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REGULATORY OBSERVATION Resolution Plan	
RO Unique No.:	RO-UKHPR1000-0010
RO Title:	Discharge estimates and limits
Technical Area(s)	Environmental
Revision:	0
Overall RO Closure Date (Planned):	2020-02-28
Linked RQ(s)	
Linked RO(s)	
Related Technical Area(s)	
Other Related Documentation	
Scope of Work	
<p><u>Background</u></p> <p>Based on the information presented in Pre-Construction Environmental Report (PCER) Chapter 6, V0 and its supporting documents:</p> <ul style="list-style-type: none"> • <i>OPEX data selected for quantification of discharges and limits for UK HPR1000, Rev B, and</i> • <i>Estimation of gaseous and liquid discharges and limits for UK HPR1000, Rev B,</i> <p>Environment Agency (EA) have started carrying out their detailed assessment and issued Regulatory Observation (RO)-UKHPR1000–0010 ‘Discharge estimates and limits’. In this RO, EA point out some gaps and clarify further their expectations on the three following aspects:</p> <ul style="list-style-type: none"> • Demonstration of the representativeness of Operating Experience (OPEX) data for the whole plant life-time; • The definition of headroom in line with their guidance on limits setting; and • The contribution of each constituent of normal operations to the discharge estimates. <p>The following actions are therefore defined in this RO:</p> <ul style="list-style-type: none"> • A1: Demonstrate that the OPEX used are representative of a full operational plant life time; 	

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- A2: Demonstrate that the calculation of discharges and proposed limits are in line with relevant Environment Agency guidance;
- A3: Show the contribution of each constituent of normal operations to the discharge estimates.

Scope of Work

General Nuclear System Limited (GNS) has reviewed RO-UKHPR1000–0010 and established the resolution plan presented hereafter to address the regulatory expectations identified in each of the above actions.

The scope of work related to this RO will be consistent with the scope of PCER Chapter 6, which focuses on quantification of UK HPR1000 radioactive gaseous and liquid discharges and setting associated limits, for normal operation of the plant.

To respond to the Regulatory Observation Actions (ROAs) of this RO, the following work will be carried out:


- a) Trend analysis of radioactive discharges of nuclear power plant during the life-time based on OPEX data from international PWRs;
- b) Adjustment of the definition of the headroom which will only cover the uncertainty of the underpinning data. The contribution of expected events will not be considered as part of the headroom factor anymore but presented separately;
- c) Provision of more evidence to underpin the correction factors applied in quantification of discharges and limits in PCER Chapter 6 V0 and its supporting documents;
- d) Adjustment of the presentation of the discharge estimates to clearly show the average monthly discharges during power operation and those during shutdown for refuelling, encompassing discharges from maintenance activities.

These tasks will be carried out during step 3, together with the existing PCER 06 V0 forward actions, including collection of additional OPEX data, analysis of expected events and refinement of the discharges and limits.

During the resolution of this RO, reports will be newly produced or updated to support the adjustments of the methodology and the results, and also to provide more evidence to demonstrate robustness of the proposed values, so as to be better aligned with EA’s expectations and guidance.

Deliverable Description

RO-UKHPR1000-0010.A1 – Demonstrate that the OPEX used are representative of a

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full operational plant life

In response to this Regulatory Observation Action, GNS should:

- a) *Demonstrate that the OPEX selected is likely to be representative of the full proposed operational life of a plant and not expected to be invalidated by any long term trends as the plant ages.*

Resolution Plan


While selecting OPEX data for use for UK HPR1000, GNS have decided to use CGN fleet OPEX data as it was an appropriate, well understood and comprehensive source of information.

GNS have also recognised that CGN fleet is quite young and therefore a preliminary analysis for the trend of radioactive discharges during life-time based on some representative international plants was undertaken when estimating the discharges and limits for PCER V0. The initial conclusions were that there appeared to be no obvious trend that could be linked to plant ageing.

To respond to action RO-UKHPR1000-0010.A1, this trend analysis will be formalised in a report to be used as evidence to prove that CGN OPEX data are appropriate and of sufficient breadth and depth to underpin quantification of UK HPR1000 discharges and limits. Publicly available OPEX data from International PWRs (See Table 1 below) and the analysis of these OPEX to identify discharge trends over time as plant ages will be presented in this report. The trend analysis will cover available PWRs OPEX (as relevant and appropriate) and will cover sufficiently long periods of operation, recognising that for some radionuclides/group of radionuclides this may be limited due to regulatory regime or operating practices having changed over time (e.g. some radionuclides are only monitored since a few years).

Table 1: OPEX data to be used in the trend analysis

No.	Nation	Site/Unit	Unit No.	Reactor Type	Electrical Power (Gross Power) (MWe)	Commercial Operation	OPEX Data Period
1	UK	Sizewell B	Unit 1	SNUPPS	1250	Sep-1995	1996-2017
2		Flamanville	Unit 1	P4	1382	Dec-1986	1987-2017
			Unit 2	P4	1382	Mar-1987	
3	France	Penly	Unit 1	P4	1382	Dec-1990	1991-2017
			Unit 2	P4	1382	Nov-1992	
4		Paluel	Unit 1	P4	1382	Dec-1985	1986-2017
			Unit 2	P4	1382	Dec-1985	

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			Unit 3	P4	1382	Feb-1986	
			Unit 4	P4	1382	Jun-1986	
5		St Alban	Unit 1	P4	1381	May-1986	1987-2017
			Unit 2	P4	1381	Mar-1987	
6	Germany	Emsland	Unit 1	Konvoi	1406	Jun-1988	1995-2017
7		Isar 2	Unit 2	Konvoi	1485	Apr-1988	1995-2017

The trend analysis will consist in:

- Identifying increase / decrease trends that seem “generic”, i.e. appearing across all the PWRs or across a relevant number of PWRs;
- Understanding and explaining, as far as possible, these trends (notably increase trends) based on available information;
- Concluding on the trends due to plant ageing and their applicability to UK HPR1000, if any.

Based on the final conclusions of this trend analysis, if any trend due to plant ageing is found, reasonable adjustments will be considered when developing discharges and limits of UK HPR1000 based on CGN fleet OPEX.


The report *Trend Analysis of Radioactive Discharges of Nuclear Power Plant During the Whole Life-time* will be produced and is proposed to be submitted to EA by the end of November 2019. It will provide the full analysis mentioned above. It will include the following information:

- The scope of the report, notably of the OPEX data considered in the analysis and verification;
- Trend analysis of the OPEX data and verification;
- Conclusion on whether there is any significant trend for increase in the discharges during the whole life-time.

RO-UKHPR1000-0010.A2 – Demonstrate that the calculation of discharges and proposed limits are in line with relevant Environment Agency guidance

In response to this Regulatory Observation Action, GNS should:

- a) *Demonstrate that the calculation of discharges and proposed limits are in line with relevant Environment Agency limit setting guidance;*

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b) Provide supporting evidence for each factor applied to the baseline data (power output, process differences, expected events, uncertainty).

Resolution Plan

During development of PCER V0, GNS analysed EA's requirements / expectations and limit setting guidance, notably on the definition of headroom. GNS have also studied the practice of previous GDAs and then decided, for PCER V0:


- to set expected discharges as discharge estimates, based on OPEX from CGN operating fleet with consideration of correction factors to account for design differences between UK HPR1000 and CGN operating fleet where and as relevant; and
- to include the contribution of expected events and the uncertainty/variability of the discharge underpinning data into headrooms to set the limits.

As a response to RO-UKHPR1000-0010.A2, GNS will adjust information presentation in PCER V1 and its supporting document *Estimation of Radioactive Gaseous and Liquid Discharges and Limits for UK HPR1000*, as follow:

- The discharges estimates (or annual discharges) will be presented as is currently the case;
- The headroom will be presented separately and will enable to account for the uncertainty and variability of the underpinning data as they are not UK HPR1000 data. This headroom will be determined by statistical analysis (standard normal distribution) of the underpinning data so as to ensure that the limits can provide reasonable margin to ensure enough flexibility for the future operator and not unduly affecting their ability to operate; and
- The expected events contribution will be provided separately.

Also, as presented in the Forward Action Plan (FAP) of PCER V0, the contribution of expected events will be further analysed and refined and the discharge estimates and limits will be refined during step 3. Also the correction factors presented in PCER06 V0 and its supporting documents, applied to OPEX data to reflect differences between UK HPR1000 and CGN fleet units, will be further substantiated.

PCER V0 will be updated to PCER V1 and the supporting document *Estimation of Radioactive Gaseous and Liquid Discharges and Limits for UK HPR1000* will also be updated for PCER V1 to reflect the above adjustments together with the relevant outcomes

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of PCER06 V0 FAP. In addition, more OPEX data from CGN fleet have been collected and will be fed into PCER V1 to support quantification of discharges and limits.

The updated report *Estimation of Radioactive Gaseous and Liquid Discharges and Limits for UK HPR1000* is to be submitted to EA by the end of November 2019.

PCER V1 will be produced consistently with this version of the report and will contain all necessary information for the public to understand how discharges and limits have been determined. It will be submitted by entry Step 4.

RO-UKHPR1000-0010.A3 – Show the contribution of each constituent of normal operations to the discharge estimates

In response to this Regulatory Observation Action, GNS should:

- *Show the contribution of each constituent of normal operations to the discharge estimates as required by the P&ID.*


Resolution Plan

During development of PCER V0, GNS analysed EA's requirements / expectations on the presentation of the discharge estimates, and studied the practice of the previous GDAs and thence decided to :

- Provide one value for average monthly discharges and one value for the maximum monthly discharges that cover all constituents of normal operation in PCER V0 and its supporting document *Estimation of Radioactive Gaseous and Liquid Discharges and Limits for UK HPR1000*.
- Provide CGN fleet discharge trends over a fuel cycle and comment these towards those expected for UK HPR1000, in the supporting document *OPEX Data Selected for Quantification of Discharges and Limits for UK HPR1000*.

As a response to RO-UKHPR1000-0010.A3, GNS will adjust the way the discharge estimates are calculated. The average discharge estimates during power operation (including contribution from maintenance activities carried out during power operation) and those during shutdown for refuelling (including contribution from maintenance activities carried out during shutdown for refuelling) will be provided in PCER V1 and its supporting documents *OPEX Data Selected for Quantification of Discharges and Limits for UK HPR1000* and *Estimation of Radioactive Gaseous and Liquid Discharges and Limits for UK HPR1000*.

Both of these updated supporting documents reflecting the adjustments mentioned above will be submitted to EA by the end of November 2019.

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PCER V1 will be produced consistently with this version of the reports and will contain all necessary information for the public to understand how discharges and limits have been determined. It will be submitted by entry Step 4.

Impact on the GDA Submissions

The information that will form part of the response to this RO will be incorporated into PCER Chapter 6 V1 and their supporting documents. The planning for submission of the documents that will provide the response to this RO is as follows:

Title of Submission	Related ROAs	Planned Submission Date
Trend Analysis of Radioactive Discharges of Nuclear Power Plant During the Whole Life-time	ROA1	2019/11/29
Estimation of Radioactive Gaseous and Liquid Discharges and Limits for UK HPR1000 (updated version)	ROA2 & ROA3	2019/11/29
OPEX Data Selected for Quantification of Discharges and Limits for UK HPR1000 (updated version)	ROA3	2019/11/29
PCER Chapter 06 V1	All ROAs	Step 4 Entry


For other PCER chapters that may be impacted by the resolution of this RO, e.g. PCER Chapter 7, Chapter 5 and Chapter 3, relevant information from the resolution of this RO will be incorporated in V1 of these chapters as relevant.

Timetable and Milestone Programme Leading to the Deliverables

A Gantt chart presenting the timetable and milestone of this RO resolution is provided in APPENDIX A.

Reference

None.

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APPENDIX A RO-UKHPR1000-0010 Gantt Chart

	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Apr-20
RO Action 1													
Development of deliverable-[Trend Analysis of Radioactive Discharges of Nuclear Power Plant During the Whole Life-time]													
Submission of deliverable-[Trend Analysis of Radioactive Discharges of Nuclear Power Plant During the Whole Life-time]									▲				
RO Action 2 & RO Action 3													
Development of deliverable-[Estimation of Radioactive Gaseous and Liquid Discharges and Limits for UK HPR1000 (updated version)]													
Submission of deliverable-[Estimation of Radioactive Gaseous and Liquid Discharges and Limits for UK HPR1000 (updated version)]									▲				
RO Action 3													
Development of deliverable-[OPEX Data Selected for Quantification of Discharges and Limits for UK HPR1000 (updated version)]													
Submission of deliverable-[OPEX Data Selected for Quantification of Discharges and Limits for UK HPR1000 (updated version)]									▲				
RO Action 1&2&3													
Development of deliverable-[Pre-Construction Environmental Report Chapter 6 Quantification of Discharges and Limits (V1)]													
Submission of deliverable-[Pre-Construction Environmental Report Chapter 6 Quantification of Discharges and Limits (V1)]											▲		
Assessment													
Regulators Assessment													
Target RO Cloure Date												▲	