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### REGULATORY OBSERVATION Resolution Plan

<b>RO Unique No.:</b>	RO-UKHPR1000-0048
<b>RO Title:</b>	Equipment Qualification for Mechanical Engineering Based Structures Systems and Components
<b>Technical Area(s)</b>	Mechanical Engineering
<b>Revision:</b>	Rev 0
<b>Overall RO Closure Date (Planned):</b>	2021-05-31
<b>Linked RQ(s)</b>	RQ-UKHPR1000-0674 (CM09 2020/117581)
<b>Linked RO(s)</b>	RO-UKHPR1000-0021 (CM09 2019/358870)
<b>Related Technical Area(s)</b>	3. Control & Instrumentation 7. Electrical Engineering 9. Fault Studies 13. Management of Safety Quality Assurance 19. Severe Accident Analysis 20. Structural Integrity
<b>Other Related Documentation</b>	

#### Scope of Work

##### Background

ONR issued Regulatory Observation (RO) – “Equipment Qualification for Mechanical Engineering Based Structures Systems and Components”.

RO-UKHPR1000-0048 placed the following actions:

*A1 – Equipment qualification processes and procedures*

*A2 – Demonstration of equipment qualification requirements*

The Requesting Party (RP) acknowledges that Equipment Qualification (EQ) contribute to reducing relevant risks so far as is reasonably practicable (SFAIRP), and makes the resolution plan for this RO.

##### Scope of work

This Resolution Plan describes RP’s current plan to address the RO. It contains; the detailed strategy, the planned activities, deliverables, milestones, timescales, as well as the resource assignment.

Equipment qualification shall be implemented to the structure, systems or components (SSCs) that are important to safety, this includes active and non-active mechanical components.

EQ processes and arrangements should cover all stages of the SSCs lifecycle, including design, verification testing,

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manufacture, installation, commissioning, and examination, maintenance, inspection and testing (EMI&T).

EQ refers to generation and maintenance of evidence to assure that equipment will operate on demand to meet system performance requirements, including environmental qualification, seismic qualification and performance testing and/or analysis.

Environmental conditions include the external environment and operational conditions. during normal operation and accidental conditions. The external environment include temperature, pressure, humidity, radiation, in the room or building where the component is located.

EQ environment room/building includes Reactor building, Safeguard building, Main Steam and Main Feed Water Valve room, Fuel Building, etc.

The seismic qualification ensures the equipment can operate during/after an earthquake.

EQ conditions should cover normal operations, maintenance, fault, and accident conditions commensurate with its safety classification for the duration of its operational life; The EQ performance such as flowrate, start-up time, mission duration should be considered under above conditions.

EQ related Management System and Quality Assurance (MSQA) include a provision that suitable qualified and experienced person (SQEP) deliver the EQ process and activities management, this should be implemented through the SSC's whole lifecycle from design, verification testing, manufacture, installation, commissioning to operation, including design assurance, modification management, Non Conformance Report management, etc.

EQ evidence includes all documents produced in the EQ process and activities.

EQ related relevant good practice (RGP) includes UK regulations, ONR Safety Assessment Principles (SAPs), ONR Technical Assessment Guides (TAGs), IAEA safety standard and industry guidance.

EQ related operating experience (OPEX), consider the experiences and feedback from nuclear plants in China and EDF. OPEX must be evaluated to ensure applicability to the UK HPR1000 SSCs.

EQ process and related activities can be divided into GDA phase and site phase.

According to the RO, CGN will demonstrate the EQ process and related requirements for the following SSCs:

- Medium Head Safety Injection (MHSI) pump;
- Residual Heat Removal exchanger;
- In-containment Refuelling Water Storage Tank (IRWST) strainer;
- Control rod drive mechanism (CRDM);
- RCP Pressure relief valve;
- RCP Severe accident dedicated valves (SADV);

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- Reactor coolant pump (RCP);
- DCL HEPA filter;
- Personal airlock and equipment hatch;
- ASG Containment isolation valves;
- VVP Main steam isolation valve;
- Emergency Diesel Generator.

### Deliverable Description

The main actions to be undertaken to resolve the RO are described as follows.

#### **RO-UKHPR1000-0048.A1 – Equipment qualification processes and procedures**

*In response to this Regulatory Observation Action (ROA), the RP should demonstrate how:*

- *EQ RGP requirements are managed for each stage of the UK HPR1000 lifecycle;*
- *EQ arrangements satisfy ONR's view of EQ RGP; and*
- *Any EQ RGP shortfalls identified are to be addressed, and by when.*

*The response to this ROA may be combined with any other ROA under this RO, if deemed appropriate.*

#### Resolution Plan:

CGN will collect the EQ related RGP, including IAEA safety standards, industry guidance etc., identify design, testing, manufacture, installation, commissioning, operation EQ related requirements, capture EQ related OPEX and undertake holistic review of UK HPR1000 EQ design and process against the RGP and OPEX, equipment qualification RGP compliance report will be submitted to ONR before 31<sup>st</sup> October 2020.

#### The Equipment qualification RGP compliance report will include:

- Main RGP list for EQ
- EQ RGP requirements for each stage of lifecycle
- EQ process/procedures compliance analysis against RGP and conclusion
- Gap analysis

The revised Equipment Qualification Methodology will be submitted to ONR before 30<sup>th</sup> November 2020.

#### The Equipment Qualification Methodology will include:

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- Equipment Qualification Scope
- Equipment Qualification Category
- Equipment Qualification Method
- Applicable Codes and Standards
- Conditions for Equipment Qualification
- Equipment Qualification Strategy
- Equipment Qualification Process
- Preservation of Qualified State
- Equipment Qualification Documentation
- SQEP management and Quality assurance

If there are other documents to update or produce according to the shortfalls/gaps identified in the equipment qualification RGP compliance report, the gap analysis section in the document will record and present plan to address them.

Deliverables:

- 1) Equipment qualification RGP compliance report (by 31<sup>st</sup> October 2020)
- 2) Equipment qualification Methodology (Updated by 30<sup>th</sup> November 2020)

Resources:

- 1) CGN: ME team, cross cutting team, systems engineer and equipment design engineer involved

**RO-UKHPR1000-0048.A2 – Demonstration of equipment qualification requirements**

*In response to this ROA, the RP should:*

- *Demonstrate how safety case EQ requirements, for the SSC's identified in this RO, are addressed by the design and achieved in practice. The response should demonstrate that a conservative approach has been used to determine the qualified life of SSCs taking account of:*
  - *Functional and non-functional safety considerations;*
  - *Environmental conditions in which plant must operate (i.e. “mild” and “harsh”\*);*
  - *Operational conditions;*
  - *Ageing and degradation;*
  - *Mission times where specific SSC performance requirements are required; and*
  - *EIMT to preserve EQ.*

*The response to this ROA may be combined with any other ROA under this RO, if deemed appropriate.*

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Resolution Plan:

For one single mechanical equipment, the EQ main related processes and key activities are as follows:

**1. EQ inputs**

EQ inputs include identification of equipment safety function, specify service conditions and define performance requirements. Identification of SSC's safety functions will be presented in the EQ schedule and will be submitted to ONR by 30th November 2020; The Environmental Requirements for the EQ will be submitted to ONR before 29<sup>th</sup> January 2021\*. The equipment safety function and performance requirements are also presented in the technical specification.

The EQ schedule will show the EQ golden thread and management for EQ process and configuration record. CGN will develop the EQ schedule based on the 12 typical components sampled to address this RO.

The EQ schedule for the 12 sampled components of ME might mainly include:

- System title (e.g. RIS),
- Item title (e.g. MHSI pump),
- Safety Function Requirement Code,
- Safety Function Description,
- EQ Design Input (e.g. Performance requirements),
- EQ Verification (e.g. EQ methods),
- EQ Implementation (e.g. requirements for manufacturing and evidence),
- EQ Preservation (e.g. requirements to preserve EQ during commissioning and operations).

Environmental Requirements for Equipment Qualification mainly include:

- Classification of Environmental Conditions,
- Normal Environmental Conditions,
- Accident Environmental Conditions,
- Severe Accident Environmental Conditions,

Note: \* *The Environmental Requirements for Equipment Qualification Report describes the harsh environmental conditions (high temperature, high pressure and/or radiation) induced by pipe break and large mass-energy release. For these harsh environmental conditions, both the thermal environmental conditions and the radiation conditions are derived from Design Basis Analysis (DBA) and Severe Accident Analysis (SAA), the relevant calculation for UK HPR1000 is still in progress, so the report is planned to be submitted in January 2021.*

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## 2. Establishing EQ

Establishing EQ includes: Defining EQ requirements, select method, qualification testing, define installation/maintenance requirements etc. In GDA phase, the main activity is to define the EQ requirements, qualification method and applicable technical and qualification specifications. Most of 12 typical equipment technical specifications and qualification requirements have been submitted to ONR. The related Technical and Qualification specifications will be updated by 29<sup>th</sup> January 2021 if needed as the RO progresses.

According to the activities and documents arrangement above, the documents in GDA phase are the followings.

### The technical specification mainly includes:

- Regulations and Standards,
- Function and Classification,
- Design requirements,
- Materials and Selection,
- Manufacturing and Inspection,
- Acceptance,
- Qualification Requirements,
- Packing and Shipment,
- The List and Requirements of Documents.

### The qualification requirement mainly includes:

- Applicable Documents,
- Quality Assurance,
- Equipment to be Qualified,
- Qualification Parameters,
- Qualification Items and Requirements,
- Requirements for Qualification Documents,
- EQ method.

Other activities are finished in detail design (out of GDA), such as qualification testing, definition installation/maintenance requirements. The related documents like EQ program/procedure/EQ report/EQ preservation sheet are also developed in detail design (out of GDA).

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### **3. Preservation of EQ**

Preservation of EQ includes activities that ensure qualified life of an SSC is assured throughout site based activities such as installation, commissioning, operation and EMIT.

In GDA phase CGN develop preliminary EMI&T requirements based on the concept design of the UK HPR1000. The proposed EQ schedule will record where future EQ preservation activities will be identified.

#### Deliverables:

- 1) EQ Schedule for the 12 sampled components of ME (by 30<sup>th</sup> November 2020)
- 2) Environmental Requirements for Equipment Qualification (by 29<sup>th</sup> January 2021)
- 3) EQ Schedule for the 12 sampled components of ME (Updated by 29<sup>th</sup> January 2021)

#### Resources:

- 1) CGN: ME team, cross cutting team, systems engineer and equipment design engineer involved

### **Impact on the GDA Submissions**

The outcome of the ROA1 RGP compliance analysis may lead to additional requirements for EQ. The impact on the UK HPR1000 safety case documentation will be established. The main documents are as follows:

PCSR V2 Sub-chapters:

PCSR Chapter 6: Reactor Coolant System

PCSR Chapter 7: Safety Systems

PCSR Chapter 10: Auxiliary Systems

PCSR Chapter 11: Steam and Power Conversion System

PCSR Chapter 23: Radioactive Waste Management

Safety Case Documents: ALARP reports for above PCSR chapters

Support Evidence Documents: System design manuals, Technical specifications, Qualification requirements, etc.

The accurate documents will be identified and revised in accordance with the corresponding actions as the RO progresses during GDA phase.

### **Timetable and Milestone Programme Leading to the Deliverables**

*Attach a Gantt chart to present the timetable and milestone of the RO resolution in APPENDIX A.*

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**Reference**

- [1] CGN, Equipment Qualification Methodology, GHX80000003DOZJ03GN, Rev. A, 2019
- [2] CGN, Technical Specification for Medium Head Safety Injection Pumps, GHX45200006DNHX44DS, Rev. B, 2020
- [3] CGN, Qualification Requirements for RIS Medium Head Safety Injection Pumps, GHX45200011DNHX44DS, Rev. A, 2019
- [4] ONR, EQ RGP presentation slides\_RM issue 2 Compliance feedback FINAL edit, 2020
- [5] CGN, RO- UKHPR1000-0021 Resolution plan, Rev.0, 2019



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APPENDIX A RO-UKHPR1000-48 Gantt Chart

Task and Schedule		2020												2021					
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	
<b>RO Action 1</b>																			
1	Development of deliverable - [Equipment qualification RGP compliance report]																		
2	Submission of deliverable - [Equipment qualification RGP compliance report]																		
3	Development of deliverable - [Equipment Qualification Methodology]																		
4	Submission of deliverable - [Equipment Qualification Methodology]																		
	Target ROA1 Closure																		
<b>RO Action 2</b>																			
5	Development of deliverable - [EQ schedule for the 12 sampled components of ME]																		
6	Submission of deliverable - [EQ schedule for the 12 sampled components of ME]																		
7	Development of deliverable - [Environmental Requirements for Equipment Qualification]																		
8	Submission of deliverable - [Environmental Requirements for Equipment Qualification]																		
9	Development of deliverable - [Updated EQ schedule for the 12 sampled components of ME]																		
10	Submission of deliverable - [Updated EQ schedule for the 12 sampled components of ME]																		
	Target ROA2 Closure																		
<b>Assessment</b>																			
9	Regulatory Assessment																		
10	Target RO Closure Date																		