

REGULATORY OBSERVATION

REGULATOR TO COMPLETE

RO unique no.:	RO-UKHPR1000-0029
Revision:	0
Date sent:	10/01/20
Acknowledgement required by:	31/01/20
Agreement of Resolution Plan Required by:	28/02/2020
CM9 Ref:	2019/363968
Related RQ / RO No. and CM9 Ref: (if any):	RQ-UKHPR1000-0015 (CM9 Ref. 2017/462111) RQ-UKHPR1000-0466 (CM9 Ref. 2019/265673) RQ-UKHPR1000-0467 (CM9 Ref. 2019/284971)
Observation title:	Internal Fire PSA
Lead technical topic:	Related technical topic(s):
15. Probabilistic Safety Analysis	12. Internal Hazards

Regulatory Observation

Background

ONR expects the safety case for new reactors to include a suitable and sufficient internal hazard Probabilistic Safety Analysis (PSA) that adequately represents the design of the facility, is realistic, uses modern approaches and covers the full scope of risks. To this end, ONR is seeking to gain confidence in GNS's plan and approach for updating the modelling of the internal fire PSA for the UK HPR1000 design.

ONR has reviewed the internal fire PSA submitted by the requesting party (RP) and has found gaps in the scope of the modelling and the approaches used. This is an important issue because the level of risk represented by internal fires to the design may be significant, but unless the scope is significantly wide the internal fire PSA will not be able to demonstrate the level of risk arising from this hazard. While the response to RQ-UKHPR1000-0015, 0466 and 0468 [1, 2 and 3] have provided some useful information it has become clear that there remain areas of internal fire PSA modelling that need to be performed during GDA in order for the scope of the PSA to be comprehensive enough to understand the level of risk from internal fires. These gaps are:

- Absence of sufficient level of detail and scope regarding detailed fire modelling;
- Absence of multi-compartment analysis;
- Absence of consideration of the effect of fires on nearby power and control cables;
- Absence of explicit consideration of multiple spurious operations due to fires at 'pinch-points' in the design; and
- Absence of information showing how the ignition frequencies have been evaluated and how ignition source counts and transient influencing factors have been established.

This regulatory observation has therefore been raised to:

- Explain ONR's regulatory expectations regarding the scope and content of modelling of internal fires in the PSA;
- Ensure that the Requesting Party (RP) provides a suitable and sufficient plan for updating the internal fire PSA to include consideration of the identified gaps during GDA timescales.

Relevant Legislation, Standards and Guidance

ONR Safety Assessment Principle (SAP) [4] FA.12 expects that the PSA model presents an adequate scope and be performed to a depth deep enough to cover all significant sources of radioactivity.

PSA should cover all significant sources of radioactivity, all permitted operating states and all relevant initiating faults.

The ONR PSA Technical Assessment Guide (TAG) [5] provides further details of ONR's expectations for analysis of Internal Fires in the PSA models for the UK HPR1000, in particular Table A.1-2.7.2.

Regulatory Expectations

ONR's regulatory expectations are that the internal fire PSA's scope should include a wide enough scope such that the consideration of hazards are sufficient so that the PSA model can demonstrate the level of risk represented by the design to the public from internal fires, in line with the guidance noted above. In response, ONR would therefore expect the RP to provide information which should:

1. Demonstrate that all relevant detailed fire scenarios (including but not limited to the MCR) have been included in the internal fire PSA;
2. Demonstrate that multi-compartment fires have been considered in the internal fire PSA
3. Demonstrate that cable-routing has been considered in the internal fire PSA;
4. Demonstrate that multiple spurious operations due to fires at 'pinch-points' in the design have been included in the internal fire PSA;
5. Demonstrate the evaluation of fire compartment ignition frequencies has been performed to an acceptable level, appropriate for the internal fire PSA

References

[1] *Clarification of PSR Section 14.3.1.2.3 - Fire PSA Cable Modelling*, RQ-UKHPR1000-0015, CM9 2017/462111

[2] *High Priority Fire PSA Queries*, RQ-UKHPR1000-0466, CM9 2019/265673

[3] *Other Internal Fire PSA Queries*, RQ-UKHPR1000-0468, CM9 2019/267111

[4] *Safety Assessment Principles for Nuclear Facilities, 2014 Edition, Revision 0*, Office for Nuclear Regulation,

2014. www.onr.org.uk/saps/saps2014.pdf

[5] *Nuclear Safety Technical Assessment Guide, Probabilistic Safety Assessment, NS-TAST-GD-030 Revision 6*, Office for Nuclear Regulation, 2019.

www.onr.org.uk/operational/tech_asst_guides/index.htm

[6] *Nuclear Safety Technical Assessment Guide, Probabilistic Safety Assessment, NS-TAST-GD-063 Revision 4*, Office for Nuclear Regulation, 2017.

www.onr.org.uk/operational/tech_asst_guides/index.htm

Regulatory Observation Actions

RO-UKHPR1000-0029.A1 – Demonstrate that detailed fire modeling has been performed to an acceptable level appropriate for the internal fire PSA

In response to this Regulatory Observation Action, GNS should:

- Demonstrate that detailed fire modeling has been performed to an acceptable level in the internal fire PSA. This may be addressed by updating the extant internal fire PSA, or by issuing a new separate report during GDA timescales.
 - It is expected the detailed fire modelling to be performed on all fire compartments quantitatively screened in and to provide evidence the steps provided in NUREG/CR-6850 guidance Section 11 have been evaluated.
 - For the MCR in addition to the abandonment analysis, the other steps provided in NUREG/CR-6850 guidance Section 11.5.2 need to be performed.
 - For the MCR need to provided evidence that explicit Main Control Board modeling has been performed using guidance provided in NUREG/CR-6850 guidance Section 11.5.2 and Appendix L.

- For the detailed fire modeling (this includes the MCR) need to fully evaluate consequences from suppressed fires.
- All assumptions need to be justified, this includes the credited system availability and reliability factors, and automatic / manual detection and suppression times.

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

RO-UKHPR1000-0029.A2 – Demonstrate that multi-compartment analysis has been considered in the internal fire PSA

In response to this Regulatory Observation Action, GNS should:

- Demonstrate that MCA scenarios have been considered in the internal fire PSA. This may be addressed by updating the extant internal fire PSA, or by issuing a new separate report during GDA timescales.
 - Show evidence that MCA has been performed in accordance with NUREG/CR-6850 guidance Section 11.5.3 and quantitatively evaluate the risk.
 - The interfacing barriers between fire compartments need to be reviewed and barrier feature need to be counted in order to determine a barrier failure probability, this should include consideration for random barrier failure.

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

RO-UKHPR1000-0029.A3 – Demonstrate that cable routing has been considered in the internal fire PSA

In response to this Regulatory Observation Action, GNS should:

- Demonstrate that cable routing has been considered in the internal fire PSA. The extant assumption that there will be no consequences beyond the fire compartment boundary (i.e. cable routing for each fire compartment is self-contained or fire compartments are large enough such that cables crossing from one fire compartment to another fire compartment is unlikely) is considered overly optimistic and does not meet ONR expectations. This action may be addressed by updating the extant internal fire PSA, or by issuing a new separate report during GDA timescales.
 - The cable routing for PSA components must be established based on a credible source, e.g. the design reference plant (FCG3) cable layout or detailed analysis of the electrical design.

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

RO-UKHPR1000-0029.A4 – Demonstrate that multiple spurious operations due to fires at 'pinch-points' in the design have been included in the internal fire PSA

In response to this Regulatory Observation Action, GNS should:

- Demonstrate that multiple spurious operations due to fires at 'pinch-points' in the design have been included in the internal fire PSA. This may be addressed by updating the extant internal fire PSA, or by issuing a new separate report during GDA timescales.
 - Evidence needs to be presented that a systematic process has been exercised to identify fire scenarios which could lead to multiple spurious operations. The resulting consequences need to be incorporated in the PSA model, along with appropriate fire frequency estimation.

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

RO-UKHPR1000-0029.A5 – Demonstrate the evaluation of fire compartment ignition frequencies has been performed to an acceptable level appropriate for the internal fire PSA

In response to this Regulatory Observation Action, GNS should:

- Demonstrate that ignition frequency evaluation has been performed to an acceptable level in the internal fire PSA. This may be addressed by updating the extant internal fire PSA, or by issuing a new separate report during GDA timescales.
 - Explanation of how the fixed ignition sources have been counted and the reference(s) used to determine the number and type of ignition source found in each room. (e.g. equipment layout drawings, equipment datasheets).

- Describe the process and inputs used when assigning transient influencing factors to each fire compartment.
- Show the intermediate steps and results of the frequency calculation to allow the frequency calculation to be fully verified and to ensure the generic per plant basis ignition frequencies has been preserved.

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:	