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UK ABWR

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UK ABWR Generic Design Assessment

Generic PCSR Chapter 21 : Human-Machine Interface

Hitachi-GE Nuclear Energy, Ltd.

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21.1 Introduction

This chapter describes Human-Machine Interface (HMI) for the UK ABWR. The HMI of the plant is distributed plant wide, from the Main Control Room (MCR) to the local control rooms and control stations. In this chapter Hitachi-GE has identified the four main Human-Machine Interface System (HMIS) locations for operation of the nuclear power plant site, and described them in detail. The four main HMIS for normal control and emergency action are:

(1) Main Control Room (MCR)
The MCR is the place where the operators conducts all of the monitoring and operation in all plant conditions, except in a time of evacuation of the MCR due to hazardous situations and other similar events.

(2) Remote Shutdown System (RSS)
RSS is used for monitoring and operation at the time of evacuation of the MCR due to hazardous situations and other similar events.

(3) Backup Building (B/B)
B/B is the place where the operators will conduct monitoring and operation at the time of evacuations from the MCR due to a Severe Accident (SA).

(4) Radioactive Waste (RW)
Although RW is not directly related to power generation or emergency action, the RW system is used to conduct all monitoring and operation during all plant conditions.

HMI of ABWR systems are designed to provide the operators with adequate information in an appropriate location under all plant conditions, thus this system design will minimise the likelihood of operator errors and omissions. The design of the HMI has also taken into account ease of operation, in terms of the usability and maintainability. The HMI design has taken into account experience from existing plants to improve the design. Each HMI has assigned tasks and obtains the functions status of the monitoring and operation at each plant, shown in Table 21.1-1.

Table 21.1-1: Assigned Tasks of HMI in each Plant's Status

HMI	Plant status					
	Normal Operation	Start-Up and Shutdown	Outage	Upset Condition/Situation		
				Transient	Accident	SA
MCR	X	X	X	X	X	X
RSS	-	-	-	-	X (*Note1)	-
B/B	-	-	-	-	-	X (*Note1)
RW	X	X	X	-	-	-

In order to construct effective HMI designs, Hitachi-GE has incorporated consideration for operation and monitoring following the design policy stated in section 21.2. Based on this design policy, Hitachi-GE will describe practical claims in each HMI section.

*Note 1: Used for monitoring and operation in the event that the MCR is not available.

21.2 Design Policy

Hitachi-GE has designed the HMI system of the UK ABWR, based on the following design policy;
(1) Regarding a working environment and a work space, Hitachi-GE creates a comfortable environment as much as possible.
(2) Regarding an operation and a monitoring, Hitachi-GE designs in such a way that an arrangement (layout) and an operational procedure (e.g. touch operation) are consistent throughout the power plant.
(3) Hitachi-GE provides easily assimilated and understood information for the operators to make a decision efficiently and accurately.
(4) Hitachi-GE applies an automated operation to important operations related to a safety function.

21.2.1 Design Requirements

The HMI meets the requirements for general plant and process operation, monitoring and control during normal operation, including outage operation.

The design of the HMI meets the requirements for plant and process operation, monitoring and control during upset situations. The HMI will be assessed against requirements from the Fault Studies and Probabilistic Safety Analysis (PSA) work. In particular operator actions identified as Initiating Events or as Safety Measures in the Fault Schedule impose specific requirements and expectations on the HMI design.

The HMI will be assessed against requirements from the Human Factors Engineering (HFE) Task Analysis.

The design of the control locations (MCR, RSS room, B/B and Radioactive Waste Control Room (RWCR)) has been developed taking into account all of the roles and activities taking place or affecting those locations, including;

- Operations Supervisor’s role and activities.
- Avoidance of disturbance and interference to the operation, monitoring and control activities.
- Communications equipment and facilities.
- Support facilities, such as information/drawing retrieval and usage.

21.2.2 Design Processes

The design of the HMI is based on the Tasks from safety measures with operator actions - the nature of the human-based safety claims related to the delivery of plant safety functions are encompassed by the HMI design.

Hence as part of the HMI design process all operator actions identified as contributing to Safety Measures are identified and are subject to Task Analysis to identify the relevant HMI design issues. These issues are addressed in the HMI design process.

Where the HMI contributes to delivering a safety or safety-related function that function is categorised, which is considered in the HMI design process.

Where the HMI is part of a Control and Instrumentation (C&I) system that system is classified, which is related to the overall C&I Architecture and is considered in the HMI design process.

A set of HMI principles, philosophies, standards, guidelines and conventions was derived and applied in the HMI design.

21.2.3 Design Assessment

The HMI is subject to task analysis and assessed in respect of ergonomics and alarm management. Human reliability analysis is also undertaken for use in the PSA.

21.2.4 Reference Standard

The reference standards that have been considered as part of the design of the HMI are listed in the table below.

No.	Reference Standard	
1	IEC	IEC61513 “Nuclear power plants-Instrumentation and Control important to safety – General requirements for systems” Ed 2 2011
2	IEC	IEC60964 “Nuclear power plants - Control rooms - Design”
3	IEC	IEC60965 “Nuclear power plants - Control rooms - Supplementary control points for reactor shutdown without access to the main control room”
4	BS	BS EN (IEC) 61508 “Functional Safety of Electrical / Electronic / programmable Safety Related Systems”
5	BS	BS EN ISO 11064 “Ergonomic design of control centres Principles for the design of control centres”
6	EEMUA	EEMUA 191 “Alarm Systems - A Guide to Design, Management and Procurement”
7	IAEA	DS-431 “Design of Instrumentation and Control Systems for Nuclear Power Plants”
8	WENRA	Issue E (Design Basis Envelope for Existing Reactors) “Instrumentation and Control systems and control room”
9	WENRA	Issue F (Design Extension of Existing Reactors) “Instrumentation for the management of beyond design basis accident conditions”

21.2.5 Reference Documents

The detailed descriptions and justification of the HMI C&I in the four main control and monitoring locations are described in the reference documents identified in the list below.

[Ref-1] "Main Control Room Human-machine Interface Basis of Safety Case"
(GA91-9201-0002-00060, Revision-DR1)

[Ref-2] "Remote Shutdown System Human-machine Interface Basis of Safety Case"
(GA91-9201-0002-00061, Revision-DR1)

[Ref-3] "Backup Building Human-machine Interface Basis of Safety Case"
(GA91-9201-0002-00062, Revision-DR1)

[Ref-4] "Radioactive Waste Human-machine Interface Basis of Safety Case"
(GA91-9201-0002-00063, Revision-DR1)

21.3 Main Control Room

21.3.1 Introduction

Main C&I HMI System of nuclear reactor facilities is established in a MCR, this is in order to concentrate manual operations for monitoring, and controlling the plant.

The operators in the MCR monitor and control the plant during a plant's start-up, shutdown, normal operation, accidents, and outages.

A MCR HMI is designed to enable the operators to remain in the MCR, conduct necessary operations in the event of a predictable transient and accidents.

In addition, the HMI is designed with adequate measures for the prevention of operator's errors and omissions.

21.3.2 The Function of the MCR

21.3.2.1 Structure

The basic layout of a MCR is shown in Figure 21.3-1.

The Main Control Console (MCC), the Wide Display Panel (WDP), an operator desk, and the 'Shift Supervisor / Assistant Shift Supervisor Desk' are installed in the MCR.

These facilities are appropriately divided and arranged in accordance with functions, this is in order for the operators to operate, monitor and control the plant in all plant conditions, except in a time of evacuation of the MCR due to hazardous situations and other similar events.

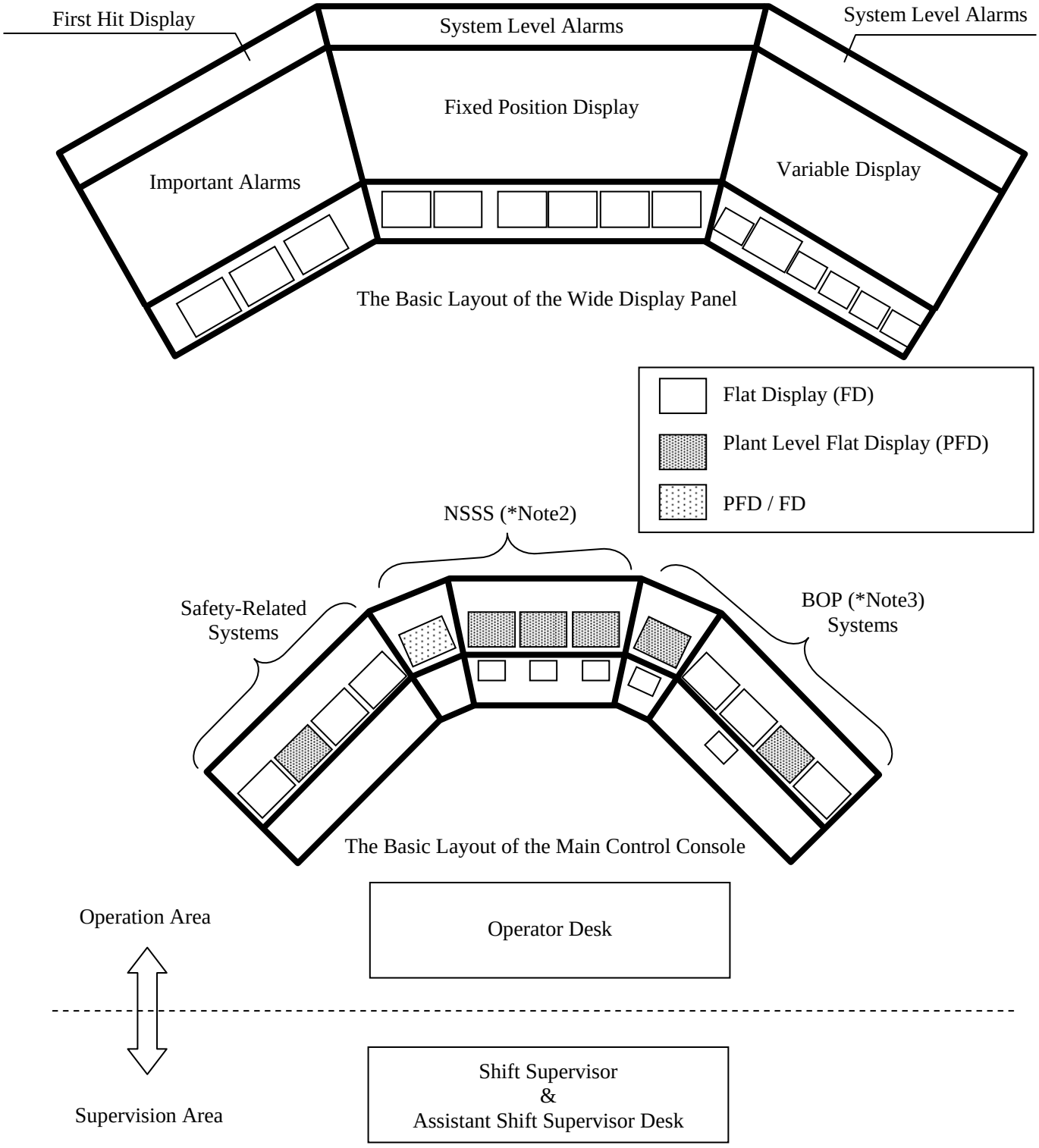


Figure 21.3-1: The Basic Layout of a MCR

*Note2: NSSS is an abbreviation words for Nuclear Steam Supply System.
*Note3: BOP is an abbreviation words for Balance of Plant.

The operation area comprises of a MCC in front of a vertical WDP to enable the operators to effectively perform operations, monitoring and control of the plant and process. There is a supervisor panel to the rear of the operational area.

The ‘Shift Supervisor / Assistant Shift Supervisor Desk', the 'MCC and the WDP’ are located in the operation area and are designed to enable the operators to adequately communicate with each other. The design also provides for good operators visibility and usability and also for clear oversight by the supervisors.

21.3.2.2 Function

The operators are able to monitor operational conditions and important parameters in the reactor and other related important facilities. In addition, the MCC is designed to allow the operators to respond quickly and accurately to undertake manual operation, required to secure the safety of the reactor and or the plant.

(1) The MCR HMI enables the operators to monitor and control operational conditions in the reactor and other facilities of related importance.
(2) In order to ensure the soundness of Reactor Core, Reactor Coolant Pressure Boundary, Reactor Containment Vessel Boundary, and other related systems, the MCR HMI is designed to enable monitoring of major parameters including:
Neutron Flux,
Control Rods positions,
Reactor Coolant Pressure, Temperature, Flow,
Reactor Water Level,
and the internal measurements of the
Reactor Containment Vessel Pressure, Temperature,
Primary Containment Vessel (PCV) Atmosphere Gas density.
(3) In the case of an accident, the operators are made aware of the conditions of the accident to enable effective measures to be taken, including those identified by the Fault Studies and PSA work. Therefore, the MCR HMI is designed to enable monitoring of the necessary plant parameters for determination of the plant conditions in order to identify the coping actions taken. These measurements are sourced from inside the Reactor Containment Vessel, include: Pressure, Temperature, Density of Hydrogen Gas, and Density of Radioactive Materials.

In order to meet the design requirements mentioned above, adequate functions and facilities are installed in the MCR.

21.3.3 Consideration for Operation and Monitoring

The MCR HMI is designed to enable comfortable operations for the operators; this includes taking in considerations of the environmental conditions, layout, and work space.

In order to allow a concentration of monitoring and control in plant operations, Hitachi-GE has designed the layout of the MCC, taking into consideration elements of human interface engineering. For example, the display devices and operation equipment are grouped by each system in the panel layout.

In order to minimise misinterpretation, errors and omissions by the operators, Hitachi-GE has designed the layout of display devices with the display and controls coloured to promote identification in accordance with importance to safety, enabled group monitoring of the plants' parameters, and have sorting the displays according to the relationship of the equipment.

In order to minimise errors by the operators, Hitachi-GE has designed the operational equipment utilising protection covers, key attached switches and so on. In addition, such equipment is also designed for easy identification by colour, shape, label, and so on.

21.3.3.1 Environmental Conditions in the MCR

In order for the operators to comfortably operate in the MCR, factors such as temperature, lighting, and noise have been taken into consideration; this is to assure the design of comfortable environment within the MCR.

The MCR environment is protected, including from radioactive contamination, during foreseeable accidents. The design will be assessed against requirements from the Fault Studies and PSA work.

21.3.3.2 Layout and Work Space in the MCR

(1) The work space and the layout of the controls and displays in the MCR is designed to take into account the actions the operators have to perform under normal and accident conditions for the operators to adequately carry out the operational task.
(2) In order to ensure safety in cases of upset conditions that require any manual operations, a task analysis is performed to consider the range of movement, and the operator's ability to survey and operate the plant.

21.3.3.3 Layout of the WDP and MCC Surface

A unified display is utilised, along with a grouped layout and arrangement representing each system of alarms, display apparatus, and control equipment, which minimises the likelihood of operator misinterpretation and errors.

21.3.3.4 Display System

(1) Information Display Functions
The displays of the information giving the state of plant systems and equipment, along with the information necessary for safety, is provided for operators in appropriate locations. The displays and controls are grouped by each system with colour identification in accordance with their importance to safety, with those most important to safety being most conspicuous and displayed in an easily assimilated and interpreted manner.

(2) Alarm Functions
In the case of an abnormality in the plant's equipment or processes that requires operator attention or action, an alarm function notifies the operators regarding the occurrence of such upset conditions, in a manner easily assimilated.

(3) Operational Support
In the case of a functional loss to the operational support devices when in use, the MCC is able to operate a plant safely.

21.3.3.5 Control Functions

(1) Control equipment and devices are designed to be easy to operate in order to minimise operator errors.
(2) Where mal-operation of the control systems and equipment of a MCR can lead to potentially hazardous outcomes consideration is given to providing protection covers, key attached switches, special labelling, etc.
(3) The operators are able to confirm the progress of the automatic operations when such operations are in an automatic operations mode.

21.4 Remote Shutdown System

21.4.1 Introduction

The RSS room is a location remote from the MCR with a system that allows the reactor to be brought into a state of cold shutdown from hot shutdown after a scram operation at the time of evacuation of the MCR.

The RSS room HMI is designed to enable the operators to monitor and control of the plants' shutdown process.

The RSS room HMI is designed to provide the operators with the required functionality to deal with all foreseeable upset situations where there is a potential threat to MCR habitability.

The RSS room HMI and its equipment and systems are designed to minimise operator misinterpretation, errors and omissions.

21.4.2 The Function of the RSS

21.4.2.1 Structure

The basic layout of a RSS room is shown in Figure 21.4-1.

The Remote Shutdown Panel (RSP), located in the RSS room, lets the operators carry out operation, monitoring, and control. In order to allow the reactor to be brought into a state of cold shutdown from hot shutdown, the RSP consist of the following:

- Monitoring Area

The monitoring equipment is installed to allow the reactor to be brought into a state of cold shutdown from hot shutdown.

- Operation Area

Operational equipment is installed to allow the reactor to be brought into a state of cold shutdown from hot shutdown.

The RSP and other equipment and systems located in the RSS room are designed to enable adequate and appropriate communication among operators; this design takes the operator's visibility and usability into account.

21.4.2.2 Function

When an evacuation from the MCR is necessary, the operators carry out a reactor scram before evacuating from the MCR. Afterwards, the operators can bring the reactor to a state of cold shutdown from hot shutdown, after the scram has been completed safely and easily with the help of the RSS.

(1) This RSS system is designed to provide operation, monitoring and control of a rapid shutdown after conducting reactor scram.
(2) The RSS system is designed to provide required operation, monitoring and control to hold the reactor and associated systems in a hot shutdown condition.
(3) This RSS system is designed to provide required operation, monitoring and control to bring the reactor to a state of cold shutdown from a hot shutdown condition.

(4) In the case of a foreseeable accident where there is a potential threat to MCR habitability, the operators are able to monitor the conditions relating to the accident and are able to take effective measures, including those identified by the Fault Studies and PSA work.

21.4.3 Consideration for Operation and Monitoring

The RSS room HMI is designed to enable the operators to work comfortably, this includes taking into consideration environmental conditions, layout, and work space.

In order to provide effective and reliable plant and process monitoring and control, Hitachi-GE's design of the control panel layout, takes into consideration elements of human interface engineering. For example, display devices and operation equipment are grouped by each system in the layout of those panels.

In order to minimise misinterpretation, errors and omissions by the operators, Hitachi-GE has designed the layout of display devices in this manner: enabled group monitoring of the plants' parameters, and sorting according to relationship.

In order to minimise errors by the operators, Hitachi-GE has designed operational equipment for easy identification by shape, label, and so on.

21.4.3.1 Environmental Conditions in the RSS Room

In order for the operators to comfortably operate in a RSS room, factors such as temperature, lighting, and noise is taken into consideration; this is to assure the design of comfortable environment within a RSS room.

21.4.3.2 Layout and Work Space in the RSS Room

(1) A RSS room is established in a separate location with enough distance from the MCR so that they are not both affected by the same hazard, and the path way leading toward the RSS room is safe for the operators. In addition, access to the RSS room is limited by its locked control.
(2) The system layout in the RSS room HMI is designed to take into account the tasks that the operators are required to carry out during foreseeable operation in upset situations where there is a potential threat to MCR habitability.

21.4.3.3 Layout of the Control Panel Surface

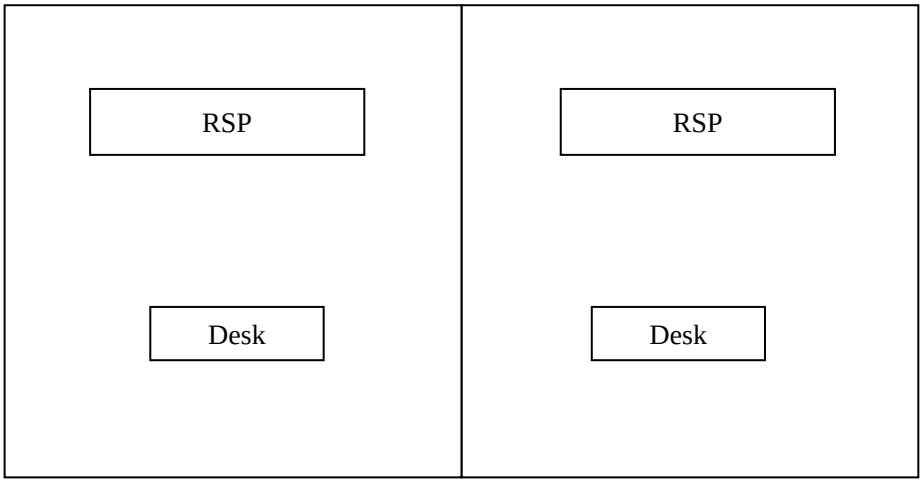
A grouped layout and arrangement will be used for each system's display apparatus on the control panel. Hitachi-GE has selected and arranged control and display equipment in a manner that minimises the likelihood of operator misinterpretation and errors.

21.4.3.4 Display System

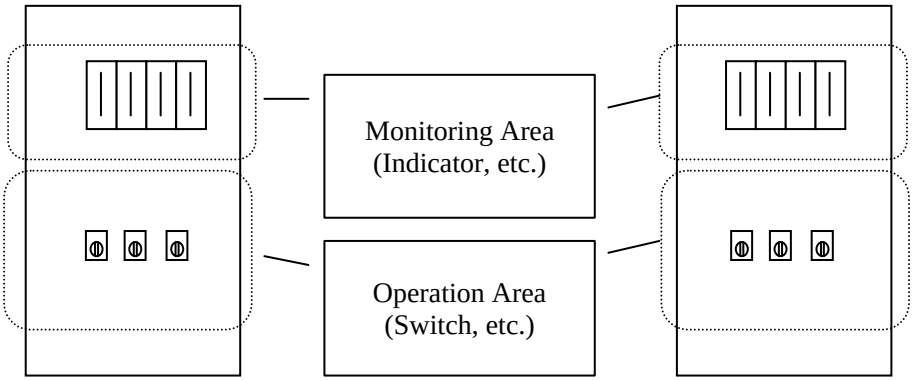
(1) Information Display Functions
Information encompassing the state of plant systems and equipment, along with information necessary for safety, is provided for operators in appropriate locations, grouped, and displayed in an easily assimilated and interpreted manner.

21.4.3.5 Control Functions

(1) Control equipment and devices are selected and arranged to be easy to operate in order to minimise operator errors to as few as possible.
(2) The control systems and equipment of in the RSS room are designed to be easily identified by shapes, label, and so on.



TOP VIEW



RSP FRONT VIEW

Figure 21.4-1: The Basic Layout of the RSS Room

21.5 Backup Building

21.5.1 Introduction

C&I systems are provided in the B/B to deliver the SA and other C&I safety measures identified and allocated to the B/B. The HMI is provided to provide operation, monitoring and control facilities.

The B/B and its HMI equipment and systems are designed to minimise operator misinterpretation, errors and omissions.

21.5.2 The Function of the B/B

21.5.2.1 Structure

The basic layout of the B/B is shown in Figure 21.5-1.

B/B Panel located in a B/B is designed to let the operators concentrate on operation, monitoring, and control of the plant. The B/B Panel consist of the following, this is in order for the operators to operate, monitor and control the plant in the B/B at the time of evacuations from the MCR due to the SA and other C&I safety measures.

- Alarm Display Area

An alarm display is installed to let the operators operate, monitor and control the plant in the B/B.

- Monitoring Area

The monitoring equipment is installed to let the operators operate, monitor and control the plant in the B/B.

- Operation Area

Operational equipment is installed to let the operators operate, monitor and control the plant in the B/B.

The desks and a B/B Panel established in the B/B are designed to enable adequate communication among operators, also the design takes the operator's visibility and utility of the controls and displays into account.

21.5.2.2 Function

Hitachi-GE has designed the B/B HMI to enable the operators monitor and control of operational conditions during a SA.

(1) The B/B HMI is designed to enable the operators to monitor and control operational conditions in the reactor and other related important facilities during a SA.
(2) In order to ensure Reactor Core soundness, Reactor Coolant Pressure Boundary, Reactor Containment Vessel Boundary, and other related systems; the B/B HMI is designed to enable the monitoring of major parameters, such as 'water level and pressure inside of the Reactor Pressure Vessel,' 'Temperature of the Reactor Pressure Vessel,' 'Flow of the Reactor coolant,' 'Water Level, Pressure, Temperature, and PCV Atmosphere Gas Density,' 'Temperature of Spent Fuel Storage Pool (SFP),' and 'Area Gas Density inside of the combination structure,' and so on.

21.5.3 Consideration for Operation and Monitoring

The B/B HMI is designed to enable the operators to work during a SA, this includes taking into considerations environmental conditions, layout, and work space.

In order to provide effective and reliable plant and process monitoring and control, Hitachi-GE's design layout of the B/B control panel, takes into consideration elements of human interface engineering. For example, the layouts for display devices and operation equipment are grouped by each system.

In order to minimise misinterpretation, errors and omissions by the operators, Hitachi-GE has designed the layout of display devices in this manner: enabled group monitoring of the plants' parameters, and sorting according to relationship.

In order to minimise errors by the operators, Hitachi-GE has designed operational equipment for easy identification by shape, label, and so on.

21.5.3.1 Environmental Conditions in the B/B

In order for the operators to comfortably operate in a B/B during a SA, factors such as temperature, lighting, and noise is taken into consideration when designing for such comfortable environments in the B/B.

21.5.3.2 Layout and Work Space in the B/B

(1) The system layout in the B/B HMI is designed to take into account the tasks that the operators are required to carry out during foreseeable SA situations.
(2) A B/B is established in a separate location with enough distance from the MCR and Reactor Building (R/B) so they are not both affected by the same hazard, and the pathway leading to the B/B is safe for the operator's usage.

21.5.3.3 Layout of the Control Panel Surface

A grouped layout and arrangement will be used for each system's display apparatus on the control panel. Hitachi-GE has selected and arranged control and display equipment in a manner that minimises the likelihood of operator misinterpretation and errors

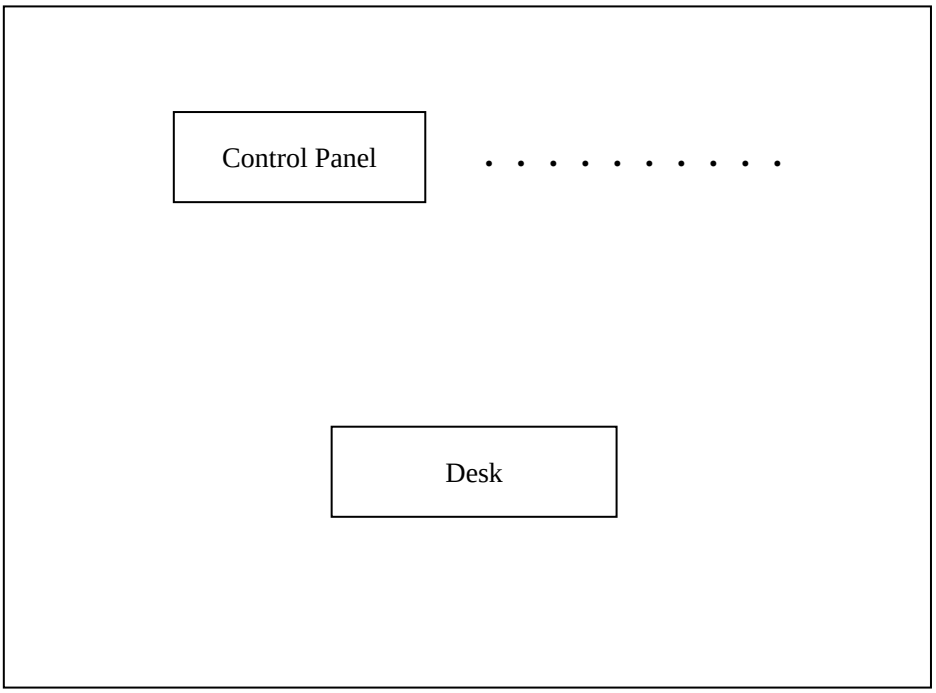
21.5.3.4 Display System

(1) Information Display Functions
Information encompassing the state of plant systems and equipment, along with information necessary for safety, is provided for operators in appropriate locations, grouped, and displayed in an easily assimilated and interpreted manner.

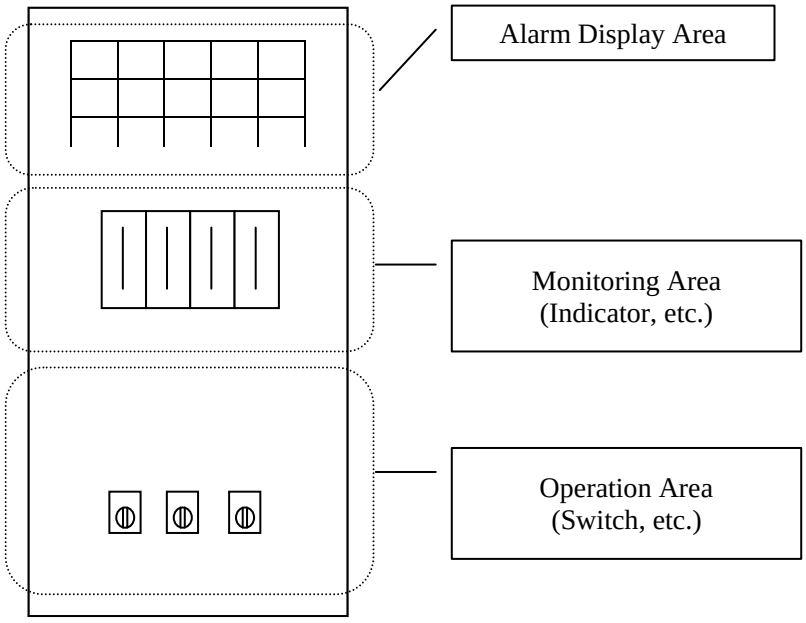
(2) Alarm Functions
In the case of an abnormality in the plant's SA management equipment or processes that requires operator attention or action, an alarm function notifies the operator regarding the occurrence of such upset conditions, in a manner easily assimilated.

21.5.3.5 Control Functions

(1) Control equipment and devices are selected and arranged to be easy to operate in order to minimise operator errors to as few as possible.
(2) The control systems and equipment of in the B/B are designed to be easily identified by shapes, label, and so on.



TOP VIEW



CONTROL PANEL FRONT VIEW

Figure 21.5-1: The Basic Layout of the B/B

21.6 Radioactive Waste Facilities

21.6.1 Introduction

Main C&I HMI System of liquid/solid RW facilities is established in a RWCR to provide a facility for effective and reliable operation, monitoring and control of the RW facilities and process.

The operators in the RWCR is enabled with the monitoring and controlling of the liquid/solid RW facilities during periods of normal treating operations/transferring operations, transients, and outages.

In addition, a RWCR HMI is designed with adequate measures for the minimisation of operator errors and omissions.

21.6.2 The Function of the RWCR

21.6.2.1 Structure

The basic layout of RW operator console is shown in Figure 21.6-1.

In order for the operators to effectively operate and control the RW facilities, all Visual Display Unit (VDU) is designed as identical function, and enabling the operation by appropriate role sharing between system operation monitoring operation, alarm monitoring, trend monitoring for major parameter, and so on.

A RW control panel established in an operation area is provided with a seating positioned operator console, to permit an enabling of the operators to concentrate operations, monitoring, and control of the plant.

The desks and a panel established in the RWCR is designed to enable adequate communication among operators, also the design takes operator’s visibility and usage of the controls and displays into account.

21.6.2.2 Function

Hitachi-GE has designed a control panel for the liquid/solid RW facilities, to be equipped with those functions necessary to enable operator panel monitoring and controlling of the operational conditions for such facilities, on the panels.

In addition, this control panel is designed to enable the operator’s response in a necessity of emergency shutdown operations, required for securing the safety of the RW facilities.

(1) Monitoring functions of the treating operation/transferring operation are to be in accordance with any particular requirement on the waste disposal, and disposal water transferring/discharging operation.
(2) Displaying functions for driving operational conditions of major equipment related to waste disposal development conditions, treatment/transferring drive operations, and the measurement results of the major instrumentations.
(3) Alarm display functions for upset conditions related to waste disposal development conditions and treatment/transferring drive operations.

21.6.3 Consideration for Operation and Monitoring

A RWCR HMI is designed to enable comfortable operations for the operators; this includes, taking into considerations the environmental conditions, the layout, and the work space.

In order to allow a concentration of the monitoring and controlling for RW facilities operations, Hitachi-GE has designed the layout of the RW control panel, taking into consideration elements of human interface engineering. For example, the display devices and the operation equipment are grouped by each system in the panel layout.

In order to minimise misinterpretation, errors and omissions by the operators, Hitachi-GE has designed the layout of display devices, enabled group monitoring of the process parameters, and have sorting the displays according to the relationship of the equipment.

In order to minimise errors by the operators, Hitachi-GE has designed the operational equipment utilising protection covers, key attached switches, and so on. In addition, the design of such equipment is also emphasised an easy of identification by shapes, label, and so on.

21.6.3.1 Environmental Conditions in the RWCR

In order for the operators to adequately operate in the RWCR, provided in residential areas (clean areas), factors such as temperature, lighting, and noise have been considered in the designing of a comfortable control environments.

21.6.3.2 Layout and Work Space in the RWCR

(1) The system layout in the RWCR HMI is designed to take into account the tasks that the operators are required to carry out during normal operation, plant's start-up, shutdown, and outages.
(2) In order to ensure safety, in cases of upset facilities conditions that require any manual operations, a task analysis is performed to consider the range of movement, and the operator’s ability to survey and operate the RW facilities.

21.6.3.3 Layout of the RW Control Panel Surface

The control panel’s layout and arrangement will be used for each system's display apparatus and the control equipment on the control panel. Hitachi-GE has selected and arranged control and display equipment in a manner that minimises the likelihood of operator misinterpretation and errors.

21.6.3.4 Display System

(1) Information Display Functions
Information encompassing the state of RW facilities systems and equipment, along with information necessary for safety, is provided for operators in appropriate locations, grouped, and displayed in an easily assimilated and interpreted manner.

(2) Alarm Functions
In the case of an abnormality in the plant’s equipment or processes that requires operator attention or action, an alarm function notifies the operator regarding the occurrence of such upset conditions, in a manner easily assimilated.

21.6.3.5 Control Functions

(1) Control equipment and devices are selected and arranged to be easy to operate in order to minimise operator errors to as few as possible.
(2) Where mal-operation of the control systems and equipment of the RWCR can lead to potentially hazardous outcomes consideration is given to providing protection covers, key attached switches, special labelling etc.
(3) The control systems and equipment of in the RWCR are designed to be easily identified by shapes, label, and so on.
(4) The operators can confirm the progression of the automatic operations when such operations are in an automatic operations mode.

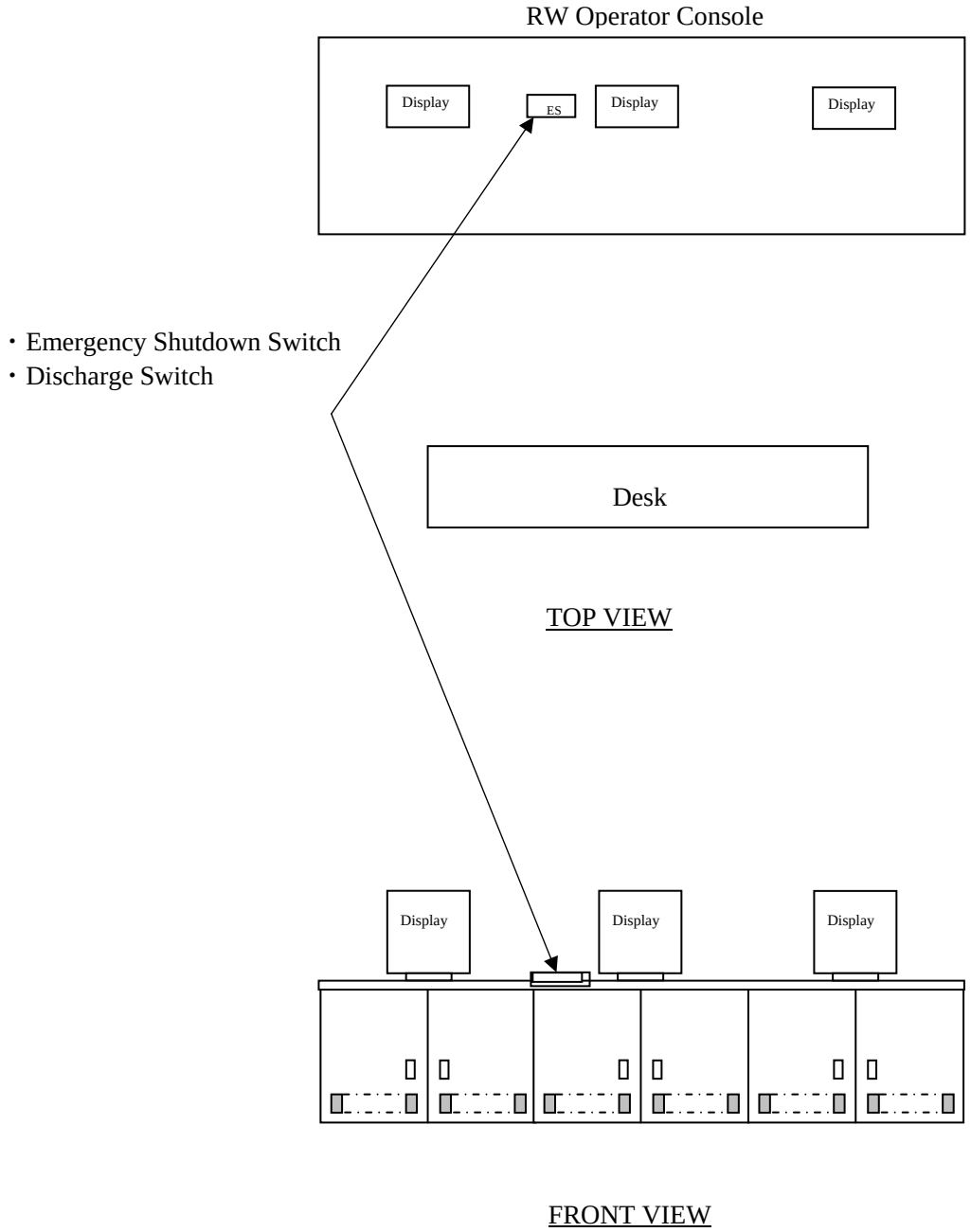


Figure 21.6-1: The Basic Layout of RW Operator Console