen gas is supplied from the AC after pressure reduction through the HPIN.

16.2.1.1.3.1.2 Backup Operation Mode

The stand-by compressor automatically starts if a pressure drop is detected in the IA Air Reservoir due to a failure in the driving compressor or insufficient air supply to satisfy an increase in the air consumption with just one unit.
Furthermore, in the event the gas pressure decreases further, the isolation valve on the line connecting with the SA automatically opens to receive compressed air from the SA.
In addition, the IA can supply air to the pneumatic components inside the PCV in the event of nitrogen supply system failure or reduced nitrogen supply.

16.2.1.1.3.2 Equipment Design and Operation

16.2.1.1.3.2.1 System Design Specification

The IA is designed to satisfy the following general conditions. Actual values for the specification can only be determined when the specification of the pneumatic equipment and instrumentation supplied is known in more detail.

Table 16.2-2 : General Requirements for IA Design

Item	Contents
Air flow rate	The adequate flow to sufficiently supply the total air consumption of the devices which require it.
Air pressure	The adequate pressure to satisfy the maximum necessary pressure among all pneumatic components and not to cause damage or inoperability to pneumatic components through excess pressure
Air quality	The adequate quality to not cause any impediment to the pneumatic components
Air humidity	The adequate humidity to not cause any impediment to instruments and controllers to achievement of required operating life and maintenance interval
Air temperature	The adequate temperature to not cause any impediment to the dryer
Dust particles size	The adequate diameter to not cause any impediment to instruments and controllers

16.2.1.1.3.2.2 IA Compressor

(1) Purpose
The IA Compressor supplies air at the highest pressure required among all loads to deliver IA_SFC_5-13.1, IA_SFC_5-13.2 and IA_SFC_5-13.3. Where necessary, any components which have a lower maximum pressure rating will be suitably protected.

(2) Configuration and Operation
Two 100 percent-capacity IA Compressors are provided and supply oil-free air to the components in order not to affect their performance. One compressor is sufficient for supplying the required consumption of compressed air, therefore one compressor is in operation and the other is in stand-by.

(3) Performance
The specification of IA Compressor required for the delivery of IA_SFC_5-13.1, IA_SFC_5-13.2 and IA_SFC_5-13.3 is shown below.
(a) Number 2 units (1 driving unit, 1 stand-by unit)
(b) Capacity(suction air flow) Approx. 15 m^3/min/unit[normal]

16.2.1.1.3.2.3 IA Air Reservoir

(1) Purpose
The IA Air Reservoir is designed to absorb and mitigate the pulsations caused by the discharge of compressed air and offer a stable supply. In addition, it is capable of supplying compressed air for 10 minutes at the required pressure after failure of all systems supplying air (IA and SA) in the event of loss of power supply.

(2) Performance
The specification of IA Air Reservoir is shown below.
(a) Number 1 unit
(b) Capacity Approx.48m^3

16.2.1.1.3.2.4 IA Dryer

(1) Purpose
The IA dryer is capable of drying the air up to the dew point, at a sufficiently low temperature to not interfere with the operating conditions of instruments and controllers, including allowance if necessary for expansion of air at the equipment.

(2) Configuration and Operation
The IA dryer consists of two 100 percent-capacity trains, in which two 100 percent-capacity IA Dryer Towers are installed. One unit operates as the driving unit and the other operates as the stand-by unit. If the driving unit fails, the stand-by unit is initiated automatically to continue supplying air at the same conditions.

16.2.1.1.3.2.5 IA Dryer Pre Filter

(1) Purpose
The IA Dryer Pre Filter removes dust particles contained in the compressed air to prevent adhesion to the desiccant and thus preserve desiccant performance.

(2) Configuration and Operation
The IA Dryer Pre Filters are installed at the inlet of the IA Dryer Tower Two 100 percent-capacity switchable units are installed.

16.2.1.1.3.2.6 IA Dryer After Filter

(1) Purpose
The IA Dryer After Filter removes desiccant particles and other dust substances that might be in the dried air and thus protect the pneumatic components.

(2) Configuration and Operation
The IA Dryer After Filters are installed at the outlet of the IA Dryer Tower. Two 100 percent-capacity switchable units are installed.

16.2.1.1.3.3 Main Support Systems

16.2.1.1.3.3.1 Instrumentation and Control Systems

(1) The IA Compressors are continuously switching between loaded operation and unloaded operation depending on the pressure in the IA Air Reservoir to control and maintain it within the determined range. If the pressure in the IA Air Reservoir drops below the specified value, the stand-by IA Compressor automatically starts and operates in parallel with the driving unit. Once the stand-by compressor has been initiated, shutoff can be implemented by the operation switch.
(2) Nitrogen gas supply is automatically switched to compressed air supply if the nitrogen gas

supply pressure to the components within the PCV drops.

(3) The isolation valve connecting the SA to the IA automatically opens to initiate the backup operation if the pressure in the IA Air Reservoir drops.

16.2.1.1.3.3.2 Power Supply System

During normal operations, the IA is supplied with power by the external grid. The Emergency Power Supply System is capable of supplying AC power to the IA Compressors and the IA dryer units and DC power to the controls and instrumentation in the event of loss of offsite power supply.

16.2.1.1.3.3.3 Reactor Building Cooling Water System (RCW)

The cooling water for the compressors is from the RCW system. The cooling water for the driving and stand-by compressors comes from different divisions of the RCW system to minimise risk of simultaneous loss of cooling water supply.

There is interdependence between the two systems as the IA provides air to pneumatic valves in the RCW. However, the valves in the RCW that receive air from the IA are not essential for delivering the RCW safety functions. Therefore, failure of the RCW due to a failure of the IA is not considered.

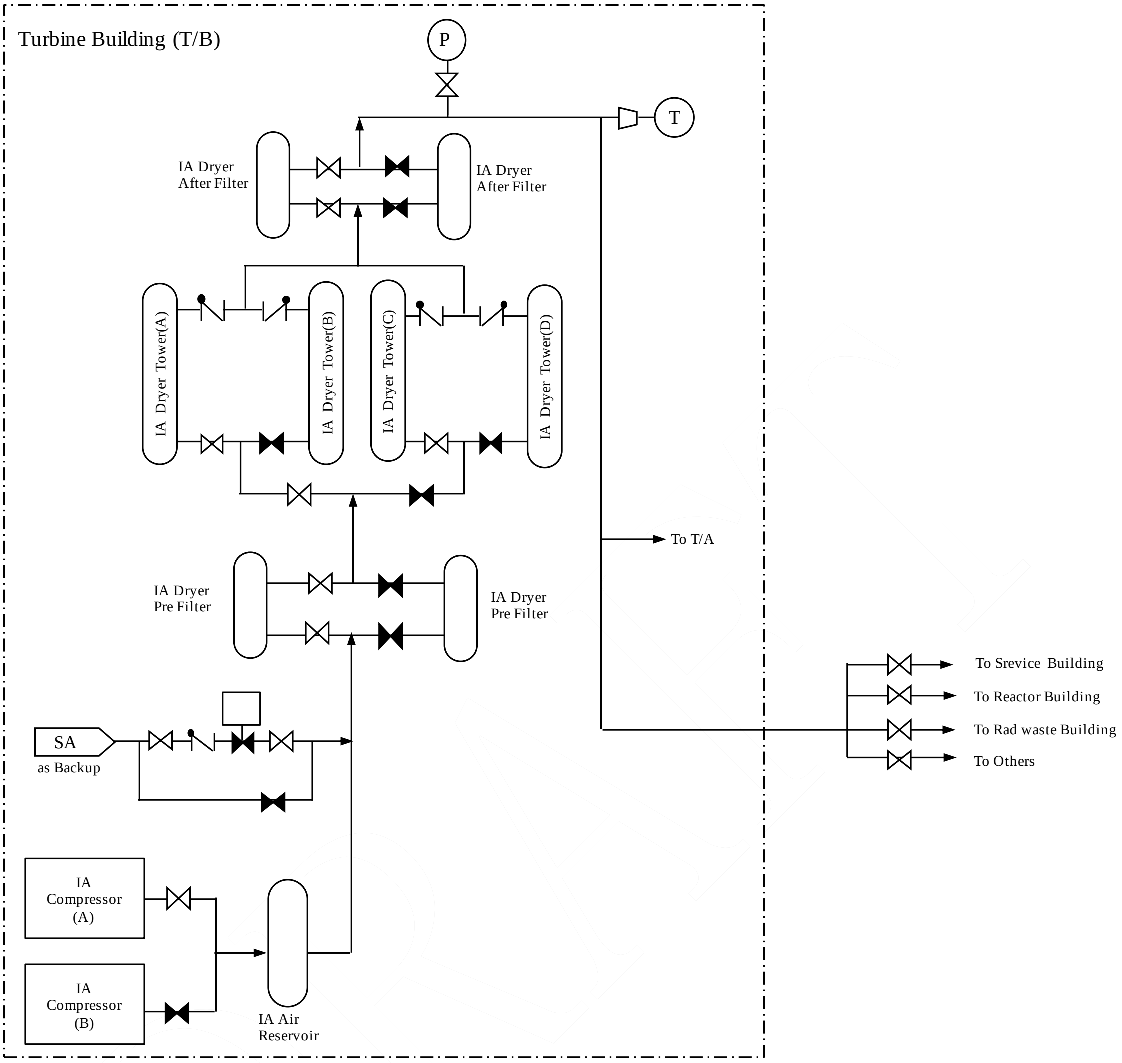

Figure 16.2-1 : Outline of IA configuration

16.2.1.2 Station Service Air System

16.2.1.2.1 System Summary Description

This section is a general introduction to the Station Service Air System (SA) where the system roles, system functions, system configuration and modes of operation are briefly described. The SA is described in detail in the system specifications [Ref-3] and the P&IDs [Ref-4][Ref-5][Ref-6]

16.2.1.2.1.1 System Roles

The SA is designed to supply compressed air for equipment purging, filter backwashing and fluid agitation as well as compressed air for pneumatic components and tools. The SA is a source of compressed air for miscellaneous purposes and is independent from the Instrument Air System (IA) except for the tie-line mentioned in the previous section on the IA to enable supply from the SA to the IA as backup measure to loss of the IA.

16.2.1.2.1.2 Functions Delivered

The SA supplies compressed air for equipment purging, filter backwashing, fluid agitation and operation of pneumatic components and tools. The main users of compressed air are shown in Table 16.2-3.

Table 16.2-3 : Main users of Service Air

Main user	Purpose
Standby Liquid Control Tank	Mixing
CUW Filter/Demineraliser	Backwashing
FPC Filter/Demineraliser	Backwashing
Condensate Filter	Backwashing
Condensate Demineraliser	Mixing
Off gas Exhaust Gas Ejector	Driving Force
LCW Filter	Backwashing
LCW Demineraliser	Transfer
HCW Demineraliser	Transfer
Instrument Air System	Backup

16.2.1.2.1.3 Basic Configuration

The SA is comprised of two parallel compressors. Compressed air from each compressor flows through the SA Air Reservoir to the respective air supply points.
The SA normally operates separately from the IA. However, if the supply pressure of the IA abnormally drops, the SA is actuated as a backup of the IA. Connecting piping and valves are provided to automatically back up the IA.
The SA consists of the following components. The outline of SA configuration is shown in Figure 16.2-2.
(1) SA Compressor 2 units (50 percent-capacity/unit)

(2)	SA Air Reservoir	1 unit
(3)	Piping and Valves	1 set
(4)	Instruments and Controllers	1 set
(5)	Hose Connections and Fittings	1 set

16.2.1.2.1.4 Modes of Operation

The SA can deliver the following operation modes by switching the position of the valves.

16.2.1.2.1.4.1 Normal Operation Mode

This is the basic operation mode of the SA where it supplies compressed air to the different equipments requiring it.

16.2.1.2.1.4.2 IA Back-up Operation Mode

In the event that the pressure in the IA abnormally drops, the valve on the line connecting the SA with the IA automatically opens and the supply of compressed air from the SA to the IA is initiated.

16.2.1.2.2 Design Bases

This section describes the design bases for the SA.

16.2.1.2.2.1 Safety Functions

The SA has been designed to meet the following SFCs. The relation between the SFCs put on this system and the high level claims is shown in Appendix-2.

Normal Operations

(1) The SA supports the Off-Gas System (OG) by supplying it with purge air which is required for normal operation. [SA_SFC_5-13.1]
(This function is categorised as Category C and the components to deliver it are designed to meet Class 3 requirements)

Fault Conditions

(2) The SA initiates supply of compressed air to the IA as a back-up of the IA in the event that the pressure in the IA drops abnormally. [SA_SFC_5-13.2]
(This function is categorised as Category C and the components to deliver it are designed to meet Class 3 requirements)
(3) The SA components within the PCVB are completely isolated by the PCIS in order to form barrier to confine the radioactive material within the containment boundary and prevent its dispersion to the environment in the event of faults. [PCIS_SFC_4-7.13]
(This function is categorised as Category A and the components to deliver it are designed to meet Class 1 requirements. This safety function is developed and justified in Generic PCSR Chapter 13 “Engineered Safety Features” (GA91-9101-0101-13000) section 13.2.3.1.2 related to the Primary Containment Facility)

16.2.1.2.3 System Design Description

This section describes the design of the SA to support and justify the delivery of SA_SFC_5-13.1 and SA_SFC_5-13.2. The SA is described in detail in [Ref-3], [Ref-4], [Ref-5] and [Ref-6]

16.2.1.2.3.1 Overall System Design and Operation

The SA consists of two parallel compressors. Compressed air from each compressor flows through the SA Air Reservoir to the respective air supply points.
The SA normally operates separately from the IA. However, if the supply pressure of the IA abnormally drops, the SA is actuated as a backup of the IA. Connecting piping and valves are provided to automatically back up the IA.

16.2.1.2.3.1.1 Normal Operation Mode

This mode is the basic operation mode of the SA which supplies compressed air to the different equipments requiring it.
One compressor is normally operating either loaded or unloaded as the driving unit.
The other compressor is on stand-by condition during normal operation. In the event the air consumption exceeds the capacity of the driving unit or the operating compressor cannot maintain the required pressure due to any kind of failure, the stand-by compressor is initiated automatically and operated either loaded or unloaded as the auxiliary unit.

16.2.1.2.3.1.2 IA Backup Operation Mode

In the event the pressure in the IA abnormally drops, the valve on the line connecting the SA with the IA automatically opens and the supply of compressed air from the SA to the IA is initiated.
The operational procedure for the compressors is the same as during the normal operating mode.

16.2.1.2.3.2 Equipment Design and Operation

16.2.1.2.3.2.1 System Design Specification

The SA is designed to satisfy the following general conditions. Actual values for the specification can only be determined when the specification of the equipment supplied is known in more detail.

Table 16.2-4 : General Requirements for Air Supply

Item	Requirement
Air flow rate	Sufficient to satisfy the supply to all components.
Air pressure	Sufficient to satisfy the highest pressure among all components requiring air supply.
Air quality	The necessary quality to supply to the components without hindrance.

16.2.1.2.3.2.2 SA Compressor

(1) Purpose
The SA compressors supply the required continuous consumption of air to the components, and are capable of sufficiently covering the cumulative consumption of the maximum intermittent loads in order to deliver SA_SFC_5-13.1 and SA_SFC_5-13.2.
(2) Configuration and Operation
Two compressors with 50 percent-capacity per unit are provided. They supply oil-free air in order to satisfy the consumption of the different loads without affecting their performance. One compressor is normally operating and the stand-by compressor initiates when the capacity of the driving compressor is exceeded due to the cumulative consumption from the intermittent loads to assure the necessary supply.
(3) Performance
The specification of the SA Compressor required for the delivery of SA_SFC_5-13.1 and SA_SFC_5-13.2 is shown below:
(a) Number 2 units
(b) Suction Air Flow Approx.12m^3/min /unit [normal]
(c) Discharge pressure 0.72MPa [gauge]

16.2.1.2.3.2.3 SA Air Reservoir

(1) Purpose
The SA Air Reservoir is designed to mitigate pulsations and prevent rapid pressure drops during load variations, and thus, ensure a stable compressed air supply.
(2) Performance
The specification of the SA Air Reservoir is shown below.
(a) Number 1 unit
(b) Capacity Approx.11m^3

16.2.1.2.3.3 Main Support Systems

16.2.1.2.3.3.1 Instrumentation and Control Systems

(1) The driving compressor is switched from load operation to unload operation depending on the pressure in the SA Air Reservoir so that the pressure is maintained within the determined range.

The stand-by compressor is automatically initiated and operated in parallel with the driving compressor if the pressure in the SA Air Reservoir drops to a pre-determined low value. A timer is provided to prevent frequent initiation/shutoff of the stand-by compressor. If the unload operation time of the stand-by compressor exceeds a set point of the timer, the compressor is automatically shut off. .

(2) The connection valve between the SA and the IA opens automatically to initiate air supply from the SA if the pressure in the IA Air Reservoir drops

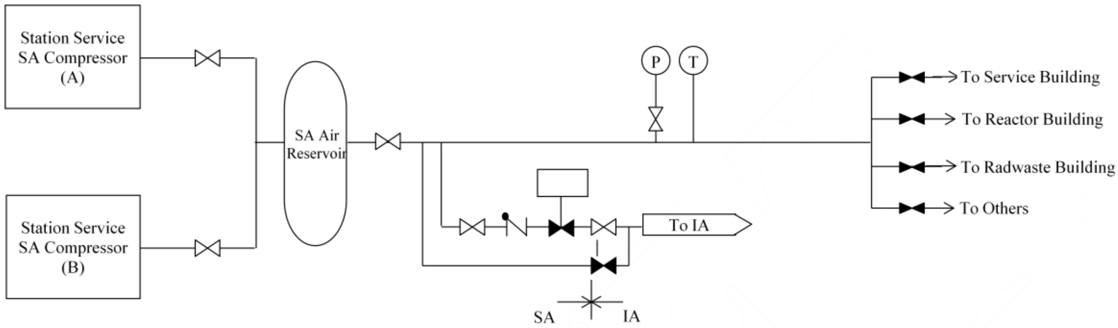

Figure 16.2-2 : Outline of SA configuration

16.2.1.3 High Pressure Nitrogen Gas Supply System

16.2.1.3.1 System Summary Description

This section is a general introduction to the High Pressure Nitrogen Gas Supply System (HPIN) where the system roles, system functions, system configuration and modes of operation are briefly described. The HPIN design is described in detail in the system specifications [Ref-7] and the P&ID [Ref-8].

16.2.1.3.1.1 System Roles

The purpose of the HPIN is to supply clean, dry and oil-free nitrogen gas to all the accumulators of the Main Steam Safety Relief Valves (SRVs) and other pneumatic valve actuators which need high pressure nitrogen gas.

16.2.1.3.1.2 Functions Delivered

(1) The HPIN supplies nitrogen gas to the following components from the nitrogen gas supply machine via the Atmospheric Control System (AC) during plant normal operation.

   (a) SRV Accumulators for the relief valve function and the Automatic Depressurisation System (ADS) function of the Safety Relief Valves (SRV)
   (b) Instrumentation and pneumatic valves in the Primary Containment Vessel (PCV) including inboard containment isolation valves (e.g. inboard MSIVs)
   (c) Equipment requiring nitrogen gas supply in the Reactor Building (R/B)

(2) The HPIN is capable of supplying nitrogen gas from the nitrogen gas evaporator to the SRV Accumulators for the ADS function of the SRVs in the event of Loss of Coolant Accident (LOCA). Furthermore, nitrogen cylinders are provided to assure the supply in the case of loss of the normal nitrogen supply.

16.2.1.3.1.3 Basic Configuration

The HPIN consists of one high pressure nitrogen gas supply division to provide nitrogen from the nitrogen gas supply machine via the AC during plant normal operation, and two high pressure nitrogen gas supply divisions (emergency gas supply line A and B) to provide nitrogen from the HPIN Nitrogen Cylinders in the case of an emergency. The basic components are as follows. The outline of the HPIN configuration is shown on Figure 16.2-3.

(1)	Nitrogen Gas Cylinder Rack	2 racks (10 cylinders per rack)
(2)	Piping and Valves	1 Set
(3)	Instruments and Controllers	1 Set
(4)	Control Panels	1 Set

16.2.1.3.1.4 Modes of Operation

The HPIN can deliver the following operation modes by switching the position of the valves.

16.2.1.3.1.4.1 Normal Operation Mode

All nitrogen-operated components are provided with nitrogen gas during plant normal operation. The nitrogen is supplied through the IA except for the SRV Accumulators which are directly supplied by the HPIN.

16.2.1.3.1.4.2 Emergency Operation Mode

The motor operated valves at the outlet of the nitrogen gas cylinders are automatically opened to supply nitrogen gas to the SRV Accumulators for the ADS function if the pressure in the inlet line to the accumulators drops below the determined pressure.

16.2.1.3.2 Design Bases

This section describes the design bases for the HPIN.

16.2.1.3.2.1 Safety Functions

The HPIN has been designed to meet the following SFCs. The relation between the SFCs put on this system and the high level claims is shown on Appendix-3.

Normal Operations

(1) The HPIN supplies nitrogen gas to fill and maintain pressure in the SRV accumulators for relief and ADS functions during normal operation. [HPIN_SFC_5-13.1]
(This function is categorised as Category C and the components to deliver it are designed to meet Class 3 requirements)

(2) The HPIN supplies nitrogen gas to the nitrogen operated equipment installed in the reactor building and the PCV (including inboard MSIV) during normal operation. [HPIN_SFC_5-13.2]
(This function is categorised as Category C and the components to deliver it are designed to meet Class 3 requirements)

Fault Conditions

(3) The HPIN supports SRV operation in the event of beyond design basis faults by supplying nitrogen to re-charge its accumulators if further actuations are required. [HPIN_SFC_5-13.3]
(This function is categorised as Category B and the components to deliver it are designed to meet Class 3 requirements)

(4) The HPIN components within the PCVB are completely isolated, when permitted, by the PCIS in order to form barrier to confine the radioactive material within the containment boundary and prevent its dispersion to the environment in the event of faults. [PCIS_SFC_4-7.14]
(This function is categorised as Category A and the components to deliver it are designed to meet Class 1 requirements. This safety function is developed and justified in Generic PCSR Chapter 13 “Engineered Safety Features” (GA91-9101-0101-13000) section 13.2.3.1.2 related to the Primary Containment Facility)

16.2.1.3.3 System Design Description

This section describes the design of the HPIN to support and justify the delivery of HPIN_SFC_5-13.1, HPIN_SFC_5-13.2 and HPIN_SFC_5-13.3. The HPIN is described in detail in [Ref-7] and [Ref-8]

16.2.1.3.3.1 Overall System Design and Operation

16.2.1.3.3.1.1 Normal Operation Mode

The system supplies nitrogen gas to the equipment described below from the nitrogen gas supplying device via the AC.
(1) SRV Accumulator (for the ADS function and relief function)
(2) The inboard MSIV
(3) The nitrogen gas-operated equipment used in PCV
(4) The nitrogen gas-operated equipment used in R/B

(3) and (4) equipment is supplied nitrogen via the Instrument Air System (IA)

The nitrogen gas to be supplied to each equipment is supplied by depressurisation by the pressure control device set up on the supply line.

In the case the pressure in the supply line falls below the determined value, the supply of the nitrogen gas to the equipment within the R/B and the PCV automatically switches to the IA.

16.2.1.3.3.1.2 Emergency Operation Mode

While normally supplying nitrogen gas from the nitrogen gas supply machine via the AC, the HPIN is designed to supply nitrogen gas to the SRV Accumulator for the ADS function from the HPIN nitrogen gas cylinders if the nitrogen gas supply stops or the nitrogen gas pressure is less than the determined value in the supply piping. The motor operated valves at the outlet of the nitrogen gas cylinders are automatically opened and the isolation valves installed at the nitrogen supply connection line between emergency gas supply line A and B and normal gas supply line are automatically closed. The supply from the cylinders can be ensured for 7 days without replacement following an accident.
The supply piping from the nitrogen gas cylinders to the SRV Accumulator for the ADS function is divided into two independent lines which are each directed to half of the SRVs with the ADS function so that half of the SRVs with the ADS function can be operated even if the nitrogen gas supply piping is blocked or broken.
The nitrogen gas to be supplied to the SRV Accumulator for the ADS function is supplied by depressurisation by the pressure control device which is set up on the supply line.

16.2.1.3.3.2 Equipment Design and Operation

16.2.1.3.3.2.1 System Design Specification

The HPIN is designed to satisfy the following general conditions. Actual values for the specification can only be determined when the specification of the equipment and instrumentation supplied is known in more detail.

Table 16.2-5: General Requirements for Air Supply

Item	Requirement
Nitrogen gas Pressure	Sufficient to satisfy the highest pressure among all components requiring nitrogen gas supply.
Cylinder capacity	Sufficient to ensure supply for 7 days without replacement.

16.2.1.3.3.2.2 Components Design Specification

16.2.2.3.3.2.2.1 HPIN Nitrogen Gas Cylinder

(1) Purpose
Nitrogen cylinders are provided to assure the supply in case of loss of the nitrogen supply from the AC in order to deliver HPIN_SFC_5-13.1 and HPIN_SFC_5-13.3.
(2) Configuration and Operation
The nitrogen gas cylinders are divided into two cylinder racks A and B. Each rack of cylinders supply half of the SRVs with the ADS function so that half of the SRVs with the ADS function can be operated even if one of the nitrogen gas supply pipes is blocked or broken.
(3) Performance
The specification of the Nitrogen gas cylinder required for the delivery of HPIN_SFC_5-13.1 and HPIN_SFC_5-13.3 is shown below:
(a) Number 10 units/rack × 2 racks
(b) Capacity 46.7L per cylinder

16.2.1.3.3.3 Main Support Systems

16.2.1.3.3.3.1 Instrumentation and Control Systems

(1) The valves are operated and their position monitored from the main control room (MCR)
(2) While normally supplying nitrogen gas from the nitrogen gas supply machine via the AC, the HPIN is designed to supply nitrogen gas to the SRV Accumulator for the ADS function from the HPIN nitrogen gas cylinders if the nitrogen gas supply stops or the nitrogen gas pressure is less than the determined value in the supply piping by automatically changing the position of the valves.
(3) The instrumentation and control requirements are as indicated in Table 16.2-5.

Table 16.2-6: List of HPIN Monitored Items

Monitored Item	Signal	Application
Pressure at HPIN nitrogen gas cylinder outlet	Low pressure	Alarm
Pressure at HPIN ADS accumulator inlet	Low pressure	Alarm
		Interlock
	High pressure	Interlock

16.2.1.3.3.3.2 Power Supply System

The power to emergency lines A and B is supplied from different divisions of emergency power sources.

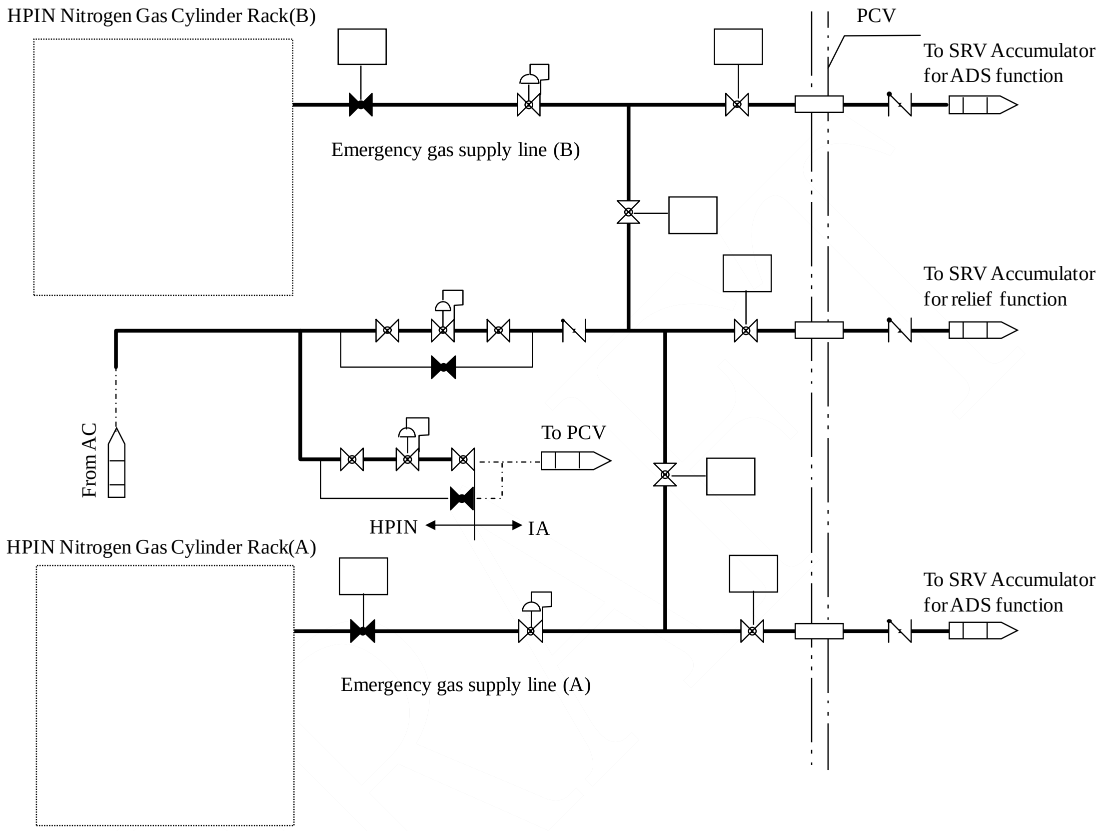

Figure 16.2-3: Outline of HPIN configuration

16.2.2 Drain System

16.2.2.1 Plumbing and Drainage System

16.2.2.1.1 System Summary Description

This section is a general introduction to the Plumbing and Drainage System (P&D) where the system roles, system functions, system configuration and modes of operation are briefly described. The P&D is described in detail in the system specifications [Ref-9].

16.2.2.1.1.1 System Roles

The system role of P&D is to collect and transfer the drain generated from each areas in the building.

16.2.2.1.1.2 Functions Delivered

The drain generated from each area in the building is classified and collected corresponding to its property and divisional area, and transferred to the drain sump of the Radioactive Drain Transfer System (RD), the Miscellaneous Non-Radioactive Drain Transfer System (MSC) or outside the system (intake seal pit and discharge seal pit).

16.2.2.1.1.3 Drain Categories

The drains of the nuclear power plant are basically divided into three categories, the drains for radioactive liquid waste (waste generated in controlled areas with possibility of radioactive contamination), the drains for non-radioactive liquid waste and the drains for special liquid waste.

(1) Radioactive Liquid Waste
- (a) Low Conductivity Waste (LCW)
- (b) High Conductivity Waste (HCW)
- (c) Laundry Drain (LD)
- (d) Hot Shower Drain (HSD)
- (e) Controlled Area Drain (CAD)

(2) Non-Radioactive Liquid Waste
- (a) Non-Radioactive Storm Drain (NSD)
- (b) Service Water Storm Drain (SWSD)

(3) Special Liquid Waste
- (a) Standby Liquid Drain (SLD)
- (b) Decontamination Drain (DD)
- (c) Non-Radioactive Oil Drain (NOD)

16.2.2.1.2 Design Bases

This section describes the design bases for the P&D.

16.2.2.1.2.1 Safety Functions

The P&D has been designed to meet the following SFC. The relation between the SFC put on this system and the high level claims is shown in Appendix-4.

Normal Operations and Fault Conditions

(1) The P&D reduces the radioactive material by dividing liquid waste into subcategories, and collecting it in the corresponding sumps so that they are treated based on their liquid properties in the Radioactive Waste (RW) facilities. [P&D_SFC_4-12.1]
(This function is categorised as Category C and the components to deliver it are designed to meet Class 3 requirements)

16.2.2.1.3 System Design Description

This section describes the design of the P&D to support and justify the delivery of P&D_SFC_4-12.1. The P&D is described in detail in [Ref-9]

16.2.2.1.3.1 Overall System Design and Operation

16.2.2.1.3.1.1 Treatment principles depending on drain properties

The different range of collected drained waste is treated in accordance with the following principles.

(1) Radioactive Liquid Waste

The waste is collected by the sumps through the drain funnel or directly transferred to the appropriate collection tank in the RW facility. After treatment at the Radioactive Waste (RW) facilities, the waste is recollected at the Condensate Storage Tank as recycled water for plant operation or transferred out of the system as plant extra water after verifying the water quality.

(2) Non-Radioactive Liquid Waste
   (a) Non-Radioactive Storm Drain
   The Waste is collected by the NSD sumps for fresh water in the non-controlled areas and discharged outside the system. The discharge point is switched to the CAD collection tank to treat the liquid waste at the RW facility if the NSD sump is contaminated by radioactivity or if waste containing rust preventing agents which may not satisfy the drain discharge requirements regarding water quality was collected.
   (b) Service Water Storm Drain
   The Waste is collected at the SWSD sumps in the non-controlled areas and drained outside the system.

(3) Special Liquid Waste
   (a) Standby Liquid Drain
   Drained boric-acid solution is completely separated from the other waste and collected by exclusive containers to avoid need for treatment in the RW Facility.
   (b) Decontamination Drain
   The decontamination liquid waste is collected through the P&D piping or the Decontamination System piping depending on its properties.
   (c) Non-Radioactive Oil Drain
   The non-radioactive oil liquid waste is collected and treated at the location where it is generated.

16.2.2.1.3.1.2 Collection principles depending on the area

The treatment principles after collecting and processing the waste generated in each building and the connecting trenches is as follows:

(1) Drains in the Drywell (Primary Containment Vessel)
Drains inside the drywell are connected to the following sumps;
  (a) HCW sump: Floor drains and drains in the Drywell Cooling System (DWC), Reactor Building Cooling Water System (RCW), HVAC Emergency Cooling Water System (HNCW) system
  (b) LCW sump: Equipment drains in other systems

(2) Drains in the Secondary Containment
Drains in the secondary containment within the Reactor Building are collected by the different sumps set up in the secondary containment to ensure the air tightness in containment.

(3) Drains in the Emergency Equipment Rooms

Drains are collected through the drainage piping of the independent divisions of the Emergency Core Cooling System (ECCS) depending on the area where the leak occurred to prevent simultaneous overflow in several ECCS divisions.
Area Divisions:
  (a) Division I: Room of the Reactor Core Isolation Cooling System (RCIC), pump room of the Residual Heat Removal System (RHR) (A)
  (b) Division II: Room of the High Pressure Core Flooder System (HPCF) (B), pump room of the RHR (B)
  (c) Division III: Room of the HPCF (C), pump room of the RHR (C)

(4) The drain generated in the Heat Exchanger Building (Hx/B) is divided into NSD and SWSD according to the collection division. Floor drains in areas where there is the possibility of service water intrusion are transferred to SWSD sumps.

(5) Sumps and drainage piping of non-controlled areas and controlled areas are separated to prevent contamination of the atmosphere in clean areas by the drainage piping.

16.2.2.1.3.2 Equipment Design and Operation

(1) The standard diameter of the main transfer piping is designed considering the flow rate of the drainage funnels.

(2) The drains and vents of components and piping are connected to component drain funnels.

(3) As a general rule, overflow from the tanks storing radioactive fluid waste is directly transferred to the corresponding sump according to the collection division.

(4) Drains containing resins are directly conducted to the sumps or tanks without transfer through funnels. In addition, flushing with water is implemented.

(5) Piping from the process side to component drain funnels are arranged with a continuous inclination downwards and routed so that there is no obstruction to access and transportation into components, piping, etc. The piping from the component floor drain funnels to the

respective sumps is arranged with a continuous inclination downwards as well.

(6) Drains and vent piping connected to sludge and slurry pipes are arranged with an inclination downwards and discharge into the High Conductivity Waste Collection Tank or the sumps without connection to drain funnels.

16.2.2.2 Miscellaneous Non-Radioactive Drain Transfer System

16.2.2.2.1 System Summary Description

This section is a general introduction to the Miscellaneous Non-Radioactive Drain Transfer System (MSC) where the system roles, system functions, system configuration and modes of operation are briefly described. The MSC is described in detail in the system specifications [Ref-10] and the P&IDs [Ref-11][Ref-12][Ref-13]

16.2.2.2.1.1 System Roles

The objective of the MSC is to collect and transfer the non-radioactive liquid waste (Non-Radioactive Storm Drain (NSD) and Service Water Storm Drain (SWSD)) generated in the radiation non-controlled areas during reactor operation and plant shutdown.

16.2.2.2.1.2 Functions Delivered

(1) The NSD and the SWSD are collected in the sump pits and transferred outside the system through the sump pumps.

(2) The NSD and the SWSD generated in each building are to be transferred as indicated as follows:

(a) Reactor Building (R/B)
The NSD in the sump pit is transferred to the Discharge Seal Pit or the Controlled Area Drain (CAD) Collection Tank in the Radwaste Building (Rw/B) through the Radioactive Drain Transfer System (RD). The transfer of the NSD is switched from the Discharge Seal Pit to the CAD Collection Tank when drainage containing antirust products from the Reactor building Cooling Water (RCW) surge tank, Heating Ventilation and Air Conditioning (HVAC) cooling system, etc. is collected into the NSD sump pit during inspection.

(b) Turbine Building (T/B)
The NSD in the sump pit is transferred to the Discharge Seal Pit or the CAD Collection Tank in the Rw/B through the RD. The transfer of the NSD is switched from the Discharge Seal Pit to the CAD Collection Tank when drainage containing antirust products from the Turbine building Cooling Water (TCW) surge tank, HVAC cooling system, etc. is collected into the NSD sump pit during inspection.

(c) Radwaste Building (Rw/B)
The NSD generated in the Rw/B is collected into the NSD sump pit of the Control Building (C/B).

(d) Control Building (C/B)
The NSD in the sump pit is transferred to the Discharge Seal Pit or the CAD Collection Tank in the Rw/B through the RD. The transfer of the NSD is switched from the Discharge Seal Pit to the CAD Collection Tank when drainage containing antirust products from the HVAC Emergency Cooling Water System (HECW), etc. is collected into the NSD sump pit during inspection.

(e) Heat Exchanger Building (Hx/B)
The NSD in the sump pit is transferred to the Discharge Seal Pit or the CAD Collection Tank in the Rw/B through the RD. The transfer of the NSD is switched from the Discharge Seal Pit to the CAD Collection Tank when drainage containing antirust products from the RCW or TCW, HVAC cooling system, etc. is collected into the NSD sump pit during inspection. The SWSD collected in the sump pit is transferred to the Discharge Seal Pit since it is not contaminated with radioactive fluids.

16.2.2.2.1.3 Basic Configuration

(1) In principle, each sump pit is provided with one sump pump with sufficient capacity to transfer the determined drains. However a sump pit is provided with two sump pumps in the following cases:
  (a) If a sump pit continuously receives drainage such as condensate water from the HVACs in the non-controlled areas.

(2) Each sump is provided with level switches in order to automatically transfer the drains by automatic initiation and shutoff of the pumps.

(3) The materials of the sump pump, transfer piping and valves for the SWSD are selected with resistance to sea water.

(4) The sump pits are located in the radiation non-controlled areas since there is normally no risk of collecting drain water with radioactivity.

16.2.2.2.1.4 Modes of Operation

(1) The sump pumps are automatically initiated and shut off by level switches depending on the water level of the sump pit. The pumps start operation upon increase of water level and when the water level of the sump pit sufficiently drops, automatic shutoff is implemented.

(2) The transfer of the NSD in the T/B is switched from the Discharge Seal Pit to the CAD Collection Tank in the following cases:
  (a) If water including antirust products or radioactive substances is collected into the sump pit
  (b) If water which does not meet the water quality requirements for discharge outside is collected into the sump pit

16.2.2.2.2 Design Bases

This section describes the design bases for the MSC.

16.2.2.2.2.1 Safety Function

The MSC collects and transfers the non-radioactive liquid wastes. The function of the MSC is not safety-categorised according to the safety categorization and classification of the UK ABWR.

16.2.2.3 Radioactive Drain Transfer System

16.2.2.3.1 System Summary Description

Radioactive drain (RD) transfer system shall transfer drains generated in controlled areas to collection tanks in individual subsystems installed in the Radwaste building. Laundry drains and radioactive shower drains are transferred to laundry drain collection tanks, which are installed in the Service building. RD transfer system is comprised of sump tanks, sump pumps, piping, valves, and instrumentation devices. The schematic drawing of RD transfer system in R/B is given in Figure 16.2-4.

16.2.2.3.2 Design Bases

16.2.2.3.2.1 Safety Function

The RD transfer system is designed to meet the following safety functions:

Normal Operations

(1) The RD transfer system provides sufficient capacity to transfer liquid waste to the Liquid Waste Management System for normal operation including startup, shutdown and outage. [RD_SFC_4-12.1]
(This function is categorised as Category C and the components to deliver it are designed to meet Class 3 requirements)

Fault Conditions

(2) In the event of a LOCA, all lines from the drywell sumps are automatically isolated to preclude uncontrolled release of primary coolant outside the primary containment. [RD_SFC_4-7.1]
(This function is categorised as Category A and the components to deliver it are designed to meet Class 2 requirements)
(3) In the event of a fault condition which resulted in excessive inflow rate of liquid waste into the drywell sump, an alarm is actuated. [RD_SFC_5-4.1]
(This function is categorised as Category C and the components to deliver it are designed to meet Class 3 requirements)

Appendix-5 shows a summarised list of claims and the corresponding fundamental and functional safety functions in the faults schedule.

16.2.2.3.2.1.1 Normal operation

The RD transfer system provides sufficient capacity to transfer liquid wastes to the Liquid Waste Management System for normal operation including startup, shutdown, and outage.

16.2.2.3.2.1.2 Faults

(1) In the event of a LOCA signals, all lines from drywell sumps are automatically isolated to preclude uncontrolled release of primary coolant outside the primary containment.

(2) In the event of a fault condition which resulted in excessive inflow rate of liquid waste into drywell sump, an alarm is actuated.

16.2.2.3.3 System Design

16.2.2.3.3.1 System design for normal operation

This section describes the system design for normal operation.

(1) All sumps which receive radioactive wastes are equipped with two pumps. The pump is sized to handle the maximum anticipated flow into the sump. When one pump is operating, another pump is on stand-by.

(2) High and low water level switches are provided on each sump to start and stop the sump pump automatically.

(3) A separate high-high water level switch is installed to start the second pump and to actuate an alarm in the main control room simultaneously.

16.2.2.3.3.2 System design for faults

This section describes the system design for faults.

(1) In the event of a LOCA signals, all drywell sump pumps are automatically stopped and the isolation valves are automatically closed.

(2) The isolation valves are motor operated valves supplied by emergency power.

(3) The inflow rate into drywell sump is monitored by checking the rise rate of water level, and the frequency and duration of pump runs.

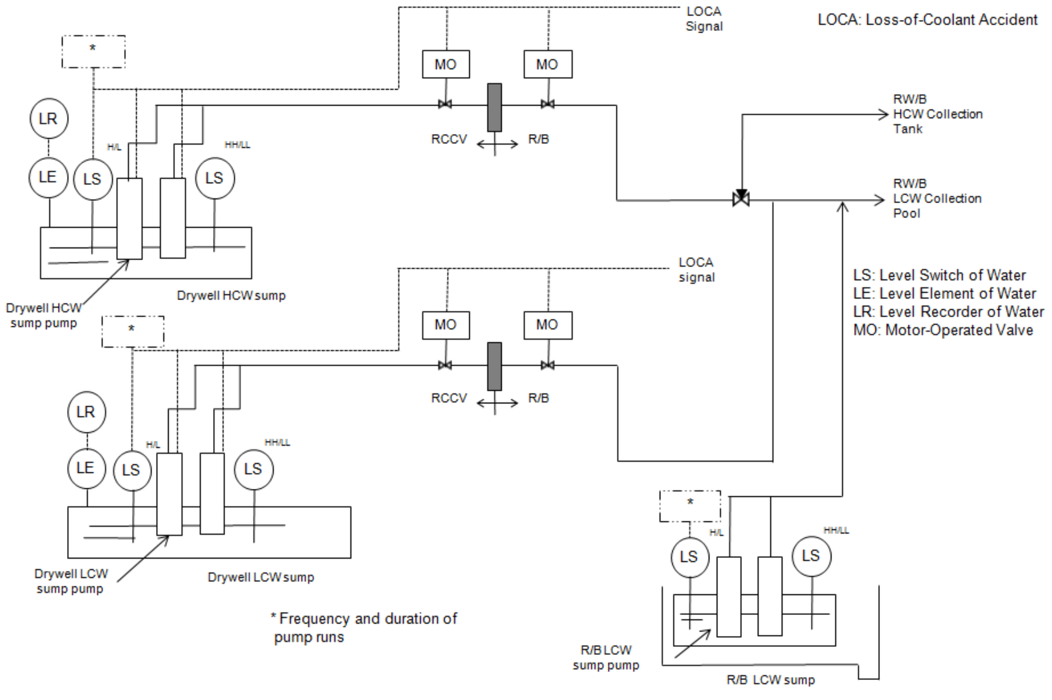

Figure 16.2-4: Outline of Radioactive drain transfer system in R/B

16.2.3 Sampling System

16.2.3.1 Process Sampling System

16.2.3.1.1 System Summary Description

This section is a general introduction to the Process Sampling System (SAM) where the system roles, system functions and system configuration are briefly described. The SAM is described in detail in the system specifications [Ref-14] and the P&IDs [Ref-15], [Ref-16], [Ref-17], [Ref-18], [Ref-19], [Ref-20], [Ref-1]and [Ref-21].

16.2.3.1.1.1 System Roles

The roles of the SAM is to collect and analyse fluid process streams associated with plant operation for providing the analytical information of each system and component to be monitored and maintained during normal operation or transient condition.

16.2.3.1.1.2 Functions Delivered

The SAM is designed to safely collect principal fluid process streams under the operational conditions during normal operations and transient conditions, and to directly measure parameters of the fluid process streams such as conductivity, hydrogen ion concentration and dissolved oxygen as necessary.

16.2.3.1.1.3 Basic Configuration

SAM consists of the following components:

(1) Sampling piping
(2) Sampling nozzle
(3) Sampling racks
(4) Sampling hoods
(5) Sampling sink
(6) Filter sampling rack

16.2.3.1.1.4 Modes of Operation

Process fluid and other items requiring continuous monitoring are continuously sampled and measured by process analysis instruments such as conductivity meters, pH meters, dissolved oxygen meters. Samples of process fluids subjected to intermittent water quality monitoring are extracted from the process line and analysed by grab sampling. Process instrumentation or grab sampling is determined based on the necessary sampling frequency and the importance of the data. Grab samples are manipulated in sampling hoods or sampling sinks after cooling or reducing the pressure as necessary.

16.2.3.1.2 Design Bases

This section describes the design bases for the SAM.

16.2.3.1.2.1 Safety Functions

The SAM has been designed to meet the following SFC. The relation between the SFCs put on this system and the high level claims is shown in Appendix-6.

Normal Operations and Fault Conditions

(1) The SAM collects representative fluid process streams for analysis and provides the analytical data required to monitor plant and equipment performance and changes in operating parameters under the environmental and operational conditions during normal operations and transient conditions. [SAM_SFC_5-14.1]
(This function is categorised as Category C and the components to deliver it are designed to meet Class 3 requirements)

Fault Conditions

(2) The SAM and PASS components within the PCVB are completely isolated by the PCIS in order to form barrier to confine the radioactive material within the containment boundary and prevent its dispersion to the environment in the event of faults. [PCIS _SFC_4-7.16]
(This function is categorised as Category A and the components to deliver it are designed to meet Class 1 requirements.This safety function is developed and justified in Generic PCSR Chapter 13 “Engineered Safety Features” (GA91-9101-0101-13000) section 13.2.3.1.2 related to the Primary Containment Facility)

16.2.3.1.3 System Design Description

This section describes the design of the SAM to support and justify the delivery of SAM_SFC_5-14.1. The SAM is described in detailed in [Ref-14], [Ref-15], [Ref-16], [Ref-17], [Ref-18], [Ref-19], [Ref-20], and [Ref-21].

16.2.3.1.3.1 Overall System Design and Operation

16.2.3.1.3.1.1 Sampled Process Streams and Analysed Parameters

Table 16.2-6 provides a list of main samples, their locations and purposes. In addition to those, on-line monitoring of parameters (temperature, pressure, radiation) is carried out but does not require sampling of process fluids and so is not part of the SAM.

Table 16.2-7: Summary of Main Samples

Item	Sampling point	Purpose
Reactor water	Reactor Pressure Vessel (RPV) bottom	Monitoring of reactor cooling water quality when the CUW is isolated
Reactor Water Clean-up System Filter-Demineraliser (CUW F/D) inlet and outlet water	F/D inlet F/D outlet	Monitoring of reactor cooling water quality Monitoring of F/D performance
Suppression Pool (S/P) water	RHR Heat Exchanger outlet	Monitoring of corrosion and radioactivity
Boric acid solution	Standby Liquid Control (SLC) Storage Tank	Monitoring of boron concentration
Residual Heat Removal System (RHR) water	RHR Heat Exchanger outlet	Monitoring of water quality
Main Condenser	Hotwell outlet Condensate Demineraliser inlet Condensate Demineraliser outlet	Detection of leakage from condenser tubes Monitoring of water quality Monitoring of demineraliser performance

16.2.3.1.3.1.2 Sampling methodology

Sampling methods are divided into the following three; depending on the required sampling frequencies and impacts of the obtained data on plant operation safety.

(1) Process stream collection with recycling line
A line to recirculate part of the process fluid from piping or components via a pump or blower is configured with instrumental detectors mounted on it to continuously obtain data.

(2) Process stream collection with a sampling line
Samples are continuously taken from the process line through a sampling pipe with instrumental detectors mounted on it to continuously obtain data.

(3) Local grab sampling
Process samples are intermittently taken from the process piping through the sampling pipes and analysed in the laboratory where data is obtained.

16.2.3.1.3.2 Equipment Design and Operation

16.2.3.1.3.2.1 Sampling Piping

(1) Depressurisation valves and stop valves are provided for the grab sampling lines.

(2) Piping for extraction of high temperature or high pressure samples is provided with coolers or depressurisation devices to cool and reduce the pressure when sampling.

(3) In principle, samples which require to be continuously extracted are returned to the process line after measuring through the sampling collection pipes connected to the process lines. Sampling is automatically shut off when the process system operations are stopped.

16.2.3.1.3.2.2 Sampling Nozzle

In principal, sampling nozzles are mounted on the pipe side surface of horizontal and straight sections of process piping. Particularly, samples of fluids containing crud should not be taken from the bottom of horizontal pipes.

16.2.3.1.3.2.3 Sampling Hoods

(1) Frequently sampled radioactive fluids of each system are collected and transferred to one sampling hood.
(2) The exhaust lines of the sampling hoods are connected to the HVAC in order to always maintain the hood at negative pressure inside and to prevent exposure to radioactive material generated during sampling.
(3) Components installed inside the hoods are limited to the minimum quantity (basically, only flow control valves and sampling valves) in order to reduce the sources of radiation exposure.

16.2.3.1.3.2.4 Sampling Sink

Sampling sinks are provided near grab sampling points for auxiliary cooling water etc. in the following conditions:
(1) Sampling points located in high radioactivity areas with high radioactivity levels (the sink is installed facing a passage).
(2) Sampling points for samples such as cooling water which require a periodic and relatively high frequent analysis (more than once a month).

16.2.3.1.3.2.5 Filter Sampling Rack

Filter sampling racks are provided to sampling points when it is necessary to measure the concentration of metal elements in the water.

(1) Filters are mounted upstream of the depressurisation devices in order to improve the precision of the measured concentration of indissoluble crud.
(2) Integral flow meters are mounted on the outlet of the filters in order to check the total volume of samples through the filter.

16.2.3.1.3.3 Main Support Systems

16.2.3.1.3.3.1 Instrumentation and Control Systems

(1) Conductivity meters, pH meters and humidity meters are constantly monitoring the process status. The measurements are monitored in the Main Control Room (MCR) where alarms are initiated if the criterion values are exceeded. However, the data necessary for local operation is locally monitored and also monitored in the MCR if necessary.

(2) Process sampling, including alarms, is displayed in the MCR and the data recorded as necessary.
(3) As a general rule, process calculators are fed back with input to manage water quality.

16.2.3.1.3.4 System Interfaces

Sampling lines branching from the respective systems and components are provided with separation valves. In principle, the design conditions of the SAM conform to the process systems into which they are connected.

16.2.3.2 Post-Accident Sampling System

16.2.3.2.1 System Summary Description

This section is a general introduction to the Post-Accident Sampling System (PASS) where the system roles, system functions and system configuration are briefly described.

16.2.3.2.1.1 System Role

The role of the PASS is to collect radioactive liquid and gaseous samples from inner RPV and PCV, respectively, under the post-DBA condition in order to obtain detail information of the accident.

16.2.3.2.1.2 Functions Delivered

The PASS is designed to collect radioactive liquid and gaseous samples under the post-DBA condition. During DBA, process monitoring system continuously measures necessary parameters for appropriate accident management. In addition, the PASS collects samples to obtain further detail information as well as to underpin those measurements after the accident ceases. Reactor coolant is sampled from the RPV and gas from the PCV. The sample is collected by remote operation at the sample rack outside secondary containment to provide safe access for the operator who transports the samples to the radiochemistry laboratory.

16.2.3.2.1.3 Basic Configuration

The PASS consists of the following components:
(1) Sampling pipe
(2) PCV isolation valve
(3) Sampling rack which contains a pump
(4) Sampling bottle.

16.2.3.2.2 Safety Design Base

The purpose of the post-accident sampling is not originated by safety requirement. Adequate accident monitoring is achieved by the plant process monitoring system which provides essential information for accident management as described in Generic PCSR Chapter 14 “Control and Instrumentation” (GA91-9101-0101-14000). The PASS provides supplementary information for detail analysis of the accident. From this perspective, the sampling function is not safety-categorised except PCV boundary is A1 according to the safety categorisation and classification of UK ABWR described in Generic PCSR Sub-chapter 5.4. “Categorisation and Classification of Structures, Systems and Components” (GA91-9101-0101-05004).

The system is designed so that the radioactive substance contained in the PCV is transferred to the outside only during sampling sequence. Occupational dose during the sampling sequence is minimised as low as reasonably practicable (RP-C3).

16.2.4 Steam Supply System

16.2.4.1 House Boiler System

16.2.4.1.1 System Summary Description

This section is a general introduction to the House Boiler System where the system roles, system functions, system configuration and modes of operation are briefly described. The House Boiler System is described in detail in the system specifications [Ref-22] and the P&IDs [Ref-23], [Ref-24], [Ref-25], [Ref-26], [Ref-27] and [Ref-28].

16.2.4.1.1.1 System Roles

The House Boiler System is designed to supply clean steam generated by the House Boiler to the equipment operating with house steam and collect the condensed water from this equipment.

16.2.4.1.1.2 Functions Delivered

The House Boiler System consists of the Heating Steam System (HS) and the Heating Steam Condensate Water Return System (HSCR).

(1) The HS supplies the necessary volume of clean steam at the required pressure (saturated steam) to the components operating with steam within the power plant.

(2) The HSCR collects the condensed water from each component and pipe and returns it to the House Boiler facility. The HSCR recovers as much condensed water as possible from the respective loads pipes to recycle it as feed-water for the House Boiler.

16.2.4.1.1.3 Basic Configuration

(1) The House Boiler facility consists of the House Boiler, feed water system, instrumentation, etc.
(2) The steam generated by the House Boiler is transferred to the respective components using steam in the power plant through the HS piping.
(3) The Condensed Water Recovery Facility, which is installed in HSCR, consists of a Heating Steam Receiver Tank, a Heating Steam Condenser and Heating Steam Drain Recovery Pumps through which the condensed water is returned to the water supply tank in the House Boiler Facility.
(4) The HS and HSCR consist of the following components equipment:
    (a) House Boiler Facility
        ・House Boiler: 2 units
    (b) Condensed Water Recovery Facility
        ・Heating Steam Receiver Tank: 1 unit
        ・Heating Steam Condenser: 1 unit
        ・Heating Steam Drain Recovery Pump: 2 units
    (c) Piping and Valves: 1 set
    (d) Instruments and Controllers: 1 set

16.2.4.1.1.4 Modes of Operation

This system supplies clean steam generated by the House Boiler to the equipments operating with house steam during normal operation, startup, shutdown and refuelling outage.

16.2.4.1.2 Design Bases

This section describes the design bases for the HS/HSCR.

16.2.4.1.2.1 Safety Functions

The HS/HSCR has been designed to meet the following SFCs. The relation between the SFCs put on this system and the high level claims is shown in Appendix-7.

Normal Operations

(1) The HS/HSCR during plant normal operation supplies the steam required to maintain the normal operation of safety class 3 systems which contributes to reducing radiation exposure from radioactive materials. [HS/HSCR_SFC_5-13.1]
(This function is categorised as Category C and the components to deliver it are designed to meet Class 3 requirements)

(2) The HS/HSCR during plant normal operation supplies the steam required to heat the plant and maintain its condition during winter. [HS/HSCR_SFC_5-13.2]
(This function is categorised as Category C and the components to deliver it are designed to meet Class 3 requirements)

16.2.4.1.3 System Design Description

This section describes the design of the HS/HSCR to support and justify the delivery of HS/HSCR_SFC_5-13.1 and HS/HSCR_SFC_5-13.2. The HS/HSCR is described in detail in [Ref-22], [Ref-23], [Ref-24], [Ref-25], [Ref-26], [Ref-27] and [Ref-28]

16.2.4.1.3.1 Overall System Design and Operation

The steam generated by the House Boiler is transferred to the respective components which use steam in the power plant through the HS piping. The steam is condensed into water by the heat exchanged with the steam loads. Most of the condensed water is returned to the water supply tank in the House Boiler Facility through the Condensed Water Recovery Facility in the HSCR, and finally is returned to the House Boiler, where it is converted into the steam again to repeat the cycle.

16.2.4.1.3.2 Equipment Design and Operation

16.2.4.1.3.2.1 System Design Specification

The HS/HSCR is designed to satisfy the following condition.

Steam Capacity Approx.50 t/h

16.2.4.1.3.2.2 House Boiler Facility

(1) Purpose
The House Boiler facility is designed to deliver steam at the required pressure and flow rate to satisfy demands for non-reactor steam and startup / stand-by steam requirements of the power plant in order to deliver HS/HSCR_SFC_5-13.1 and HS/HSCR_SFC_5-13.2.

(2) Configuration and Operation
The House Boiler facility will be oil-fuelled boiler and located in the House Boiler Building (Hb/B) of the Power Plant. The number of boiler units has been selected considering the variable steam demand on the system depending on plant status (e.g. power operation, outage, startup).

(3) Performance
The specification of the House Boilers required for the delivery of HS/HSCR_SFC_5-13.1 and HS/HSCR_SFC_5-13.2 is shown below:

(a) Number	2 units
(b) Capacity	Approx.25t/h /unit

16.2.4.1.3.2.3 Condensed Water Recovery Equipments

(1) Purpose
The condensed water recovery equipments collect the drains and condensed steam from the HS after use by the equipments, and sends them back to the House Boiler Building for recovery in order to deliver HS/HSCR-SFC1 and HS/HSCR-SFC2.

(2) Configuration and Operation
The condensed water recovery equipments consist of a Heating Steam Receiver Tank, a Heating Steam Condenser and Heating Steam Drain Recovery Pumps.

(a) Heating Steam Receiver Tank
The Heating Steam Receiver Tank is provided with the necessary gaseous space for gas-liquid separation of the in-flow of condensed water and for prevention of steam suction by the Heating Steam Drain Recovery Pumps. Moreover, the Heating Steam Receiver Tank is employed as a water reservoir for the control operation of the Heating Steam Drain Recovery Pumps.

(b) Heating Steam Condenser
The Heating Steam Condenser is capable of condensing all the steam which flashes off from condensate flowing in from the Heating Steam Receiver Tank by cooling water. The Heating Steam Condenser condenses the re-evaporated steam and sub-cools the condensate to maintain the temperature below 100 °C (water boiling point at atmospheric pressure) and prevent re-evaporation.

(c) Heating Steam Drain Recovery Pump
The Heating Steam Drain Recovery Pump transfers the condensed water from the Heating Steam Receiver Tank to the water supply tank in the House Boiler Facility. HSCR is equipped with two 100 percent-capacity Heating Steam Drain Recovery Pumps.

16.2.4.1.3.2.4 Steam Trap

(1) The HS line will be equipped with steam traps to allow drainage of condensed steam. The appropriate design of steam trap will be selected for each individual location based on likely steam conditions, layout, maintainability and other relevant factors.

(2) A bypass line is provided for trap maintainability.

16.2.4.1.3.2.5 Piping and Valves

As a general rule, the piping of the HS and the HSCR is arranged downwards with inclinations to ensure no drain accumulation on the piping routes.

The HS piping will be provided with drain traps for draining water accumulated at the bottom of rising pipes and drain pots, the inlet of control valves, and other points.

16.2.4.1.3.3 Main Support Systems

16.2.4.1.3.3.1 Instrumentation and Control Systems

(1) The House Boiler Facility is provided with monitoring to measure the operation conditions and appropriate protective devices to shut down the House Boiler safely in an emergency.

(2) The water level in the Heating Steam Receiver Tank is controlled by the level switch installed inside it, which sends signals to initiate and shut off the Heating Steam Drain Recovery Pumps to ensure adequate net pressure suction head for the pumps to avoid cavitation.

16.2.5 Claims and Link to High Level Safety Functions

The list of claims in this sub chapter and the linkage to corresponding High Level Safety Functions is shown in Appendixes 1 to 7. A short description on the application of High Level Safety Fucntions in the development of the claims, arguments and evidence is provided in Generic PCSR Chapter 1 “Introduction” (GA91-9101-0101-01000).

16.2.6 References

[Ref-1] Hitachi-GE Nuclear Energy, Ltd., *"Instrument Air System System Design Description"*, GP52-1001-0001-00001 (SD-GD-0020) Rev. 0, June 2014

[Ref-2] Hitachi-GE Nuclear Energy, Ltd., *"Instrument Air System P&ID"*, GP52-2101-0001-00001 (310QC98-449) Rev.0, June 2014

[Ref-3] Hitachi-GE Nuclear Energy, Ltd., *"Station Service Air System System Design Description"*, GP51-1001-0001-00001 (SD-GD-0019) Rev. 0, June 2014

[Ref-4] Hitachi-GE Nuclear Energy, Ltd., *"Station Service Air System P&ID (1/3)"*, GP51-2101-0001-00001 (310QC98-446) Rev. 0, May 2015

[Ref-5] Hitachi-GE Nuclear Energy, Ltd., *"Station Service Air System P&ID (2/3)"*, GP51-2101-0001-00002 (310QC98-447) Rev. 0, May 2015

[Ref-6] Hitachi-GE Nuclear Energy, Ltd., *"Station Service Air System P&ID (3/3)"*, GP51-2101-0001-00003 (310QC98-448) Rev. 0, May 2015

[Ref-7] Hitachi-GE Nuclear Energy, Ltd., *"High Pressure Nitrogen Gas Supply System System Design Description"*, GP54-1001-0001-00001 (SD-GD-0021) Rev. 0, September 2013

[Ref-8] Hitachi-GE Nuclear Energy, Ltd., *"High Pressure Nitrogen Gas Supply System P&ID"*, GP54-2101-0001-00001 (310QC98-450) Rev. 0, December 2013

[Ref-9] Hitachi-GE Nuclear Energy, Ltd., *"Plumbing and Drainage System System Design Description"*, GU45-1001-0001-00001 (SD-GD-0031) Rev. 0, January 2015

[Ref-10] Hitachi-GE Nuclear Energy, Ltd., *"Miscellaneous Non-Radioactive Drain Transfer System System Design Description"*, GU63-1001-0001-00001 (SD-GD-0034) Rev. 0, September 2013

[Ref-11] Hitachi-GE Nuclear Energy, Ltd., *"Miscellaneous Non-Radioactive Drain Transfer System P&ID (1/3)"*, GU63-2101-0001-00001 (310QC98-490) Rev. 0, February 2014

[Ref-12] Hitachi-GE Nuclear Energy, Ltd., *"Miscellaneous Non-Radioactive Drain Transfer System P&ID (2/3)"*, GU63-2101-0001-00002 (310QD02-030) Rev. 0, January 2014

[Ref-13] Hitachi-GE Nuclear Energy, Ltd., *"Miscellaneous Non-Radioactive Drain Transfer System P&ID (3/3)"*, GU63-2101-0001-00003 (310QC98-491) Rev. 0, February 2014

[Ref-14] Hitachi-GE Nuclear Energy, Ltd., *"Sampling System System Design Description"*, GP91-1001-0001-00001 (SD-GD-0024) Rev. 0, June 2014

[Ref-15] Hitachi-GE Nuclear Energy, Ltd., *"Sampling System P&ID (1/9)"*, GP91-2101-0001-00001 (310QC98-457) Rev. 0, July 2014

[Ref-16] Hitachi-GE Nuclear Energy, Ltd., *"Sampling System P&ID (2/9)"*, GP91-2101-0001-00002 (310QC98-458) Rev. 0, July 2014

[Ref-17] Hitachi-GE Nuclear Energy, Ltd., *"Sampling System P&ID (3/9)"*, GP91-2101-0001-00003 (310QC98-457) Rev. 0, July 2014

[Ref-18] Hitachi-GE Nuclear Energy, Ltd., *"Sampling System P&ID (4/9) (T/B)"*, GP91-2101-0001-00004 (310PB64-667) Rev. 0, May 2014

[Ref-19] Hitachi-GE Nuclear Energy, Ltd., *"Sampling System P&ID (6/9)"*, GP91-2101-0001-00006 (310QC98-460) Rev. 0, July 2014

[Ref-20] Hitachi-GE Nuclear Energy, Ltd., *"Sampling System P&ID (7/9)"*, GP91-2101-0001-00007 (310RC03-267) Rev. 0, July 2014

[Ref-21] Hitachi-GE Nuclear Energy, Ltd., *"Sampling System P&ID (9/9) (RW System)"*, GP91-2101-0001-00009 (310PB45-405) Rev. 0, October 2014

[Ref-22] Hitachi-GE Nuclear Energy, Ltd., *"Heating Steam System and Heating Steam Condensate Water Return System System Design Description"*, GP61-1001-0001-00001 (SD-GD-0022) Rev. 0, September 2013

[Ref-23] Hitachi-GE Nuclear Energy, Ltd., *"HS and HSCR P&ID (1/6)"*, GP61-2101-0001-00001 (310QC98-451) Rev. 0, March 2014

[Ref-24] Hitachi-GE Nuclear Energy, Ltd., *"HS and HSCR P&ID (2/6)"*, GP61-2101-0001-00002 (310QC98-452) Rev. 0, March 2014

[Ref-25] Hitachi-GE Nuclear Energy, Ltd., *"HS and HSCR P&ID (3/6)"*, GP61-2101-0001-00003 (310QC98-453) Rev. 0, March 2014

[Ref-26] Hitachi-GE Nuclear Energy, Ltd., *"HS and HSCR P&ID (4/6)"*, GP61-2101-0001-00004 (310QC98-454) Rev. 0, March 2014

[Ref-27] Hitachi-GE Nuclear Energy, Ltd., *"HS and HSCR P&ID (5/6)"*, GP61-2101-0001-00005 (310QC65-841) Rev. 0, February 2014

[Ref-28] Hitachi-GE Nuclear Energy, Ltd., *"HS and HSCR P&ID (6/6)"*, GP61-2101-0001-00006 (310QC98-842) Rev. 0, February 2014

[Ref-29] Hitachi-GE Nuclear Energy, Ltd. *"List of Safety Category and Class for UK ABWR"* GA91-9201-0003-00266 (AE-GD-0224) Rev. 1, June 2015

16.2.7 Appendixes

Appendix-1: Claim tree for Ch. 16.2.1.1 (IA)
Appendix-2: Claim tree for Ch. 16.2.1.2 (SA)
Appendix-3: Claim tree for Ch. 16.2.1.3 (HPIN)
Appendix-4: Claim tree for Ch. 16.2.2.1 (P&D)
Appendix-5: Claim tree for Ch. 16.2.2.3 (RD)
Appendix-6: Claim tree for Ch. 16.2.3.1 (SAM)
Appendix-7: Claim tree for Ch. 16.2.4 (HS/HSCR)

16.2.7.1 Appendix-1: Claim tree for Ch. 16.2.1.1 (IA)

	Top Claim for mechanical system						Safety Functional Claim for the mechanical system and components (SFC)		
	Fundamental Safety Function (FSF)		High Level Safety Function (HLSF)		Fault Schedule (Bounding Fault)				
	PCSR Ch.5.4 (List of Safety Category and Class for UK ABWR (AE-GD-0224) 3.2 Identification of ABWR Safety Functions)		PCSR Ch.5.4 (List of Safety Category and Class for UK ABWR (AE-GD-0224) 3.6 Summary of Safety Category and Classification)		Topic Report on Fault Assessment (UE-GD-0071) Table.4.2-1 Fault Schedule		State	Claim ID	Claim Contents
1	5	Others	5-13	Auxiliary functions for plant operation	-	No claim	Normal Operations	IA_SFC_5-13.1	The IA continuously supplies compressed air to prevent inoperability of the pneumatic components required for plant continuous operation to all the loads important for within systems required for plant continuous operation, which are: (a) Turbine Building: Feedwater System (FDW), Off-Gas System (OG) (b) Reactor Building: Control Rod Drive System (CRD), Main Steam System (MS) (c) Heat exchanger Building: Reactor Building Cooling Water System (RCW)
2	5	Others	5-13	Auxiliary functions for plant operation	-	No claim	Normal Operations	IA_SFC_5-13.2	The IA in plant normal operation supplies the air required to maintain the normal operation of safety class 3 systems that contribute to reducing radiation exposure from radioactive material.
3	5	Others	5-13	Auxiliary functions for plant operation	-	No claim	Fault Conditions	IA_SFC_5-13.3	The IA backs up the HPIN by automatically supplying compressed air to drive the instruments, controllers and pneumatics valves that are normally supplied with nitrogen gas by the HPIN, in the event that the HPIN supply is interrupted.
4	4	Confinement/Containment of radioactive materials	4-7	Functions to confine radioactive materials, shield radiation, and reduce radioactive release	-	No claim	Fault Conditions	PCIS_SFC_4-7.12	The IA components within the PCVB are completely isolated by the PCIS in order to form barrier to confine the radioactive material within the containment boundary and prevent its dispersion to the environment in the event of faults.

16.2.7.2 Appendix-2: Claim tree for Ch. 16.2.1.2 (SA)

	Top Claim for mechanical system						Safety Functional Claim for the mechanical system and components (SFC)		
	Fundamental Safety Function (FSF)		High Level Safety Function (HLSF)		Fault Schedule (Bounding Fault)				
	PCSR Ch.5.4 (List of Safety Category and Class for UK ABWR (AE-GD-0224) 3.2 Identification of ABWR Safety Functions)		PCSR Ch.5.4 (List of Safety Category and Class for UK ABWR (AE-GD-0224) 3.6 Summary of Safety Category and Classification)		Topic Report on Fault Assessment (UE-GD-0071) Table.4.2-1 Fault Schedule		State	Claim ID	Claim Contents
1	5	Others	5-13	Auxiliary functions for plant operation	-	No Claim	Normal Operations	SA_SFC_5-13.1	The SA supports the Off-Gas System (OG) by supplying it with purge air which is required for normal operation.
2	5	Others	5-13	Auxiliary functions for plant operation	-	No claim	Fault Conditions	SA_SFC_5-13.2	The SA initiates supply of compressed air to the IA as a back-up of the IA in the event that the pressure in the IA drops abnormally.
3	4	Confinement/Containment of radioactive materials	4-7	Functions to confine radioactive materials, shield radiation, and reduce radioactive release	-	No claim	Fault Conditions	PCIS_SFC_4-7.13	The SA components within the PCVB are completely isolated by the PCIS in order to form barrier to confine the radioactive material within the containment boundary and prevent its dispersion to the environment in the event of faults.

16.2.7.3 Appendix-3: Claim tree for Ch. 16.2.1.3 (HPIN)

	Top Claim for mechanical system						Safety Functional Claim for the mechanical system and components (SFC)		
	Fundamental Safety Function (FSF)		High Level Safety Function (HLSF)		Fault Schedule (Bounding Fault)				
	PCSR Ch.5.4 (List of Safety Category and Class for UK ABWR (AE-GD-0224) 3.2 Identification of ABWR Safety Functions)		PCSR Ch.5.4 (List of Safety Category and Class for UK ABWR (AE-GD-0224) 3.6 Summary of Safety Category and Classification)		Topic Report on Fault Assessment (UE-GD-0071) Table.4.2-1 Fault Schedule		State	Claim ID	Claim Contents
1	5	Others	5-13	Auxiliary functions for plant operation	-	No claim	Normal Operations	HPIN_SFC_ 5-13.1	The HPIN supplies nitrogen gas to fill and maintain pressure in the SRV accumulators for relief and ADS functions during normal operation.
2	5	Others	5-13	Auxiliary functions for plant operation	-	No claim	Normal Operations	HPIN_SFC_ 5-13.2	The HPIN supplies nitrogen gas to the nitrogen operated equipment installed in the reactor building and the PCV (including inboard MSIV) during normal operation.
3	5	Others	5-13	Auxiliary functions for plant operation	-	No claim	Fault Conditions	HPIN_SFC_ 5-13.3	The HPIN supports SRV operation in the event of beyond design basis faults by supplying nitrogen to re-charge its accumulators if further actuations are required.
4	4	Confinement/Containment of radioactive materials	4-7	Functions to confine radioactive materials, shield radiation, and reduce radioactive release	-	No Claim	Fault Conditions	PCIS_SFC_ 4-7.14	The HPIN components within the PCVB are completely isolated, when permitted, by the PCIS in order to form barrier to confine the radioactive material within the containment boundary and prevent its dispersion to the environment in the event of faults.

16.2.7.4 Appendix-4: Claim tree for Ch. 16.2.2.1 (P&D)

	Top Claim for mechanical system						Safety Functional Claim for the mechanical system and components (SFC)		
	Fundamental Safety Function (FSF)		High Level Safety Function (HLSF)		Fault Schedule (Bounding Fault)				
	PCSR Ch.5.4 (List of Safety Category and Class for UK ABWR (AE-GD-0224) 3.2 Identification of ABWR Safety Functions)		PCSR Ch.5.4 (List of Safety Category and Class for UK ABWR (AE-GD-0224) 3.6 Summary of Safety Category and Classification)		Topic Report on Fault Assessment (UE-GD-0071) Table.4.2-1 Fault Schedule		State	Claim ID	Claim Contents
1	4	Confinment/Containment of radioactive materials	4-12	Functions to store the radioactive materials as liquid waste	-	No Claim		P&D_SFC_4-12.1	The P&D reduces the radioactive material by dividing liquid waste into subcategories, and collecting it in the corresponding sumps so that they are treated based on their liquid properties in the Radioactive Waste (RW) facilities.

16.2.7.5 Appendix-5: Claim tree for Ch. 16.2.2.3 (RD)

	Top Claim for mechanical system						Safety Functional Claim for the mechanical system and components (SFC)		
	Fundamental Safety Function (FSF)		High Level Safety Function (HLSF)		Fault Schedule (Bounding Fault)				
	PCSR Ch.5.4 (List of Safety Category and Class for UK ABWR (AE-GD-0224) 3.2 Identification of ABWR Safety Functions)		PCSR Ch.5.4 (List of Safety Category and Class for UK ABWR (AE-GD-0224) 3.6 Summary of Safety Category and Classification)		Topic Report on Fault Assessment (UE-GD-0071) Table.4.2-1 Fault Schedule		State	Claim ID	Claim Contents
1	4	Confinement/Containment of radioactive materials	4-12	Function to store the radioactive materials as liquid wastes	-	No Claim	Normal Operations	RD_SFC_4-12.1	The RD transfer system provides sufficient capacity to transfer liquid waste to the Liquid Waste Management System for normal operation including startup, shutdown, and outage.
2	4	Confinement/Containment of radioactive materials	4-7	Functions to confine radioactive materials, shield radiation, and reduce radioactive release	TBD	TBD	Fault Scenarios	RD_SFC_4-7.1	In the event of a LOCA signals, all lines from drywell sumps are automatically isolated to preclude uncontrolled release of primary coolant outside the primary containment.
3	5	Others	5-4	Functions to monitor plant conditions in case of an accident	TBD	TBD	Fault Scenarios	RD_SFC_5-4.1	In the event of a fault condition which resulted in excessive inflow rate of liquid waste into drywell sump, an alarm is actuated.

16.2.7.6 Appendix-6: Claim tree for Ch. 16.2.3.1 (SAM)

	Top Claim for mechanical system						Safety Functional Claim for the mechanical system and components (SFC)		
	Fundamental Safety Function (FSF)		High Level Safety Function (HLSF)		Fault Schedule (Bounding Fault)				
	PCSR Ch.5.4 (List of Safety Category and Class for UK ABWR (AE-GD-0224) 3.2 Identification of ABWR Safety Functions)		PCSR Ch.5.4 (List of Safety Category and Class for UK ABWR (AE-GD-0224) 3.6 Summary of Safety Category and Classification)		Topic Report on Fault Assessment (UE-GD-0071) Table.4.2-1 Fault Schedule		State	Claim ID	Claim Contents
1	5	Others	5-14	Functions important to emergency measures and monitoring of abnormal conditions	-	No claim	Normal Operations and Fault Conditions	SAM_SFC_5-14.1	The SAM collects representative fluid process streams for analysis and provides the analytical data required to monitor plant and equipment performance and changes in operating parameters under the environmental and operational conditions during normal operations and transient conditions.
2	4	Confinement/Containment of radioactive materials	4-7	Functions to confine radioactive materials, shield radiation, and reduce radioactive release	1.4	Feedwater controller failure - Maximum demand	Fault Conditions	PCIS_SFC_4-7.16	The SAM and PASS components within the PCVB are completely isolated by the PCIS in order to form barrier to confine the radioactive material within the containment boundary and prevent its dispersion to the environment in the event of faults.
					2.1	Inadvertent MSIV closure			
					2.2	Reactor pressure regulator failure in the open direction			
					2.3	Loss of main condenser vacuum			
					3.1	Loss of all feedwater flow			
					5.1	Short term LOOP			
					5.1.1	Short-term LOOP with CCF of EDGs			
					5.2	Medium term LOOP			
					5.2.1	Medium term LOOP with CCF of EDGs			
					5.3	Long-term LOOP			
					5.3.1	Long-term LOOP with CCF of EDGs			
					7.1	LOCA - RPV bottom drain line break			
					8.1	LOCA - HPCF line break			
					8.2	LOCA - LPFL line break			
					9.1.1	LOCA - FWD line (LPFL connected) break			
					9.1.2	LOCA - FWD line (RCIC connected) break			
					9.2	LOCA - MS line break			
					9.3	LOCA - RHR line break			

16.2.7.7 Appendix-7: Claim tree for Ch. 16.2.4 (HS/HSCR)

	Top Claim for mechanical system						Safety Functional Claim for the mechanical system and components (SFC)		
	Fundamental Safety Function (FSF)		High Level Safety Function (HLSF)		Fault Schedule (Bounding Fault)				
	PCSR Ch.5.4 (List of Safety Category and Class for UK ABWR (AE-GD-0224) 3.2 Identification of ABWR Safety Functions)		PCSR Ch.5.4 (List of Safety Category and Class for UK ABWR (AE-GD-0224) 3.6 Summary of Safety Category and Classification)		Topic Report on Fault Assessment (UE-GD-0071) Table.4.2-1 Fault Schedule		State	Claim ID	Claim Contents
1	5	Others	5-13	Auxiliary functions for plant operation	-	No claim	Normal Operations	HS/HSCR_SFC_5-13.1	The HS/HSCR in plant normal operation supplies the steam required to maintain the normal operation of safety class 3 systems which contributes to reducing radiation exposure from radioactive materials.
2	5	Others	5-13	Auxiliary functions for plant operation	-	No claim	Normal Operations	HS/HSCR_SFC_5-13.2	The HS/HSCR in plant normal operation supplies the steam required to heat the plant and maintain its condition during winter.