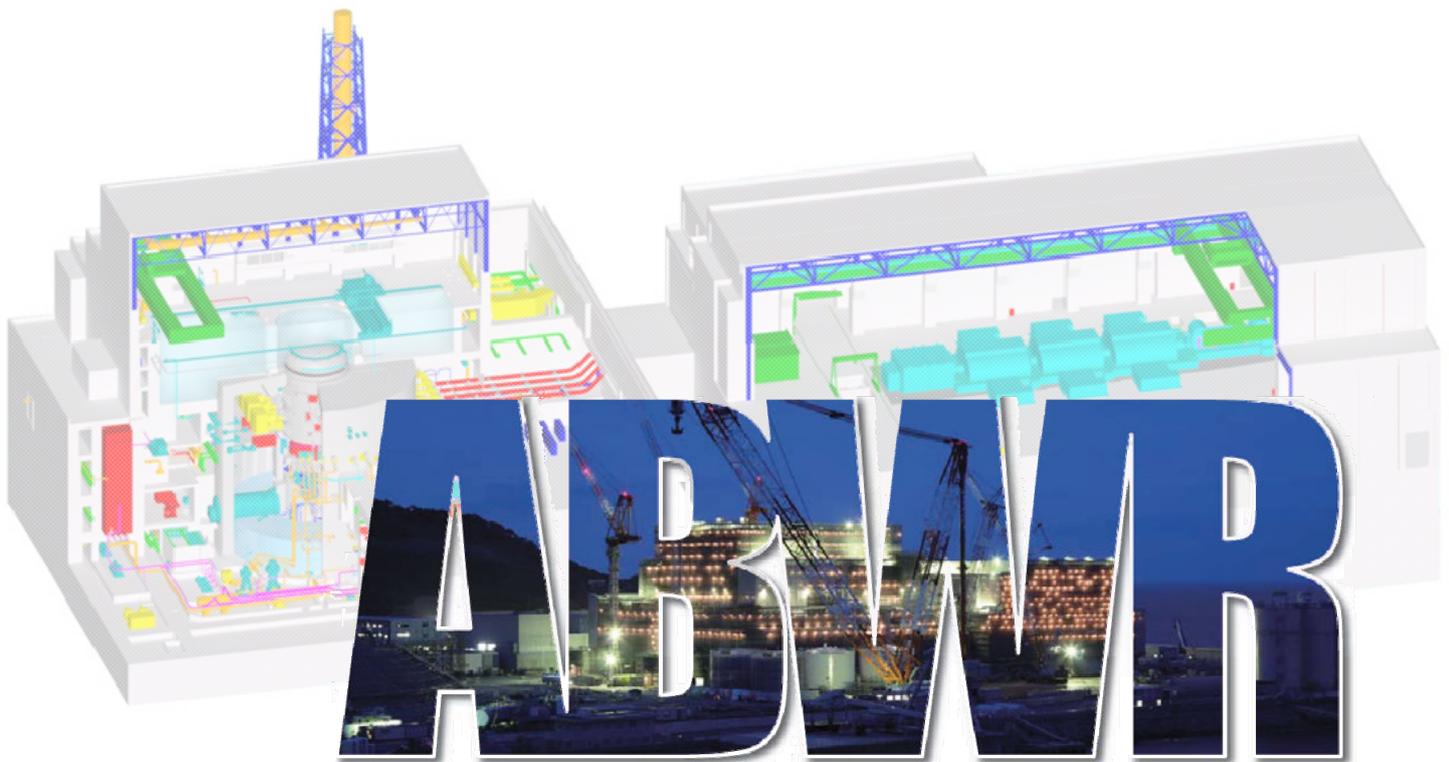


**UK ABWR**

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## **UK ABWR Generic Design Assessment**

### **Generic PCSR Sub-chapter 20.6 : Radiation and Contamination Monitoring of Occupational Exposure**



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## **20.6.1 Objective**

This section describes the safety case of radiation monitoring of occupational exposure.

Radiation monitoring provides significant information in order to ensure the protection of people from harmful effects of ionizing radiation and the safety of radiation sources. The entire scheme of the radiation monitoring is the responsibility of the operating license holder who is responsible for developing a radiation monitoring programme. Hitachi-GE will provide occupational radiation monitoring systems to the future operator as a main component of that programme. In this section, Hitachi-GE describes the safety case of the radiation and contamination monitoring of occupational exposure and the systems designed into the plant to perform this function.

## **20.6.2 Scope**

The scope of this section is radiation monitoring related to occupational radiation protection. Radiation monitoring related to plant operation and safety is scope of Chapter 14 Control and Instrumentation. Also, equipment reliability, digital data link, and the other common issues on instrumentation are developed in accordance with Chapter 14. Human factors are described in Chapter 27 Human Factors. Sampling and monitoring of radioactive substance with respect to environmental assessment is described in GEP-RSR. Radiation monitoring of public exposure is a subject of site license and will be submitted by the operating license holder with Hitachi-GE support.

## **20.6.3 Legislation and Standard**

The UK ABWR is designed to comply with the UK legislations and major international standards, such as IAEA safety standards, WENRA reference level and IEC. The design also complies with regulatory principles. Note that a criticality incident detection system stated in SAPs is not provided in the UK ABWR except in the reactor core as result of reactivity assessment that ensures the impossibility of a criticality excursion as shown in Chapter 11 Reactor Core, 19 Fuel Storage and Handling, and 32 Spent Fuel Interim Storage.

## **20.6.4 Design Strategy**

### **20.6.4.1 Design Principle**

The UK ABWR is designed to achieve two fundamental radiation protection purposes;

- (1) Minimise occupational dose as low as reasonably practicable,
- (2) Ensure that occupational dose complies with the regulatory limit.

Radiation monitoring provides significant information for these purposes from which the following design principles derives.

One of the approaches to minimise occupational dose is to prevent unnecessary exposures due to adequate radiation monitoring. When operating personnel accesses anywhere in the Controlled area, radiation level should be confirmed to be within the predicted level prior to entry. The level is also being appropriately monitored during his/her stay. If actual radiation level is higher than the predicted level and inappropriate, work plan shall be rearranged to minimise occupational dose. From this perspective, ambient dose equivalent rate and airborne radioactivity at any locations are measured and indicated. At strategic locations, ambient dose equivalent rates are monitored continuously. The data is centralised in the MCR to provide information on plant total radiological condition. Personal dose equivalent is continuously measured during the operating personnel stay. Alarm is activated upon detecting high radiation level to warn the operating personnel to avoid inadvertent exposure. Radiation monitoring data is recorded and archived in a database system.

Prevention and mitigation of radioactive contamination is also an essential approach to minimise occupational dose. Surface radioactive contamination of any SSC is measured as necessary. That of all personnel is measured prior to exit the Controlled area. If actual contamination level is higher than the predicted level, measures are taken to control the spread of the contamination and to decontaminate.

Evidences that occupational doses are less than the regulatory limit can be provided due to adequate radiation monitoring. Personal dose equivalent from external exposure is continuously measured during any stay in the Controlled area. Also, personal dose equivalent from internal exposure is estimated. Dose histories of all personnel are recorded and readable.

Sufficient quantity of each equipment along with sufficient space is available considering periodic maintenance and irregular faults. All equipment is periodically maintained and calibrated with a method traceable to a national standard to ensure its performance.

#### **20.6.4.2 Category and Class**

The UK ABWR safety categorisation and classification is defined in Sub-chapter 5.4 Categorisation and Classification of SSCs. The installed area radiation monitoring system can provide timely information of radiological risk and support plant operation to ensure it is ALARP. Therefore it is categorised and classified as C3. Functions of any other systems and equipments are not safety-categorised.

## **20.6.5 Installed Equipment**

### **20.6.5.1 Installed Area Monitoring Equipment**

Installed area monitoring equipment is provided to continuously measure, indicate and record the photon ambient dose equivalent rates at strategic locations throughout the plant with the exception of inner the PCV. The system activates audible and visible alarms locally as well as in the MCR on high levels to warn operating personnel.

The locations are selected based on the following criteria with regarding an actual building design.

- (1) Locations in the Controlled area where operating personnel routinely stays or accesses for operation, monitoring, inspection, patrol and the other purposes.
- (2) Locations where the radiation level is increased according to operational state.
- (3) Main control room as a significant important location where operating personnel stays at all times.

Note that no location is selected in the PCV. Atmosphere is nitrogen in the PCV and access is prohibited except maintenance period. The portable equipment is used appropriately with considering a maintenance programme. Decommissioning of the plant is not considered at present. The location will be renewed due to a prospective decommissioning programme.

The detector is positioned as the measurement is representative in the area. Inadvertent shielding form SSC is minimised. Height of the detector position is practicably common for all locations. Because periodic calibration and maintenance is necessary, sufficient space is secured around the detector.

In the selection of the equipment, range of temperature, humidity, vibration and any other conditions at each location is considered. Range of measurement depends on the radiation zone at each location to cover the predicted radiation level. Data processing is designed to be fail-safe.

In the MCR, measurements and status of all detectors are centralised in a common system to display and record information on plant total radiological condition. Each detection channel is independent from the other channels not to affect the others. Note that detached areas such as B/B or interim spent fuel storage area may be monitored independent form the centralised system based on the radiation protection programme.

In order to ensure continuous monitoring, the system is powered by the vital source. Reliability of the system as well as each assembly is managed with the same approach described in Chapter 14 Control and Instrumentation.

### **20.6.5.2 Installed Individual Monitoring Equipment**

Installed individual monitoring equipment is provided in order to monitor radioactive contamination. The monitoring is carried out according to the radiation protection programme.

The equipment is located at the boundary of the Controlled area. All operating personnel shall pass a check point to enter the Controlled area in order to monitor spent time and radiation exposure during his/her stay. Prior to exit, surface contamination of personnel's body is measured. The UK ABWR is designed as the check point is unique for a cluster of buildings to restrict an access route. At each point, sufficient quantity of the equipment along with sufficient space is provided. The quantity is determined by number of operating personnel working in the Controlled area with considering periodic maintenance.

## **20.6.6 Portable Equipment**

### **20.6.6.1 Portable Area Monitoring Equipment**

Portable area monitoring equipment is provided in order to measure ambient dose equivalent and radioactivity in any airspace and on/around any SSCs at any time. This equipment also measures operating personnel to survey for surface contamination. The monitoring is carried out as necessary according to the radiation protection programme. The equipment is used during normal and accident conditions.

### **20.6.6.2 Portable Individual Monitoring Equipment**

Portable individual monitoring equipment is provided in order to measure personal dose equivalent of operating personnel during his/her stay in the Controlled area. All operating personnel entering the Controlled area shall carry dosimeter wearable on working clothes.

## **20.6.7 Laboratory Equipment**

An onsite laboratory is provided in S/B to analyse radioactive samples timely. The sampling and analysis is carried out as necessary according to operating personnel judgment on the basis of the radiation protection programme.

## **20.6.8 Database**

A database system dedicated from the plant function logs radiation measurements. For area radiation monitoring, all continuous measurements and necessary spot measurements are logged. For individual radiation monitoring, all measurements for all operating personnel are logged. The specific data can be read out at any time. Individual dose history ensures compliance with regulatory limit.