Hitachi-GE Nuclear Energy, Ltd.
UK ABWR GENERIC DESIGN ASSESSMENT
Resolution Plan for RO-ABWR-0064
(Design approach to identification and provision of both permanent and temporary features necessary for the adequate control of radioactive contamination across the full lifetime of UKABWR)

RO TITLE:	Design approach to identification and provision of both permanent and temporary features necessary for the adequate control of radioactive contamination across the full lifetime of UKABWR	
REVISION :	2	
Overall RO Closure Date (Planned):	March 2017	
REFERENCE DOCUMENTATION RELATED TO REGULATORY OBSERVATION		
Regulatory Queries	RQ-ABWR-0506, RQ-ABWR-0541	
Linked ROs	RO-ABWR-0006, RO-ABWR-0009, RO-ABWR-0010, RO-ABWR-0011, RO-ABWR-0014, RO-ABWR-0015, RO-ABWR-0016, RO-ABWR-0017, RO-ABWR-0018, RO-ABWR-0020, RO-ABWR-0034, RO-ABWR-0035, RO-ABWR-0036, RO-ABWR-0037, RO-ABWR-0040, RO-ABWR-0044, RO-ABWR-0045, RO-ABWR-0047, RO-ABWR-0049, RO-ABWR-0050, RO-ABWR-0051, RO-ABWR-0054, RO-ABWR-0056, RO-ABWR-0065	
Other Documentation	RI-ABWR-0001, RI-ABWR-0002	

Scope of work :

Background

ONR expects that UK ABWR is designed such that permanent and temporary features required to manage and prevent the spread of contamination. RQ-ABWR-0506 was raised to gain understanding of Hitachi-GEs approach and design for the management of contamination within the UK ABWR. The response to the RQ was reasonably detailed and provided high level statements on the design philosophy used, certain examples and general statements on compliance with UK expectations. It did not however address some level of detail with regard to specifications required for surface preparation and examples of locations of features to which contamination control is applied. Hitachi-GE is therefore required to demonstrate to:

(1) Identify and present the location of expected potential contamination and nature (Solid, Liquid and Gas) and extent (Volume and Activity) of potential contamination
(2) Explain the design philosophy in relation to the control and containment of radioactive material (which includes all aspects of contamination control through fixed features or through the provision of movable features, in addition to selection criteria in relation to contamination control)
(3) Explain how the design philosophy will apply into the UK ABWR design and provide the detailed examples

Note: These considerations are maintained through normal operation, conditions beyond normal operation up to the design basis faults in relation to design basis analysis and decommissioning of the UK ABWR.

The objective of the Regulatory Observation (RO) RO-ABWR-0064 [Ref-1] is to:

a) State ONR's expectations related to the design for contamination control and management
b) Request Hitachi-GE shows how it will implement a design approach that meets ONR expectations for the design of the UK ABWR related to contamination control

In the tasks in relation to this RO Resolution Plan, 'contamination' is defined as:

"Contamination is the presence of radioactive material where it is not wanted – most commonly by depositing on surfaces or inside structures, objects, or people." [Ref-3]

Scope of Work

In order to meet the Regulator's expectations and the GDA timeline, Hitachi-GE would like to take immediate actions to incorporate a contamination control philosophy in line with UK good practice into its design process appropriately and reflect them to the design of the UK ABWR.

In the Resolution Plan Hitachi-GE's current plan to address the RO is described however as the work develops we may optimise the means to address the RO.

Description of work:

Under the RO-ABWR-0064, the following 11 actions have been requested from ONR:

RO-ABWR-0064.A1: Hitachi-GE to provide a resolution plan detailing the process to be followed and how it intends to comply with the remaining actions.

RO-ABWR-0064.A2: Identify and presents the locations, nature (Solid, Liquid or Gas) and extent (Volume and Activity) of potential radioactive contamination.

RO-ABWR-0064.A3: Explain the design philosophy in relation to the control and containment of radioactive material. This should include all aspects of contamination control through fixed features, including ventilation and barriers, as well as through the provision of movable features.

RO-ABWR-0064.A4: Identify and present the relevant standards from which specifications for materials, surfaces and surface-finishes are identified in relation to minimising contamination adherence, and to aid with decontamination.

RO-ABWR-0064.A5: Following the identification of the specifications which define the materials, surfaces and surface-finishes used in areas with the potential to become radioactively contaminated provide examples of how they are applied within the UK ABWR design.

RO-ABWR-0064.A6: Identify the features needed by the design to facilitate decontamination techniques prior to

intrusive maintenance or following an unplanned leak from primary containment (Note: Primary Containment is used in general containment usage and not just primary reactor containment).

RO-ABWR-0064.A7: Identify how Hitachi-GE intends to manage HVAC/LEV arrangements within the relevant buildings of the GDA design to ensure a balanced and controlled cascade ventilation system is maintained.

RO-ABWR-0064.A8: Identify the nature and location of monitoring (Airborne, Radiation and Surface Contamination) equipment required to control and minimise contamination spread within the UK ABWR, providing examples.

RO-ABWR-0064.A9: Can Hitachi GE provide details of the strategy by which access to high dose rate and high dose areas e.g. "Paragraph 59 Where doses forming a significant fraction of any statutory dose limits could be incurred in a matter of minutes during normal operations" will be controlled by physical means such as interlocks, alarms, or locked doors to prevent unauthorised entry. Note the focus of any strategy should be based on the Hierarchy of controls as detailed in the SAPs, TAGs and IRRs 99.

RO-ABWR-0064.A10: Following on from the above action can Hitachi GE provide details of the Cat and Class of the relevant Interlocks or engineered protective systems in line with the Hitachi GE Safety Case manual.

RO-ABWR-0064.A11: Can Hitachi GE identify the necessary EMIT requirements for the identified interlocks or engineered protective systems as identified above.

Following the review of the above actions, Hitachi-GE have put together a resolution plan that enables Hitachi-GE experts to demonstrate to ONR the contamination control philosophy generally adopted in the UK nuclear industry has been understood and implemented. This will be carried out through a systematic method with the aim to facilitate knowledge transfer from UK experts to Hitachi-GE experts, and will allow Hitachi-GE to implement such principles effectively to the UK ABWR design.

The UK ABWR design will be subjected to the systematic review as described in this Resolution Plan, which is expected to continue over the duration of the GDA as well as post-GDA. On satisfactory demonstration that a sufficiently robust review process is in place and the 8 actions points have been suitably addressed, it is considered that RO-ABWR-0064 may be closed out whilst the remaining contamination control continue to undergo the same review process. This is planned to be demonstrated to ONR by the end of November 2016.

Hitachi-GE will carry out the following tasks to address the RO:

- ***A1: Hitachi-GE to provide a resolution plan detailing the process to be followed and how it intends to comply with the remaining actions.***

Hitachi-GE's scope:

Detailed process to be followed and how it intends to comply with the remaining actions are addressed in this resolution plan (see sections of each action below).

Deliverables:

(1) This Document (Resolution Plan)

■ ***A2: Identify and presents the locations, nature (Solid, Liquid or Gas) and extent (Volume and Activity) of potential radioactive contamination.***

Hitachi-GE's scope:

The key factors in order to identify and present the locations, nature and extent of expected potential contamination are addressed below:

(1) Locations of expected potential contamination

Locations of expected potential contamination depend on the following.

- Source Terms: Type of substances in the components such as equipment and valve (i.e. radioactive or non-radioactive substances)
- Event of potential contamination spread from such components (i.e. worker activities such as operation and maintenance during normal operation, faults/accidents events such as pipe rupture during faults or accidents, and worker activities for pipe disconnection during decommissioning)

(2) Nature (Solid, Liquid and Gas) of potential contamination

Nature of potential contamination depends on the following in addition to the key factors of locations of potential contamination.

- Process conditions
- Environment around areas containing the contaminated components (e.g. temperature and pressure), which depends on system structure (e.g. filter and demineraliser)

(3) Extent (Volume and Activity) of potential contamination

Extent of potential contamination depends on the following in addition to the key factors of locations and nature of potential contamination.

- Specification of the components such as equipment and piping
- Decay time of radionuclides

These will directly link to the UK ABWR design source terms in relation to RI-ABWR-0001 and RO-ABWR-0006, and the other relevant source terms such as a spent fuel.

In terms of normal operation (i.e. Operating Condition I), the locations, nature and extent of potential contamination will be demonstrated based on the UK ABWR of End User Source Term (EUST) for Radiation Protection and the Operational Experiences (OPEX) of the Japanese ABWR.

(1) Locations of expected potential contamination

The components such as equipment and piping containing radioactive substances will be identified in the UK ABWR design source term reports in relation to RI-ABWR-0001. The events of potential contamination spread from the components during normal operation are the worker activities (e.g. opening contaminated equipment). The worker activities including potential spread of contamination will be identified based on the OPEX of the Japanese ABWR because worker activities of the UK ABWR will be assumed based on worker activities of the Japanese ABWR. According to these considerations, the locations of potential contamination will be demonstrated.

(2) Nature of potential contamination

Nature of potential contamination will be demonstrated based on the UK ABWR design source term, determined taking into account the process conditions and the environment of located areas depending on system structure, which links to RI-ABWR-0001. The OPEX of the Japanese ABWR will also be used to demonstrate nature of potential contamination.

(3) Extent of potential contamination

Concentration of radioactive sources in the components will be identified based on the UK ABWR design source term in relation to RI-ABWR-0001. Surface contamination of inner surface of the components will also be identified in RI-ABWR-0001. Airborne contamination will be evaluated based on surface and liquid contamination taking into account appropriate re-suspension factor and release fraction from surface and liquor to air. In addition, the OPEX of the Japanese ABWR will also be used for demonstration of the extent of potential contamination. The surface contamination of equipment and floor, and airborne contamination are measured and controlled with the appropriate work permit on regular a basis for each area.

It should be noted that the reactor water chemistry regime of the Japanese ABWR is Normal Water Chemistry (NWC) and the UK ABWR water chemistry regime will be Hydrogen Water Chemistry (HWC) with Noble Metal Chemical Addition (NMCA) and Depleted Zinc Oxide (DZO). This difference will be compared appropriately using the UK ABWR design source term provided by RI-ABWR-0001 progress.

Also, the Japanese ABWR is the reference design of the UK ABWR. Therefore, the Japanese ABWR OPEX is selected as reference data to demonstrate the locations, nature and extent of potential contamination because the locations of contamination sources and contamination levels deeply depend on worker activities (e.g. opening and disassembling) and geometry of equipment (e.g. size of equipment). The influence of design modifications and changes in the maintenance and outage regimes for the UK ABWR will be considered if they are available and applicable.

In terms of faults and accidents, this RO Resolution Plan covers contamination control beyond normal operation up to the design basis faults in relation to Design Basis Analysis (DBA) (hereinafter called as ‘Fault’s). The locations, nature and extent during Faults will be identified by EUST for DBA and other relevant sources such as a spent fuel.

(1) Locations of expected potential contamination

The Fault events in relation to contamination spread and the areas that these events may occur will be identified taking into account the event frequency, dose / contamination level and so on.

(2) Nature of potential contamination / (3) Extent of potential contamination

The nature and extent of potential contamination during Fault events will be demonstrated based on the UK ABWR design source term in relation to RI-ABWR-0001 (EUST for DBA) and other relevant source terms such as the spent fuel.

In terms of decommissioning, the basic approach to identify and present the locations, nature and extent will be the same as normal operation, except for type of EUST and use of the Japanese ABWR OPEX. To evaluate these for decommissioning, the EUST for decommissioning will be used. The Japanese ABWR OPEX will also be used on a case by case basis because, for example, the operating condition at the beginning of decommissioning phase is similar to outages of normal operation. However, it is not appropriate to use the OPEX data for the end of decommissioning phase because the source terms during outages are expected to be different from the end of decommissioning phase. In such case, the EUST for decommissioning will be used taking into account time to decommissioning, i.e. radionuclides decay time.

As transport of contained contaminated materials, including any secondary wastes produced from operations, will link to the future operator management. The detailed routes, nature and extent of these materials will be identified by the future operator and the generic design will provide adequate design considerations.

Deliverables:

(1) Document(s) to identify:
- Location of expected potential contamination (Note: The location during normal operation will be linked to the Topic Report on Zoning [Ref-2].)
- Events with possibility of contamination spread, e.g. opening radioactive equipment for maintenance and sampling, pipe rupture during faults or accidents, and pipe disconnection for decommissioning
- Nature (Solid, Liquid and Gas) of potential contamination
- Extent (Volume and Activity) of potential contamination

(2) Topic Report on Radiation and Contamination Zoning [Ref-2] will be updated to be consistent with the (1) deliverable(s).

■ ***A3: Explain the design philosophy in relation to the control and containment of radioactive material. This should include all aspects of contamination control through fixed features, including ventilation and barriers, as well as through the provision of movable features.***

Hitachi-GE's scope:

Explanation of the design philosophy in relation to the control and containment of radioactive material will be facilitated by the following tasks:

i) Familiarisation of Hitachi-GE of Contamination Control in line with UK Good Practice

ii) Performance of a Design Study of Contamination Control between UK ABWR and UK Good Practice

iii) Performance of an ALARP Assessment of UK ABWR Contamination Control

i) Hitachi-GE designs the UK ABWR features in relation to contamination control based on the Japanese ABWR design as a starting point of the UK ABWR design. Japanese ABWR was designed based on As Low As Reasonably Achievable (ALARA) principle in line with the relevant international guidance and standards. In addition to them, UK industry good practice should be applied into the UK ABWR to ensure that workers and the public doses are As Low As Reasonably Practicable (ALARP). Therefore, UK good practice in relation to contamination control will be identified as a first step.

Hitachi-GE will develop, with appropriate input from the UK experts, the contamination control philosophy document including general design philosophy in relation to contamination control, contamination control measures adopted in the UK supported by case studies where appropriate, to provide examples of how the philosophy is put into practice in the UK. These case studies will be addressed for each area of contamination potential (contamination risk). In addition, the contamination control measures and case studies will be addressed based on the hierarchy of control, i.e. these will be provided in the ERIC-PD order ('Eliminate', 'Reduce', 'Isolate', 'Control', 'Personal Protective Equipment' and 'Discipline' contamination risk).

The contamination control philosophy document will be studied by Hitachi-GE experts to raise awareness and understanding of the contamination control approach in the UK, seeking clarification from UK experts where necessary.

This philosophy document will be made taking the followings into account:

- Hierarchy of Control: the ERIC-PD approach in line with IRR99 Reg 8(2) and SAP RP.7 is considered and all contamination control aspects including engineered / administrative controls (e.g. permanent / temporary facilities) are to be covered
- All Relevant Technical Areas: all relevant technical areas in relation to contamination control are to be covered
- All Operating Conditions: normal operation, conditions beyond normal operation up to the design basis faults in relation to DBA and decommissioning are to be covered
- All Tasks / Roles: all tasks / roles in relation to contamination control such as maintenance, sampling, etc. are to be covered
- Criteria: criteria in relation to contamination control if necessary, e.g. criteria for when/what to use if decontaminating
- Relevant Input: the information in relation to the design philosophy is used as an input to make the contamination control philosophy document, e.g. a design philosophy document in relation to other RO
- PCSR Chapter 20.4 Rev.B

ii) Hitachi-GE will understand contamination control in line with UK good practice using the contamination control philosophy document, especially the case studies. Then Hitachi-GE will carry out the design study of contamination control between UK ABWR and UK good practice. It is anticipated that the contamination control design study will be

performed through an interactive workshop, where the design will be openly challenged by both Hitachi-GE and UK experts as necessary to test the contamination control adopted in the UK ABWR. The review in the workshop will be performed using the contamination control philosophy document as a tool. Hitachi-GE experts of all relevant technical areas and UK experts (as necessary) will attend this workshop. The justification of the UK ABWR will be provided and the design change will be performed as necessary if the significant gap is identified.

Hitachi-GE understand that ONR have an interest in understanding the design features implemented in the UK ABWR for the control of contamination across the plant. Hitachi-GE will ensure that the philosophy of ensuring a hierarchy of control will be met firstly by installed design features and only when these installed features need to be augmented by additional mobile controls will they then be also implemented. It is during outage and maintenance operations that additional features are likely to be needed when controlled breach of primary containment will occur. These additional features are likely to include temporary barrier arrangements, further mobile monitoring equipment and enhanced ventilation provision.

Hitachi-GE will provide sufficient installed design features which will make the deployment of temporary features more effective. These features are likely to include, but are not limited to; spurs on the HVAC system allowing for temporary higher contamination zones to established, sufficient space to enable the construction of temporary containment facilities and the additional services required to support them.

Sufficient facilities should be identified at the design stage to ensure that any temporary equipment utilised has sufficient storage space when not in use, is designed in such a way that it is easily decontaminated after use and any secondary wastes produced are minimised and consistent with the established waste routes.

iii) Hitachi-GE will perform the ALARP assessment. The expected contamination risks will be identified in Action 2 and the countermeasures for minimising contamination itself and contamination spread of such contamination risks will be identified based on the hierarchy of control in Action 3. These steps will lead to demonstration of contamination risks to ALARP. During these steps, BAT considerations will also be taken into account. Therefore, the ALARP demonstration will be performed by summary of the results of Action 2 and 3.

iv) In addition, protection against direct radiation will also be considered in this RO resolution. Hitachi-GE will perform the design study and ALARP assessment from the aspect of the exposure from the direct radiation.

Deliverables:

(1) Contamination Control Philosophy Document

(2) Contamination Control and Protection against Direct Radiation: Design Study Document(s)

- ***A4 to A8: (Identify and present how the design philosophy in relation to the control and containment of radioactive material is applied into the UK ABWR design.)***

Hitachi-GE's scope:

In terms of Action 4 to 8, these actions basically link to how the contamination control philosophy document will be

applied into the UK ABWR design. The common approach in relation to Action 4 to 8 is addressed in this section and specific approach of these actions is addressed after that.

As mentioned in Action 3, in the step of production of the philosophy document, contamination control measures and case studies in relation to all relevant technical areas will be addressed based on the hierarchy of control. During contamination control design study of UK ABWR against UK good practice, the justification of the UK ABWR will be provided and the design change will be performed as necessary if a significant gap is identified. This will be performed for all relevant technical areas.

Therefore, contamination control in relation to all relevant technical areas will be considered in the same steps and UK ABWR design in relation to contamination control will be finalised through the design study and ALARP assessment.

- ***A4: Identify and present the relevant standards from which specifications for materials, surfaces and surface-finishes are identified in relation to minimising contamination adherence, and to aid with decontamination.***

Hitachi-GE's scope:

To identify the standards of materials and surfaces, the relevant objects are categorised as follows at first.

Materials and Surfaces of:

(1) General Plant Equipment and Piping, (surface finishes and structural integrity), including valves, pumps, heat exchangers and sampling points.
(2) Floors, Walls and Ceilings, (all areas in the RCA (Radiation Controlled Area)).
(3) Design and layout of the specialist decontamination areas within the Service Building.
(4) Decontamination Equipment, (design for post operational cleaning).
(5) Temporary Containment Equipment - including "Tacky Mats" and sheeting for minimisation of contamination spread, including mobile air filtration units.
(6) Personal Protective Equipment used during decontamination operations, storage and disposability.

The materials and surfaces of mobile objects such as (5) and (6) mentioned above will be considered in the site license phase. Therefore, the responses of this RO focus on the installed objects mentioned above.

Hitachi-GE will present a comprehensive discussion on the design features which represent good practice in the UK nuclear industry with regard to applicable standards. This action will be captured in the main contamination control philosophy document. A detailed description will be provided of the requirements of BS 4247-1: 1981 "Surface materials for use in radioactive areas - Part 1: Methods of measuring and evaluating the decontamination factor" and BS 4247-2: 1982 "Surface materials for use in radioactive areas - Part 2: Guide to the selection of materials". It will also take into account of guidance produced by the Environment Agency for the design of new radiological facilities. It should be noted that these standards have been withdrawn and not replaced, but provide a good overview of the issue. Then Hitachi-GE will carry out the contamination control design study and ALARP assessment.

Deliverables:

The deliverables of this action are same as the deliverables of Action 3 (the output of this action will be included in the deliverables for Action 3).

- ***A5: Following the identification of the specifications which define the materials, surfaces and surface-finishes used in areas with the potential to become radioactively contaminated provide examples of how they are applied within the UK ABWR design.***

Hitachi-GE's scope:

As detailed specification in relation to materials and finishes will be considered by a future operator in the Site License Application (SLA), the scope of GDA and SLA will be clarified as a first step.

Hitachi-GE will ensure that the contamination control philosophy document will include sufficient, relevant examples where this requirement has been identified and implemented. Then Hitachi-GE will carry out a design study and ALARP assessment using the contamination control philosophy document as a guideline to provide the relevant examples of how these requirements are applied within the UK ABWR design. This builds on the requirements of Action 3 and substantiates the response by the provision of practical examples.

Deliverables:

The deliverables of this action are same as the deliverables of Action 3 (the output of this action will be included in the deliverables for Action 3).

- ***A6: Identify the features needed by the design to facilitate decontamination techniques prior to intrusive maintenance or following an unplanned leak from primary containment (Note: Primary Containment is used in general containment usage and not just primary reactor containment).***

Hitachi-GE's scope:

Hitachi-GE will ensure that the contamination control document includes sufficient detail of the UK good practice on how planned maintenance operations and faults are generally managed, how the design features make this operation more robust with regards to the control of contamination for intrusive maintenance or an unplanned leak. The contamination control philosophy document will be produced with the UK experts who have considerable experience in the area of temporary containment design, construction and commissioning. They have supported a wide range of UK nuclear sites during outage operations requiring C3 and C4 working conditions. As part of the overall commitment of the UK experts to provide knowledge transfer to Hitachi-GE, the UK experts will share their operational experience in this area to highlight design features and controls which demonstrate good practice. Then Hitachi-GE will carry out the design study and ALARP assessment using the contamination control philosophy document in order to identify the features needed by the design to facilitate decontamination.

Deliverables:

The deliverables of this action are same as the deliverables of Action 3 (the output of this action will be included in

the deliverables for Action 3).

- ***A7: Identify how Hitachi-GE intends to manage HVAC/LEV arrangements within the relevant buildings of the GDA design to ensure a balanced and controlled cascade ventilation system is maintained.***

Hitachi-GE's scope:

Hitachi-GE will ensure that the contamination control philosophy document and the contamination control design study document(s) contain sufficient examples of this design requirement for the UK good practice and UK ABWR. It is noted that there is an overlap with the requirements of RO-ABWR-0017, but further practical examples will be provided. These documents will be produced with an appropriate input from the UK experts who have considerable project knowledge in this area and have been working closely with Hitachi-GE to ensure that the UK ABWR will meet all relevant UK standards and good practice.

Deliverables:

The deliverables of this action are same as the deliverables of Action 3 (the output of this action will be included in the deliverables for Action 3).

- ***A8: Identify the nature and location of monitoring (Airborne, Radiation and Surface Contamination) equipment required to control and minimise contamination spread within the UK ABWR, providing examples.***

Hitachi-GE's scope:

Hitachi-GE will ensure that included within the contamination control philosophy document will be a detailed commentary on the regulatory and good practice requirements for the provision of monitoring equipment within the plant. In addition to this, further plans will be provided showing the location of and functional specification for installed instruments and the likely location of mobile equipment for temporary works whilst essential aspects have been described in [Ref-4]. Hitachi-GE will carry out the contamination control design study and ALARP assessment using the contamination control philosophy document in order to address the provision and the location of and functional specification for permanent and temporary instruments for the UK ABWR based on [Ref-4]. It is noted that selection and specification of instruments as well as exact installed location is not a GDA issue and is the responsibility of the site licensee, beyond the provision of the necessary services.

Deliverables:

The deliverables of this action are same as the deliverables of Action 3 (the output of this action will be included in the deliverables for Action 3). In addition, Topic Report on Radiation and Contamination Monitoring of Occupational Exposure [Ref-4] will be updated to be consistent with the deliverables for Action 3.

- ***A9: Can Hitachi GE provide details of the strategy by which access to high dose rate and high dose areas e.g. "Paragraph 59 Where doses forming a significant fraction of any statutory dose limits could be incurred in a***

matter of minutes during normal operations" will be controlled by physical means such as interlocks, alarms, or locked doors to prevent unauthorised entry. Note the focus of any strategy should be based on the Hierarchy of controls as detailed in the SAPs, TAGs and IRRs 99.

Hitachi-GE's scope:

Hitachi-GE will develop the detailed strategy on the access control to the high dose rate and high dose areas with the appropriate input from the UK experts. In brief, the strategy will comprise of:

1. Evaluation of the radiological risk in case of unauthorised entry
2. Optioneering of physical means to prevent unauthorised entry based on the hierarchy of controls
3. Determination of the Category and Class and necessary EMIT requirements for engineered protective system in relation to required physical means

More detailed information for each step is outlined below:

1. Evaluation of the radiological risk
   (1) The high dose rate and high dose areas will be identified based on the UK ABWR design source terms. It will be assumed and taken into account that the workers enter the high dose rate and high dose areas during normal operation and fault conditions. It is noted that the scope of the fault conditions will be up to the design basis faults.
   (2) The initiating event frequency of unauthorised entry will be estimated.
   (3) The worker occupancy within the high dose rate and high dose areas in case of unauthorised entry will be assumed.
   (4) The unmitigated worker dose will be evaluated based on the above-mentioned considerations.
   (5) The criteria for the high radiological risk in case of unauthorised entry will be determined.

   *: Design Basis Analysis and Probabilistic Safety Assessment will be carried out (if appropriate) as part of the Fault Study to determine the associated Safety Function which will define the quantity of SSCs required and their classes.
2. Optioneering of physical means
   (1) According to the evaluated radiological risk, the optioneering of physical means such as the interlocks, trapped key, alarms, and/or locked doors to prevent unauthorised entry will be performed based on the hierarchy of controls, i.e. the ERIC-PD method will be also applied in this assessment.
3. Determination of the Cat and Class and EMIT
   (1) The Category and Class for the engineered protective system in relation to the required physical means will be determined based on the frequency-consequence matrix. Where it is necessary to identify engineered safeguards, the hierarchy as given in the Hitachi-GE Safety Case Development Manual [Ref-5] will be applied along with the Hitachi-GE ALARP Methodology [Ref-6].
   (2) According to the determined Category and Class, necessary EMIT requirements for engineered protective systems in relation to the required physical means will be determined.

These will be addressed in the stand alone document on the strategy for the access control to the high dose rate and high dose areas, i.e. the deliverable (1) given below. In addition, how this strategy for access control is applied into a specific design will be demonstrated using representative examples. This will be covered in the deliverable (2).

Also, the topic of the access control will be identified in the Design Study document addressed in Action 3 as one of the countermeasures for minimisation of exposure from contamination and direct radiation. The above-mentioned documents on the access control will be produced as the supporting documents of the Design Study document.

Deliverables:

(1) Strategy for access control to high dose rate and high dose areas

(2) Access control to high dose rate and high dose areas (representative examples)

- ***A10: Following on from the above action can Hitachi GE provide details of the Cat and Class of the relevant Interlocks or engineered protective systems in line with the Hitachi GE Safety Case manual.***

Hitachi-GE's scope:

The strategy document for access control addressed in Action 9, i.e. the deliverable (1), will cover how the Category and Class of the engineered protective system in relation to the physical means to prevent unauthorised entry is determined based on the process given in the Hitachi-GE Safety Case Development Manual [Ref-5]. In addition, the detailed Category and Class of the physical means for the representative examples will be demonstrated within the deliverable (2) from Action 9.

Deliverables:

The deliverables of this action are same as the deliverables of Action 9 (the output of this action will be included in the deliverables for Action 9).

- ***A11: Can Hitachi GE identify the necessary EMIT requirements for the identified interlocks or engineered protective systems as identified above.***

Hitachi-GE's scope:

The strategy document for access control addressed in Action 9, i.e. the deliverable (1), will cover how the necessary EMIT requirements for the engineered protective system in relation to the physical means to prevent unauthorised entry is determined. In addition, the detailed EMIT requirements of the physical means for the representative examples will be demonstrated within the deliverable (2) from Action 9.

Deliverables:

The deliverables of this action are same as the deliverables of Action 9 (the output of this action will be included in the deliverables for Action 9).

Summary of impact on GDA submissions:

The GDA submissions that will be affected by the actions to resolve this RO are summarised below. These documents will be originated and/or revised in accordance with the corresponding Resolution Plan Actions.

Impacted GDA Submission Documents:

Related RO Actions	GDA Submission Document Title (Generic PCSR)	Document ID (Document No.)	Submission Date to the Regulators
ROA1 to 11	Chapter 6: External Hazards	GA91-9101-0101-06000 (AE-GD-0168)	20th October 2015
	Chapter 7 : Internal Hazards	GA91-9101-0101-07000 (SE-GD-0127)	
	Chapter 8 : Structural Integrity	GA91-9101-0101-08000 (RE-GD-2043)	
	Chapter 9 : General Description of the Unit (Facility)	GA91-9101-0101-09000 (SE-GD-0136)	
	Chapter 10 : Civil Works and Structures	GA10-9101-0101-10000 (LE-GD-0035)	
	Sub-chapter 12.1 : Reactor Coolant Systems and Associated Systems	GA91-9101-0101-12001 (SE-GD-0134)	
	Sub-chapter 12.2 : Reactivity Control Systems	GA91-9101-0101-12002 (SE-GD-0135)	
	Sub-Chapter 13.1 : Summary of Description of Engineered Safety Systems	GA91-9101-0101-13001 (ASE-GD-0009)	
	Sub-Chapter 13.2 : Containment System	GA91-9101-0101-13002 (ASE-GD-0010)	
	Sub-chapter 13.3 : Emergency Core Cooling System	GA91-9101-0101-13003 (SE-GD-0137)	
	Chapter 14: Control and Instrumentation	GA91-9101-0101-14000 (3E-GD-A0063)	
	Sub-chapter 16.1 : Water Systems	GA91-9101-0101-16001 (SE-GD-0129)	
	Sub-chapter 16.2 : Process Auxiliary Systems	GA91-9101-0101-16002 (SE-GD-0130)	
	Sub-chapter 16.3 : Heating Ventilating and Air Conditioning System	GA91-9101-0101-16003 (HPE-GD-H018)	
	Sub-chapter 16.4 : Other Auxiliary Systems	GA91-9101-0101-16004 (SE-GD-0131)	
	Sub-chapter 17.2 : Turbine Generator	GA91-9101-0101-17002 (TEQ-14-282)	
	Sub-chapter 17.3 : Turbine Main Steam, Turbine Auxiliary Steam and Turbine Bypass System	GA91-9101-0101-17003 (SBD-GD-0023)	
	Sub-chapter 17.4 : Extraction Steam System	GA91-9101-0101-17004 (SBD-GD-0024)	
	Sub-chapter 17.5 : Turbine Gland Steam System	GA91-9101-0101-17005 (SBD-GD-0025)	
	Sub-chapter 17.6 : Feedwater Heater Drain and Vent System	GA91-9101-0101-17006 (SBD-GD-0026)	
	Sub-chapter 17.7 : Condenser	GA91-9101-0101-17007 (SBD-GD-0027)	
	Sub-chapter 17.8 : Circulating Water System	GA91-9101-0101-17008 (SBD-GD-0028)	
	Sub-chapter 17.9 : Condensate and Feedwater System	GA91-9101-0101-17009 (SBD-GD-0029)	
	Sub-chapter 17.10 : Condensate Purification System	GA91-9101-0101-17010 (VPD-GD-0002)	
	Sub-chapter 18.1 : Source Terms	GA91-9101-0101-18001 (WE-GD-0018)	
	Sub-chapter 18.2 : Liquid Radioactive Waste Management System	GA91-9101-0101-18002 (WE-GD-0019)	
	Sub-chapter 18.3 : Off-Gas Radioactive Waste Management System	GA91-9101-0101-18003 (GE-GD-0022)	
	Sub-chapter 18.4 : Solid Radioactive Waste Management System	GA91-9101-0101-18004 (WE-GD-0020)	
	Chapter 19 : Fuel Storage and Handling	GA91-9101-0101-19000 (M1D-UK-0004)	
	Sub-chapter 20.2 : Definition of Radioactive Sources	GA91-9101-0101-20002 (HE-GD-5052)	
	Sub-chapter 20.3 : Strategy to Ensure that the Exposure is ALARP	GA91-9101-0101-20003 (HE-GD-5053)	
	Sub-chapter 20.4 : Protection and Provisions against Direct Radiation	GA91-9101-0101-20004 (HE-GD-5054)	
	Sub-chapter 20.6 : Radiation and Contamination Monitoring of Occupational Exposure	GA91-9101-0101-20006 (3E-GD-K025)	
	Sub-chapter 20.7 : Dose Assessment for Public from Direct Radiation	GA91-9101-0101-20007 (HE-GD-5055)	
	Sub-chapter 20.8 : Post Accident Accessibility	GA91-9101-0101-20008 (HE-GD-0045)	
	Chapter 21 : Human-Machine Interface	GA91-9101-0101-21000 (3E-GD-A0060)	
	Chapter 23 : Reactor Chemistry	GA91-9101-0101-23000 (WPE-GD-0058)	
	Chapter 24 : Design Basis Analysis	GA91-9101-0101-24000 (UE-GD-0208)	
	Chapter 25 : Probabilistic Safety Assessment	GA91-9101-0101-25000 (AE-GD-0171)	
	Chapter 27 : Human Factors	GA91-9101-0101-27000 (HFE-GD-0057)	
	Chapter 28 : ALARP Evaluation	GA91-9101-0101-28000 (SE-GD-0140)	
	Chapter 29 : Commissioning	GA91-9101-0101-29000 (QGI-GD-0011)	
	Chapter 30 : Operation	GA91-9101-0101-30000 (QGI-GD-0012)	
	Chapter 31 : Decommissioning	GA91-9101-0101-31000 (DCE-GD-0007)	
	Chapter 32 : Spent Fuel Interim Storage	GA91-9101-0101-32000 (FRE-GD-0008)	

	Relevant Supporting Documents	-	-

As the work progress other areas affected may be identified and will be updated as required.

Programme Milestones/ Schedule:

Refer to the attached Gantt-chart (Table 1) for the programmed activities and the schedule for the resolution of the RO.

Reference:

[Ref-1] Office for Nuclear Regulation, RO-ABWR-0064, "Design approach to identification and provision of both permanent and temporary features necessary for the adequate control of radioactive contamination across the full lifetime of UKABWR", 16 May 2016

[Ref-2] Hitachi-GE Nuclear Energy, Ltd., "Topic Report: Radiation and Contamination Zoning for All Relevant Buildings during System Start-up, Power Operation, Normal Hot Stand-by, System Shutdown and Outages excluding ILW, LLW and SFIS", GA91-9201-0001-00116 (HE-GD-5085) Rev.2, May 2016

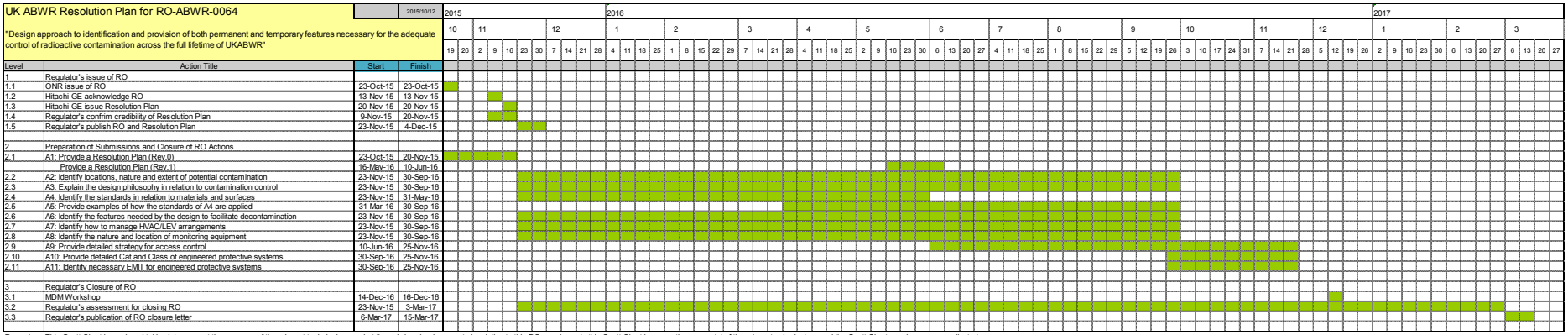
[Ref-3] The Society for Radiological Protection (SRP), Glossary of Terms

[Ref-4] Hitachi-GE Nuclear Energy, Ltd., "Topic Report on Radiation and Contamination Monitoring of Occupational Exposure", GA91-9201-0001-00136 (3E-GD-K049) Rev.2, October 2016

[Ref-5] Hitachi-GE Nuclear Energy, Ltd., "GDA Safety Case Development Manual", GA10-0511-0006-00001 (XD-GD-0036) Rev.1, November 2015

[Ref-6] Hitachi-GE Nuclear Energy, Ltd., "GDA ALARP Methodology", GA10-0511-0004-00001 (XD-GD-0037) Rev.1, November 2015

Table 1 RO-ABWR-0064 Gantt Chart



UK ABWR Resolution Plan for RO-ABWR-0064

2015/10/12

"Design approach to identification and provision of both permanent and temporary features necessary for the adequate control of radioactive contamination across the full lifetime of UKABWR"

Level	Action Title	Start	Finish
1	Regulator's issue of RO		
1.1	ONR issue of RO	23-Oct-15	23-Oct-15
1.2	Hitachi-GE acknowledge RO	13-Nov-15	13-Nov-15
1.3	Hitachi-GE issue Resolution Plan	20-Nov-15	20-Nov-15
1.4	Regulator's confirm credibility of Resolution Plan	9-Nov-15	20-Nov-15
1.5	Regulator's publish RO and Resolution Plan	23-Nov-15	4-Dec-15
2	Preparation of Submissions and Closure of RO Actions		
2.1	A1: Provide a Resolution Plan (Rev.0)	23-Oct-15	20-Nov-15
	Provide a Resolution Plan (Rev.1)	16-May-16	10-Jun-16
2.2	A2: Identify locations, nature and extent of potential contamination	23-Nov-15	30-Sep-16
2.3	A3: Explain the design philosophy in relation to contamination control	23-Nov-15	30-Sep-16
2.4	A4: Identify the standards in relation to materials and surfaces	23-Nov-15	31-May-16
2.5	A5: Provide examples of how the standards of A4 are applied	31-Mar-16	30-Sep-16
2.6	A6: Identify the features needed by the design to facilitate decontamination	23-Nov-15	30-Sep-16
2.7	A7: Identify how to manage HVAC/LEV arrangements	23-Nov-15	30-Sep-16
2.8	A8: Identify the nature and location of monitoring equipment	23-Nov-15	30-Sep-16
2.9	A9: Provide detailed strategy for access control	10-Jun-16	25-Nov-16
2.10	A10: Provide detailed Cat and Class of engineered protective systems	30-Sep-16	25-Nov-16
2.11	A11: Identify necessary EMIT for engineered protective systems	30-Sep-16	25-Nov-16
3	Regulator's Closure of RO		
3.1	MDM Workshop	14-Dec-16	16-Dec-16
3.2	Regulator's assessment for closing RO	23-Nov-15	3-Mar-17
3.3	Regulator's publication of RO closure letter	6-Mar-17	15-Mar-17

Remarks: This Gantt Chart is produced taking into account the progress of the relevant technical areas, but the only header documents in relation to this RO are shown in this Gantt Chart because there are a lot of the relevant submissions and the Gantt Chart may become complicated.
All relevant references will be addressed in these header documents appropriately.