

REGULATORY OBSERVATION

REGULATOR TO COMPLETE

RO unique no.:	RO-UKHPR1000-0009
Revision:	0
Date sent:	18/01/19
Acknowledgement required by:	08/02/19
Agreement of Resolution Plan Required by:	29/03/19
TRIM Ref:	2019/19011
Related RQ / RO No. and TRIM Ref: (if any):	RQ-UKHPR1000-0096 (TRIM 2018/156362)
Observation title:	Geotechnical Design Parameters
Lead technical topic: 2. Civil Engineering	Related technical topic(s): 5. Conventional Health & Safety 8. External Hazards 21. Environmental

Regulatory Observation

Background

The UK HPR1000 design reference plant, Fangchenggang Unit 3 (FCG3), currently under construction in China, is located on a hard rock site; as such this will be reflected in the design of the civil structures. It is not apparent that the significance of differences between ground conditions at the FCG3 site and potential UK sites has been suitably considered by the Requesting Party (RP). Furthermore, it is not clear whether the unique challenge posed by the London Clay at the Bradwell 'B' site will be adequately reflected in the generic design of the UK HPR1000. This includes any challenges posed to the overall deployment of the facility on a UK site, including design and construction considerations.

Regulatory Query RQ-UKHPR1000-0096 (Ref. 1) was raised during GDA Step 2 and queried the ground bearing capacity quoted in the RP's Generic Site Report Rev. 0 (Ref. 2). A consensus on the approach to demonstrate the UK HPR1000's suitability on a UK geology site was not agreed between ONR and the RP during Step 2 engagements (Ref. 3). The RP's response to RQ-UKHPR1000-0096 committed to address the issue in their updated Generic Site Report, at the end of Step 2 of GDA.

Following a review of the updated Generic Site Report Rev. 1 (Ref. 5), ONR's observations and concerns on the geotechnical parameters stated in RQ-UKHPR1000-0096 (Ref. 1) have not been adequately addressed. The soil bearing capacity selected to represent generic site soil properties is based on a Eurocode-specific approach, using a narrow field of parameters and assumptions which are not representative of a generic UK site, nor the Bradwell 'B' site. In addition, the compatibility of this Eurocode approach with the selected design codes for the UK HPR1000 has not yet been demonstrated. It is therefore unclear how the parameter defined in the generic site envelope is going to be used to demonstrate, during GDA, that the UK HPR1000 is deployable in the UK.

In addition, the RP's response to RQ-UKHPR1000-0096 (Ref. 1) states that the "*intention* [of the Generic Site Report] *is to derive a soil bearing capacity that is more specific to the Bradwell area, so it is not intended to envelope any other potential EN6 sites*". The updated Generic Site Report Rev. 1 (Ref. 5), under Section 7.3.1 – Soil Bearing Capacity states "*the potential candidate sites in the UK vary in geology from soil to rock, therefore a value for the UK HPR1000 Generic Site Envelope has been chosen using reference data to envelope the parameters*". It is therefore unclear to ONR what is being presented due to these contradicting statements.

In summary, the currently selected geotechnical design parameter in Generic Site Report Rev. 1 (Ref. 5) is not suitable to demonstrate that the plant is deployable in the UK, nor at the Bradwell 'B' site.

Relevant Legislation, Standards and Guidance

The requirement to develop a Generic Site Envelope during GDA Steps 2, 3 and 4 is stated in the ONR Guidance to Requesting Parties (Ref. 6). Further clarity on ONR's expectations for specifying generic site characteristics can be found in paragraphs 82 – 84 and Appendix 3 of the ONR Guidance to Requesting Parties (Ref. 6).

Expectations for Civil Engineering investigations are contained within the ONR SAPs (Ref. 7).

Engineering principles: civil engineering: investigations	Natural site materials	ECE.4
Investigations should be carried out to determine the suitability of the natural site materials to support the foundation loadings specified for normal operation and fault conditions.		

Engineering principles: civil engineering: investigations	Geotechnical investigation	ECE.5
The design of foundations and sub-surface structures should utilise information derived from geotechnical site investigation.		

As stated in ONR's Civil Engineering Step 2 Assessment Report (Ref. 4), the RP is not required to undertake intrusive ground investigations to support their design during GDA. However, it is expected that sufficient study work is undertaken to produce a generic design envelope which is representative of natural site materials to support the foundation loadings. The design of foundations and sub-surface structures should utilise appropriately bounding generic information to understand the attendant limitations such a choice may have on deployment of the UK HPR1000 within the UK.

In the preparation of the design for the UK HPR1000, consideration must be given by designers to the elimination, reduction or control of conventional (non-nuclear) foreseeable health and safety risks, so far as is reasonably practicable, as required by the CDM Regulations (Ref. 8) which are applicable to GDA. In the assessment of construction and plant, operational risks account should be taken of pre-construction information, for example site construction hazards (including ground conditions). Guidance on the CDM Regulations can be found in Ref. 9.

Regulatory Expectations

ONR's expectations are stated in the ONR Guidance to Requesting Parties (Ref. 6). Paragraph 112 states that for the ONR to issue a Design Acceptance Confirmation (DAC) to the RP it must be *"confident that, based on the GDA submissions, the design is capable of being built and operated in Great Britain, on a site bounded by the generic site envelope, in a way that is acceptably safe and secure."* Alternatively, during the post-GDA nuclear site licensing phase the prospective licensee's safety case submissions will need to address *"site-specific aspects not covered by the generic site envelope"*.

In addition, the ONR Guidance to Requesting Parties (Ref. 6) states *"the RP should specify the 'site envelope' within which the plant is designed to operate safely. The definition of the site envelope can be as broad or narrow as the RP wishes. However, it should be unambiguous and specify any site-related characteristics which have been explicitly included within or excluded from that definition."*

It is therefore imperative that the RP clearly defines an envelope of representative geotechnical parameters that can be used during GDA to demonstrate that the UK HPR1000 is suitable for deployment on a UK site. The RP should state which geotechnical parameters they intend to investigate post-GDA, and how they intend to demonstrate that they are bound by the generic site envelope.

Post GDA, the prospective licensee should be able to demonstrate that the geotechnical design parameters selected during GDA bound those at the proposed site.

References

1. RQ-UKHPR1000-0096, Ground Bearing Capacity in Generic Site Report, 25 June 2018 - Full Response; TRIM 2018/208136
2. UK HPR1000 Generic Site Report Rev. 0, HPR/GDA/REPO/0015, November 2017; TRIM 2017/422938.

3. ONR-NR-CR-18-216 Revision 0, UK HPR1000 GDA - Civil Engineering Level 4. Step 2 Technical Workshop; TRIM 2018/206046
4. ONR-GDA-UKHPR1000-AR-18-0005 Revision 0, GDA Step 2 Assessment of Civil Engineering of the UK HPR1000 Reactor Civil Engineering Step 2 AR; TRIM 2018/206452
5. UK HPR1000 Generic Site Report Rev. 1, HPR/GDA/REPO/0015, October 2018; TRIM 2018/320115
6. ONR New Nuclear Reactors: Generic Design Assessment Guidance to Requesting Parties, ONR-GDA-GD-001, Rev. 3. September 2016.
www.onr.org.uk/new-reactors/ngn03.pdf
7. ONR Safety Assessment Principles for Nuclear Facilities, Revision 0, 2014 Edition.
www.onr.org.uk/saps/index.htm
8. The Construction (Design and Management) Regulations 2015
www.legislation.gov.uk/ukxi/2015/51/contents/made
9. Managing health and safety in construction: Construction (Design and Management) Regulations 2015 Guidance on Regulations, HSE publication L153.
www.hse.gov.uk/pubns/books/l153.htm

Regulatory Observation Actions

RO-UKHPR1000-0009.A1 – Scope of Geotechnical Design Parameters in GDA

In response to this Regulatory Observation Action (ROA), the RP should identify the scope of work they intend to complete within GDA regarding geotechnical design parameters.

ONR would expect the RP to:

- Identify explicitly whether the geotechnical parameters specified in the Generic Site Report cover the full range of candidate sites (i.e. soil to rock) or solely Bradwell 'B' (i.e. London Clay).
- Provide a scope and programme for work to be undertaken during GDA which will demonstrate that the UK HPR1000 is deployable on UK sites, and specifically Bradwell 'B', using the geotechnical parameters specified in the Generic Site Report.
- Provide an indicative scope of post GDA work that will demonstrate if the site specific geotechnical parameters are enveloped by the parameters specified in the Generic Site Report. This should describe how site specific geotechnical parameters will be determined and the subsequent comparison exercise that will be undertaken against the GDA Pre-Construction Safety Report (PCSR) and supporting documents.

It is expected that the Generic Site Report is updated as part of this work.

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

Resolution required by 'to be determined by General Nuclear System Resolution Plan'

RO-UKHPR1000-0009.A2 – Methodology for use of Geotechnical Design Parameters

In response to this ROA, the RP should develop methodologies which can demonstrate that UK HPR1000 can be designed, constructed and operated using geotechnical design parameters representative of UK sites.

ONR would expect the RP to:

- Explain how geotechnical parameters specified in the Generic Site Report will be used during GDA to support the Civil Engineering safety case and show that they are sufficiently bounding.
- Develop a series of methodologies and supporting assumptions that will demonstrate how the geotechnical design parameters specified in the Generic Site Report will be used to demonstrate the deployability of the UK HPR1000 on a UK site. This should support all technical areas affected by geotechnical design parameters, including, but not limited to:
 - Justification for proposed nuclear island foundation and other principal structures;
 - Global stability of civil structures;
 - Deformation and settlement;
 - Bearing capacity;
 - Slope stability; and
 - Potential implications on construction.
- Develop methodologies which state how the specified geotechnical design parameters in the Generic Site Report will be used to support GDA work. Where outputs from different codes and standards are

being compared, values should be justified and their mutual compatibility demonstrated as per the ONR SAPs (Ref 7).

- Develop methodologies which identify anticipated safety margins and for areas where it is likely that these margins are unable to be achieved, identify available suitable ground remedial measures or improvement techniques.
- Clarify how assumptions made on the site specific parameters will be checked during post-GDA work to demonstrate that the site specific design is bound by the generic site envelope.

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

Resolution required by '*to be determined by General Nuclear System Resolution Plan*'

RO-UKHPR1000-0009.A3 – Demonstration of Suitability of Geotechnical Design Parameters

In response to this ROA, the RP should provide sufficient evidence on the output of the work identified in response to Actions 1 and 2 above. The evidence should suitably demonstrate that challenges relating to ground conditions, posed by the deployment of the facility on a UK site, have been suitably addressed by the UK HPR1000.

The extent of this demonstration should be defined by the RP, based upon the responses to Action 1 and 2. The RP should identify already planned deliverables or any new deliverables identified to meet ONR's expectations as described within this RO.

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

Resolution required by '*to be determined by General Nuclear System Resolution Plan*'

REQUESTING PARTY TO COMPLETE

Actual Acknowledgement date:

RP stated Resolution Plan agreement date: