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REGULATORY OBSERVATION Resolution Plan	
RO Unique No.:	RO-UKHPR1000-0051
RO Title:	Demonstration of BAT for the Examination, Maintenance, Inspection and Testing (EMIT) of Systems, Structures and Components (SSC) that provide an Environmental Protection Function (EPF)
Technical Area(s)	Environment
Revision:	00
Overall RO Closure Date (Planned):	2021-04-30
Linked RQ(s)	RQ-UKHPR1000-0498,RQ-UKHPR1000-0536.
Linked RO(s)	RO-UKHPR1000-0021
Related Technical Area(s)	Mechanical Engineering, Radiological Protection, RadWaste, Decommissioning & Spent Fuel Management
Other Related Documentation	NA
Scope of Work	

Abbreviations and Acronyms

CGN	China General Nuclear Power Corporation
EA	Environment Agency
EMIT	Examination, Maintenance, Inspection and Testing
EPF	Environmental Protection Function
GDA	Generic Design Assessment
IAEA	International Atomic Energy Agency
ISI	In-Service Inspection
KRT	Plant Radiation Monitoring System [PRMS]
NSL	Nuclear Site Licensing
ONR	Office for Nuclear Regulation(UK)

OPEX	Operating Experience
PCER	Pre-Construction Environmental Report
PCSR	Pre-Construction Safety Report
PSI	Pre-Service Inspection
RSE-M	The In-service Surveillance Rules for Mechanical Components of PWR Nuclear Power Stations
RO	Regulatory Observation
RP	Requesting Party
SSC	Structures, Systems and Components
TEG	Gaseous Waste Treatment System [GWTS]
TER	Nuclear Island Liquid Waste Discharge System [NLWDS]
UK HPR1000	UK Version of the Hua-long Pressurised Reactor

Background

The *Radioactive Substance Regulation Environmental Principles (REPs)* [1] includes several principles relevant to Examination, Maintenance, Inspection and Testing (EMIT) of Structures, Systems and Components (SSC) providing an Environment Protection Function (EPF), including ENDP4 (Environment protection functions and measures) and ENDP11 (Maintenance, inspection and testing). The information from the Nuclear Industry Safety Directors Forum, the *Best Available Techniques (BAT) for the Management of the Generation and Disposal of Radioactive Wastes – Good practice Guide* [2] and the IAEA guidance documents *No.GS-G-3.3* [3] and *No.GS-G-3.4* [4] provide guidance on EMIT for SSC providing EPF.

During GDA, *Examination, Maintenance, Inspection and Testing (EMIT) Strategy* [5] and related methodologies for UK HPR1000 are developed. The EMIT strategy clearly outlines the strategy that has been and will continue to be implemented to ensure that a systematic approach has been and will continue to be applied regarding EMIT throughout the whole lifetime of the UK HPR1000.

From the environment perspective, the *Pre-Construction Environmental Report (PCER) Chapter 3* [6] identifies the SSC that are deemed BAT to prevent and, where not practicable to minimise and optimise the production, management and disposal of radioactive waste to protect the environment and the members of the public. It also, to some extent, identifies how these SSC are to be operated to ensure they fulfil their environmental protection function(s), noting that flexibility is to be ensured wherever possible so as not to unduly constrain a future operator and to enable the future operator to maximise the safety of the plant, of workers and the protection of the environment and the public. These SSC and relevant function delivered by them are documented in *List of SSCs and Engineered Controls that Contribute to the Application of BAT* [7].

During GDA Step 3, The Office for Nuclear Regulation (ONR) raised Regulatory Observation (RO) RO-UK HPR1000-0021 'Demonstration of the adequacy of Examination, Maintenance, Inspection and Testing (EMIT) of structures, systems and components important to safety' [8] focusing on SSC important to safety. The RP has developed a number of reports to address this RO which scope is limited to SSCs providing safety functions. The RP recognise that these reports may partly address the environmental requirements. Therefore, the RP carried out a gap analysis in June 2020 to notably identify gaps against environmental requirements in the EMIT related reports (including the EMIT strategy and related methodologies), to ensure that environment requirements for EMIT are adequately captured and considered during GDA. This gap analysis that was shared with EA yielded a number of gaps, some being GDA related and others site-specific. Among the GDA gaps identified none has been assessed as impacting the design or the capability of SSC to deliver BAT as, while they are gaps in the EMIT related reports, the design has been developed with due consideration of all relevant requirements, including the general requirements to facilitate EMIT.

In parallel to the RP internal discussions on the GDA gaps identified in EMIT reports, the EA raised RO-UKHPR1000-0051 on EMIT for SSC fulfilling environmental protection functions to :

- Explain the environmental regulator's expectations
- Ensure the RP provides a demonstration that EPF of SSC can be maintained at all times under

normal operations, commensurate to GDA stage and scope

- Obtain confidence that adequate evidence will be provided by the RP to support the claims and arguments made in the PCER

This Resolution Plan describes the current plan to address RO-UKHPR1000-0051. It contains the strategy, the planned activities, deliverables, milestones and timescales. The overall design management process for UK HPR1000 is presented in *Requirement Management Summary Report* [9], which includes management of operational requirements and environment requirements. Detailed information regarding the operational management processes for the UK HPR1000 is provided in *Pre-Construction Safety Report (PCSR) Chapter 31* [10] and some information (though limited) is also included in PCER Chapter 3 [6]. The EMIT design process is presented in operational management, which lacks description of environment needs protection as explained above.

Scope of work

The proposed scope of work for this RO will cover the EMIT strategy and related methodologies with respect to SSC providing an environmental protection function. It will also cover some typical examples to demonstrate an appropriate EMIT regime can be defined at site-specific stage for equipment fulfilling an environment protection function.

Deliverable Description

RO-UKHPR1000-0051.A1 - A demonstration in the environment case that the environment protection function of structures, systems and components, identified as having an environmental protection function in the Pre-Construction Environmental Report Chapter 3 'Demonstration of BAT', can be maintained at all times under normal operations

The RO action states that:

In response to this Regulatory Observation Action, GNSL should:

- *Provide a demonstration of BAT for the methodology to be used to develop an EMIT regime for SSCs that provide an EPF under normal operations*
- *Provide a demonstration of BAT for how the design enables an appropriate EMIT regime to be defined*
- *Provide a clear statement of underpinning assumptions made when defining the methodology used for developing the EMIT regime*
- *Provide clarity on where a future operator may need to expand on the BAT case for EMIT made for GDA*

Resolution Plan Action

At the GDA stage, consideration is given to operational management with the main objectives to present the approach/methodologies that are to be used for operational management and to ensure the design allows an appropriate EMIT regime to be defined and implemented at the site-specific stage. The means of operational management for the UK version of the Hua-long Pressurised Reactor (UK HPR1000) include operating procedures; operating limits and conditions; Examination, Maintenance, Inspection and Testing (EMIT) procedures; and ageing and degradation management programmes. For these, the methodology and principles as well as a demonstration they can be implemented are provided during GDA phase. The detailed operational management documents will be developed during the site-licensing phase. Details are given in *Requirement Management*

Summary Report [9] and PCSR Chapter 31 [10].

As presented in the background, the RP carried out a gap analysis between GDA operational management documents (including EMIT related documentation) and UK environment requirements/practice and identified a number of gaps. The gaps relevant to GDA are being addressed by updating relevant document to include information relevant to SSC providing an EPF. This gap analysis and its outcomes will be reflected in a dedicated report. This report will be referenced as appropriate in next revision of *Requirement Management Summary Report* [9].

- *Provide a demonstration of BAT for the methodology to be used to develop an EMIT regime for SSCs that provide an EPF under normal operations* [A1.1]

As presented in the background section, the strategy and relevant methodologies to be used to develop EMIT arrangements and regime for UK HPR1000 SSC have been developed, drawing upon the RP's substantial experience and expertise, relevant standards and guidance and UK context requirements. These strategy and methodologies are:

- The *Examination, Maintenance, Inspection and Testing (EMIT) Strategy* [5]: the objective of this report is to clearly outline the strategy that has been and will continue to be implemented to ensure that a systematic approach is being applied regarding EMIT throughout the whole lifetime of the UK HPR1000. This document covers the scope, philosophy, design process and documentation hierarchy. The current version has been produced to respond to RO-UKHPR1000-0021 and is therefore focused on SSC important to safety, as explained in the background. It implicitly covers those SSC providing an environmental protection function for which safety related EMIT requirements bound/supersede environment related EMIT requirements, such as the Plant Radiation Monitoring System KRT [PRMS] monitoring on the stack. However, this is not made explicit in the report and the report does not cover per se environmental protection functions. This information is key to respond to this action and

therefore, it is necessary to update EMIT strategy. The existing EMIT strategy will therefore be complemented to explicitly cover the EMIT strategy for all SSC that provide an environmental protection function.

- The *Periodic Test Design Methodology* [11]: the aim of the periodic test design is to define a comprehensive list of periodic tests that are to be performed for UK HPR1000. *Periodic Test Design Methodology* [11] presents the methodology to be applied for the development of UK HPR1000 periodic tests and has been developed taking into account the RP expertise and decades of experience in PWR periodic testing as well as relevant UK and international guidance and UK context requirements. It includes generic principles and process of periodic tests development, definition of rules and requirements for periodic testing and so on. These are applicable and appropriate for developing periodic tests for SSC important to safety but also for SSC providing an environmental protection function. However, the report only makes it explicit that the methodology should be applied for SSC important to safety, it does not mention its applicability to SSC providing an environmental protection function. So as to ensure this methodology will be used to develop appropriate periodic tests for SSC providing an environmental protection function, *Periodic Test Design Methodology* [11] needs to be updated to extend the applicability of the methodology to SSCs providing an EPF.
- The *Outline of PSI and ISI Requirements for UK HPR1000* [12]: the purpose of the Pre-Service Inspection (PSI)/In-Service Inspection (ISI) is to ensure the structural integrity of the mechanical components during service and is therefore not dependent on the functional classification of the SSC but on their mechanical classification. The PSI and ISI methodology [12] draws upon the In-service Surveillance Rules for Mechanical Components of Nuclear Power Stations (RSE-M) and the component inspection requirements are based on the RSE-M classification. Therefore, the *Outline of PSI and ISI Requirements for UK HPR1000* [12] is considered appropriate and will not be updated.
- The *Preventive Maintenance Programme Principle* [13]: it contains the basic principles and

requirements for preventive maintenance programme in a nuclear power plant, and it also determines the principles and methods for UK HPR1000 preventive maintenance programme. This document is generic in nature and covers maintenance principles/requirements for both safety and environment. Therefore, the *Preventive Maintenance Programme Principle* [13] is considered appropriate and will not be updated.

The updated version of Reference [5] will be submitted at the end of March 2021, and the updated version of Reference [11] will be submitted at the end of January 2021.

These reports (updated version or existing version) will form a strong framework for developing UK HPR1000 EMIT arrangements to ensure BAT is and will continue to be applied.

- *Provide a demonstration of BAT for how the design enables an appropriate EMIT regime to be defined* [A1.2]

PCER Chapter 3 (Reference [6]) presents the demonstration that the design of the UK HPR1000 and, commensurately to GDA stage and scope, its operation and decommissioning, have been optimised through the application of BAT. The SSC that deliver BAT have been selected during GDA considering the technology but also the way they will have to be operated, maintained and decommissioned. For the latter, considering they are operator/equipment's supplier dependent and are therefore not determined during GDA, focus is given during GDA to ensuring there are sufficient flexibility and all relevant provisions (e.g. monitoring equipment, space and access, isolation means, redundancy, etc.) in the design so that a future operator can apply BAT for operation, maintenance and decommissioning of the UK HPR1000. Appropriate operational procedures, including EMIT arrangements and regime for specific SSC that provide an EPF will be further developed by the future operator once detailed design information and equipment's suppliers

recommendations/requirements will be available.

To address A1.2, a number of typical examples covering SSC providing EPFs will be added as an appendix in the updated version of the EMIT strategy report, Reference [5]. This appendix will aim to provide confidence, through typical examples, that for SSC that provide an EPF, the SSC can be maintained, inspected and tested for their EPF. It will focus on identification of EMIT activities, frequencies and windows.

The RP recognises that EMIT regime and arrangements depend on a multitude of factors, including the type of SSC, the functions that the SSC is to deliver, SSC operating modes (including continuous, intermittent and standby modes of operation), how the SSC is operated (i.e. passive, automatic or manual operation), etc. They also set a number of requirements on the design, including access and space requirements (from both a workers and any necessary equipment point of view), environment conditions (e.g. temperature, ambient dose rates, Humidity, etc.), compatibility of the SSC operating mode and EMIT arrangements (e.g. frequency, SSC normal position (e.g. close/open, in/out, on/off, etc.)/tested position, etc.). In order to ensure the examples selected provide the confidence that an EMIT regime and arrangements can be set by a future operator without impairing the SSC functions, huge modification and/or huge burden on the operator, the RP looked at the design with due consideration of above aspects, considering relevant experience, and selected the following examples to show that the design does not prevent an appropriate EMIT regime from being defined at site specific stage:

- The Liquid Waste Storage Tank (TER1110/1120/1130BA-) of Nuclear Island Liquid Waste Discharge System TER [NLWDS], which are designed to receive liquid waste from upstream systems and discharge them under relevant sampling and monitoring and after mixing and sampling. TER [NLWDS] system waste collection shall be always available to receive liquid waste from upstream systems. Other functions fulfilled by the TER tanks, including mixing, sampling, storing and discharging are operated intermittently.

- The Delay Beds (TEG6205/311/6213FI-) of Gaseous Waste Treatment System (TEG [GWTS]), which are used for treatment of noble gases by ensuring decay before discharge. The TEG [GWTS] delay beds are passive equipment that are to be always available and are operated in a continuous manner;
- The discharge valve (TER1243K-) of TER [NLWDS], which is designed to enable/stop the discharge of liquid waste by opening/closing automatically or manually. The valves are open to enable discharge if all discharge conditions are fulfilled, including appropriate quality of liquid waste, FPS being operational, KRT monitoring channel being operational, etc. The valves are closed if any of the discharge condition is not fulfilled. The valve is an active equipment that is operated automatically or manually.

The updated EMIT strategy report (Reference [5]) with this new appendix added in will be submitted at the end of March 2021.

- *Provide a clear statement of underpinning assumptions made when defining the methodology used for developing the EMIT regime* [A1.3]

When developing the EMIT strategy and related methodologies, a number of sources, including UK context requirements, UK and international standards and guidance, etc., as well as relevant OPEX and expertise, have been used to ensure the EMIT arrangements and regime that will be developed following these strategy and methodologies will enable risks to be reduced ALARP and BAT to be applied. In some instances, assumptions may need to be made due to detailed design information for UK HPR1000, notably the information from equipment's suppliers, not being available. In such instances, the assumptions will be clearly stated in the relevant reports and will be managed according to *Requirement Management Provisions for UK HPR1000 Generic Design Assessment (GDA) Project (GH-40M-026)* [14].

- *Provide clarity on where a future operator may need to expand on the BAT case for EMIT made for GDA* [A1.4]

At GDA stage, the RP mainly develops the EMIT strategy, principles and methodologies to make sure that the future operator is able to develop appropriate EMIT arrangements and regime in site-specific stage.

As presented above, PCER Chapter 3 presents the demonstration that the UK HPR1000 design and, commensurately to GDA stage and scope, its operation and decommissioning, have been optimised through the application of BAT, focusing on technology selection and providing flexibility and relevant design provisions to enable a future operator to operate and decommission the UK HPR1000 in a way that is BAT. The BAT case will have to be expanded at site-specific stage to notably cover the selected operational practices and EMIT arrangements/regime. PCER Chapter 3 contains a list of site specific FAP that covers those aspects that are not considered as normal business and will have to be addressed by the future operator. Some of these FAP relate to EMIT.

These FAP and the requirement to develop the EMIT arrangements and regime will be captured, managed and transferred to the future licensee in line with the relevant project procedures, notably the *Management of Commitments for UK HPR1000 Generic Design Assessment (GDA) Project (GH-40M-020)* [15].

Impact on the GDA Submissions

GDA Submission Document	Related ROAs	Planned schedule for submission
Updated Examination, Maintenance, Inspection and Testing (EMIT) Strategy	ROA1	2021.3
Updated Periodic Test Design Methodology	ROA1	2021.1

Timetable and Milestone Programme Leading to the Deliverables

See attached Gantt Chart in APPENDIX A.

Reference

[1] Environment Agency, RSR1 – Radioactive Substances Regulation - Environmental Principles (REPs), Version 2, April 2010.

[2] Nuclear Industry Safety Directors Forum, Best Available Techniques (BAT) for the Management of the Generation and Disposal of Radioactive Wastes, A Nuclear Industry Code of Practice, Issue 1, December 2010.

[3] IAEA, The Management System for the Processing, Handling and Storage of Radioactive Waste, Safety Guide No. GS-G-3.3, 2008.

[4] IAEA, The Management System for the Disposal of Radioactive Waste, Safety Guide No. GS-G-3.4, 2008.

[5] CGN, Examination, Maintenance, Inspection and Testing (EMIT) Strategy, GHX42EMT001DOYX45GN, Revision C, July 2020.

[6] General Nuclear System Limited, Pre-Construction Environmental Report Chapter 3 - Demonstration of BAT, HPR/GDA/RCER/0003, Rev 001-1, September 2020.

[7] CGN, List of SSCs and Engineered Controls that Contribute to the Application of BAT, GHX00100012DOHB00GN, Rev B, October 2020.

[8] UK HPR1000, RO-0021, Demonstration of the adequacy of Examination, Maintenance, Inspection and Testing (EMIT) of structures, systems and components important to safety, September 2019.

[9] CGN, Requirement Management Summary Report, GHX00100127DOZJ03GN, Rev B, September 2020.

[10] General Nuclear System Limited, Pre-Construction Safety Report Chapter 31 – Operational Management, HPR/GDA/PCSR/0031, Revision 001, 2020.

[11] CGN, Periodic Test Design Methodology, NE15BWXYX0000000021, Rev. B, September 2018.

[12] CGN, Outline of PSI and ISI Requirements for UK HPR1000, GHX10000330DPCH01GN, Rev. D, December 2020.

[13] CGN, Preventive Maintenance Programme Principle, GHX37PMP001DOYX45GN, Rev. A, November 2019.

[14] CGN, Requirement Management Provisions for UK HPR1000 Generic Design Assessment (GDA) Project (GH-40M-026), Rev. A, September 2020.

[15] CGN, Management of Commitments for UK HPR1000 Generic Design Assessment (GDA) Project (GH-40M-020), Rev. C, June 2020.

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APPENDIX A RO-UKHPR1000-0051 Gantt Chart

Task and Schedule		2020			2021					
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
RO Action 1										
1	Development of deliverable – Updated Examination, Maintenance, Inspection and Testing (EMIT) Strategy									
2	Submission of deliverable - Updated Examination, Maintenance, Inspection and Testing (EMIT) Strategy						▲			
3	Development of deliverable - Updated Periodic Test Design Methodology									
4	Submission of deliverable - Updated Periodic Test Design Methodology				▲					
Assessment										
5	Regulatory Assessment									
6	Target RO Closure Date							▲		