REGULATORY OBSERVATION

REGULATOR TO COMPLETE

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Date sent:	02/03/2021
Acknowledgement required by:	11/03/2021
Agreement of Resolution Plan Required by:	22/03/2021
CM9 Ref:	2021/11046
Related RQ / RO No. and CM9 Ref: (if any)**:**	RQ-UKHPR1000-1409, RQ-UKHPR1000-1498, RO-UKHPR1000-0035.
Observation title:	Scope and Plan for Radiation Shielding Assessments for the UK HPR1000 Generic Design
Lead technical topic: 16. Radiological Protection	**Related technical topic(s):** 2. Civil Engineering 13. Management of Safety Quality Assurance 14. Mechanical Engineering 20. Structural Integrity

Regulatory Observation

Background

The primary objective of this Regulatory Observation (RO) is to state ONR's expectations for Generic Design Assessment (GDA) of the UK HPR1000, for the Requesting Party (RP) to provide suitable and sufficient evidence to demonstrate that radiation shielding provisions for openings, penetrations and local shielding are adequate to meet radiation zoning requirements, and are capable of minimising collective occupational radiation exposures and reducing them to As Low As Reasonably Practicable (ALARP).

ONR has received and assessed the RP's submissions: *Penetrations Shielding Design Report* [Ref. 1] and *Radiation Protection Design Principles of Opening Report* [Ref. 2] and raised several Regulatory Queries (RQ) [Ref. 3], relating to the RP's methods, assumptions, and other technical matters, as presented in Refs. 1 and 2. The RP's proposed responses to ONR's RQs have been discussed during routine technical Level 4 meetings [Ref. 4] in the Radiological Protection discipline. On the basis of ONR's assessment of Refs. 1 and 2 and our engagements with the RP on the topic of radiation shielding provisions for opening, penetrations and local shielding, the following gaps have been identified:

- Ambiguity regarding the RP's planned work for GDA to assess penetrations through bulk radiation shielding for the UK HPR1000 generic design, and the veracity of their assumption that this work can be completed post-GDA.
- The RP's shielding design reports [Ref.5] have been updated several times as GDA has progressed, such as the inclusion of additional areas and revised dose rates. Dose rates may increase further due to radiation streaming through penetrations, which is yet to be assessed by the RP for the UK HPR1000 generic design. Furthermore, the shielding design reports [Ref.5] do not clearly state the dose rates presented omit contributions from penetrations.
- A lack of evidence in Ref. 1 to demonstrate the RP's initial method for identifying and sealing penetrations is adequate. The RP is also intending to make significant changes to their initial method for identifying and assessing radiation shielding penetrations in the design, and will revise Ref. 1 as a result. During GDA, the RP will need to provide suitable and sufficient evidence to demonstrate their methodology is fit-for-purpose for the UK HPR1000 generic design.
- The RP has not provided any evidence, examples, nor operating experience (OPEX), to demonstrate the adequacy of the penetration shielding design, e.g. shield plates and angled penetrations, for either the UK HPR1000 generic design, or for the Reference Plant Design, Fangchenggang Unit-3 (FCG-3).

This RO has therefore been raised to articulate ONR's expectations regarding these shortfalls and to ensure they are addressed in a timely manner by the RP, during GDA.

Relevant Legislation, Standards and Guidance

The following summarises the relevant legislation, standards and guidance associated with this RO:

1. IRR17 Regulation 9 Restriction of exposure [Ref. 6] with specific regard for shielding provisions.
    a. Hierarchy of Control Measures (paragraphs 101 & 102).
    b. Types of Physical Control Measure (paragraph 104).
    c. Enclosure and Radiation Shielding (paragraphs 107 & 108).
2. Safety Assessment Principles [Ref. 7]
    a. RP.7 Hierarchy of Control Measures. Paragraph 584 makes reference to IRR17 Regulation 9(2) and establishes a hierarchy of control measures for restricting exposure (see above).
    b. RP.6 Shielding - Where shielding has been identified as a means of restricting dose, it should be effective under all normal operation and fault conditions where it provides this safety function. See paragraph 602(b) with specific regard to "incidence of localised levels of radiation due to streaming (e.g. through locations where the shielding is less effective)."
3. TAG-002 Radiation Shielding [Ref. 8] with specific regard to the following sections.
    a. Section 4.7 with respect to penetration shielding.
    b. Section 4.8 regarding movable shielding (e.g. shield doors).
    c. Section 5.30 regarding penetration shielding calculations.
    d. Section 5.31 with regards to identifying penetrations requiring shielding assessment.

Regulatory Expectations

The following summarises ONR's expectations with regards to the shielding assessments provided in support of GDA Step 4 with respect to the claims, arguments, and evidence approach, often employed in the UK-context to develop nuclear safety cases:

- Claims – It is recognised by the RP that adequate shielding provisions are required to support the claim that worker doses are restricted such that they meet legal limits and are ALARP.
- Arguments - The argument supporting this claim, is that the RP has Suitably Qualified and Experienced Personnel (SQEP) using suitable processes and methods to assess and specify adequate shielding provisions; however, it now appears that the RP is making significant changes to the penetration shielding methodology during GDA Step 4.
- Evidence – The samples submitted by the RP have provided a degree of confidence in the assessment of bulk shielding provisions. However, there remains a significant lack of evidence within the generic safety case documentation, to demonstrate the RP's ability to assess and deliver adequate shielding for penetrations and openings for the UK HPR1000 generic design.

The RP have submitted initial evidence in the assessment of bulk shielding, openings and local shielding provisions which has been sampled by ONR during GDA Step 4. However, there remains a lack of evidence within the generic safety case documentation, to demonstrate the RP's ability to assess and deliver adequate shielding of penetrations for the UK HPR1000 generic design.

When responding to this RO, ONR expects the RP to provide the following information, evidence and examples:

1. Clearly identify and justify what shielding assessments i.e. bulk shielding, openings, penetrations and local shielding, for the UK HPR1000 generic design, have already been completed and those planned to be completed both during, and post-GDA.

2. Clearly document the method(s) for identifying and assessing radiation shielding penetrations in the UK HPR1000 generic design and justify why they represent good practice and are fit-for-purpose. ONR would therefore expect to see suitable and sufficient evidence to demonstrate:

    a. The appropriate application of the method(s) selected to identify and assess penetrations requiring radiation shielding.

    b. The adequacy of radiation shielding penetrations assessment, e.g. shield plates and angled penetrations, for either the UK HPR1000 generic design, or the Reference Plant Design, Fangchenggang Unit-3 (FCG-3).

    c. Confidence in the RP's method for application of shielding techniques which are in line with the UK practices.

    d. That any increases in dose rates due to penetrations, openings and local shielding will not significantly impact radiation zoning or worker doses, for the UK HPR1000 generic design, and justify that doses are reduced to ALARP.

ONR recognises the RP has already developed and applied methods to assess radiation shielding provisions for the Reference Design, FCG-3, which *may* constitute adequate/applicable sources of evidence to respond to this RO. ONR also recognises a lot of further work on radiation shielding penetrations will be performed post-GDA, as part of the detailed design process.

Therefore, in response to this RO, ONR is not seeking the RP to extensively apply their method(s) for identifying and assessing radiation penetrations for the generic design. Overall, ONR is seeking confidence that for GDA, the RP's method(s) represent good practice, that all potential "significant" design modifications have been identified and that ONR has sufficient information on which to form a judgement as to whether radiation doses are capable of being reduced to ALARP.

References

1. GHX00100035DNFP03GN, GDA for UK HPR1000 – Penetrations Shielding Design Report, Revision A, 30/10/2019. CM9 2019/318410.
2. GHX90300010DNFP02GN, GDA for UK HPR1000 - Radiation Protection Design Principles of Opening Report, Revision A, 04/05/2020. CM9 2020/131324.
3. GDA Regulatory Queries:
    - RQ-UKHPR1000-1409, Queries regarding the Penetrations Shielding Design Report, GDA Regulatory Query, January 2021. CM9 2021/2388.
    - RQ-UKHPR1000-1498, Radiation Protection Design Principles of Opening Report, GDA Regulatory Query, February 2021. CM9 2021/11702.
4. ONR-NR-CR-20-905, UK HPR1000 Generic Design Assessment – Radiological Protection Level 4, 28th and 29th January 2021, ONR Contact Record, February 2021, CM9 2021/12851.
5. UK HPR1000 Shielding Design Reports:
    - GHX00100031DNFP03GN, GDA for UK HPR1000 – Reactor Building Shielding Design Report, Revision B, 05/03/2020.
    - GHX00100031DNFP03GN, GDA for UK HPR1000 – Reactor Building Shielding Design Report, Revision D, 22/01/2021.
    - GHX00100032DNFP03GN, GDA for UK HPR1000 – Nuclear Auxiliary Building Shielding Design Report, Revision B, 05/03/2020.
    - GHX00100032DNFP03GN, GDA for UK HPR1000 – Nuclear Auxiliary Building Shielding Design Report, Revision F, 01/02/2021
    - GHX00100033DNFP03GN, GDA for UK HPR1000 – Fuel Building Shielding Design Report, Revision B, 05/02/2020.
    - GHX00100033DNFP03GN, GDA for UK HPR1000 – Fuel Building Shielding Design Report, Revision D, 22/01/2021.

- GHX00100034DNFP03GN, GDA for UK HPR1000 – Safeguard Building Shielding Design Report, Revision B, 05/03/2020.
- GHX00100034DNFP03GN, GDA for UK HPR1000 – Safeguard Building Shielding Design Report, Revision E, 22/01/2021.

6. Work with Ionising Radiation, Ionising Radiations Regulations 2017, Approved Code of Practice and Guidance, L121, HSE Books, 2018. http://www.hse.gov.uk/pubns/priced/l121.pdf
7. Safety Assessment Principles for Nuclear Facilities, 2020 Edition, Revision 1, Office for Nuclear Regulation, 2020. www.onr.org.uk/saps/saps2014.pdf
8. NS-TAST-GD-002, Revision 8, ONR Guide on Radiation Shielding, http://www.onr.org.uk/operational/tech_asst_guides/ns-tast-gd-002.pdf

Regulatory Observation Actions

RO-UKHPR1000-0060.A1 – Radiation Shielding Assessment Scope and Delivery

Overall, in response to this Regulatory Observation Action (ROA), the RP should clearly identify and justify what shielding assessments i.e. bulk shielding, openings, penetrations and local shielding, for the UK HPR1000 generic design, have already been completed and those planned to be completed both during, and post-GDA. ONR would therefore expect the RP to:

- Provide a robust demonstration showing an appropriate balance has been struck between radiation shielding assessments planned to be delivered during and post-GDA, which minimises the potential impact on the UK HPR1000 generic design, with respect to physical design modifications.
- Clearly define what radiation shielding assessments will be undertaken post-GDA and provide details of the methods intended to be used, supported by adequate evidence/examples of similar radiation shielding assessments previously undertaken e.g. for FCG-3, where applicable, and to justify their applicability to UK HPR1000.
- Clearly identify where new radiation shielding assessment work will be undertaken and where updates to existing assessments are planned.
- The RP should therefore provide suitable and sufficient evidence to demonstrate that any increases in dose rates due to future assessments will not significantly impact radiation zoning or worker doses, and justify that doses are reduced to ALARP.
- Provide delivery dates for submission to ONR, for any outstanding radiation shielding assessments planned to be submitted during GDA.

RO-UKHPR1000-0060.A2 – Suitable and Sufficient Evidence for Radiation Shielding Provisions for Penetrations

Overall, in response to this ROA, the RP should clearly document the method(s) for identifying and assessing radiation shielding penetrations in the UK HPR1000 generic design and justify why they represent good practice and are fit-for-purpose. The RP should therefore provide suitable and sufficient evidence to demonstrate:

- The appropriate application of the method(s) selected to identify and assessing penetrations requiring radiation shielding.
- The adequacy of radiation shielding penetrations assessments, e.g. shield plates and angled penetrations, supported by OPEX, and examples from their application to FCG-3 and/or other plants the RP may justify as being applicable.
- The RP's method application of shielding techniques for penetrations which are in line with the UK practices.

REQUESTING PARTY TO COMPLETE	
Actual Acknowledgement date:	
RP stated Resolution Plan agreement date:	