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REGULATORY OBSERVATION Resolution Plan	
RO Unique No.:	RO-UKHPR1000-0018
RO Title:	Substantiation of HRA Inputs in PSA Model
Technical Area(s)	PSA
Revision:	0
Overall RO Closure Date (Planned):	2021-02-28
Linked RQ(s)	RQ-UKHPR1000-0236;RQ-UKHPR1000-0253;RQ-UKHPR1000-0254
Linked RO(s)	-
Related Technical Area(s)	Human Factors
Other Related Documentation	-

Scope of Work

Background and Regulator's Expectations

The Requesting Party (RP) has submitted the Internal Events Level 1 Probabilistic Safety Assessment (PSA) report (Ref. 1) for the UK HPR1000. Chapter 9 is related to the human reliability analysis for Type A, Type B and Type C human actions. This includes the assumptions made, identification of actions, quantification and dependency analysis.

ONR expects that the safety case for new reactors will include a suitable and sufficient Probabilistic Safety Analysis (PSA) that adequately represents the design of the facility, that is realistic and that uses relevant data which are suitably underpinned. In particular, ONR is seeking to gain confidence in the RP's plan and approach for the modelling of human reliability in the PSA for the UK HPR1000 generic design assessment (GDA).

Although the RP has already responded to RQ-UKHPR1000-0236, 0253 and 0254 which have provided some useful information, they broadly rely on future reports and analysis, and thus at present, ONR expects to see:

- Justification of the source of data to be used in Human Error Probabilities (HEPs) assessment and demonstration that it is suitably underpinned.

- Justification of how the relevant standards for modelling human reliability have been applied and how the methodology follows industry-accepted practices.

There is a gap between regulatory expectations and the Requesting Party (RP)'s submissions, which needs further work to be done by the RP to ensure that the Human Reliability Analysis (HRA) meets UK expectations during Generic Design Assessment (GDA). These works are described in the resolution plan of RO-UKHPR1000-0018.

Description of the Response and of the Scope of Work

This resolution plan provides a response to the gap on Human Reliability Analysis used in Internal Events Level 1 PSA in order to provide the required justifications, including:

a) Information to demonstrate that the HRA methodologies and approaches used in the UK HPR1000 PSA are substantiated and appropriate for use in the UK HPR1000 PSA.

b) Inputs to the HRA to model the HEPs including Type A, B and C human errors, and substantiate those are useable and suitable.

c) Demonstration that the quantification of the human error probabilities used in the UK HPR1000 PSA is well documented, the inputs are clearly traceable back to the underlying analysis, has been performed correctly, is underpinned by proportionate task decomposition and analysis as is in accordance with justified HRA method/s selected by the RP and quality checked.

Deliverable Description

RO-UKHPR1000-0018.A1 – Demonstrate the Validity of the HRA Methods

The Regulatory Observation Action 1 states that:

General Nuclear System Limited should

- *Provide an adequate justification to demonstrate that the the methods and approaches used to create the HEPs modelled in the UK HPR1000 PSA are suitable and sufficient for use in the safety case, and meets ONR's regulatory expectations.*

- *Provide adequate substantiation with enough examples for GDA to demonstrate that the inputs to the UHPR1000 PSA HRA are suitable and sufficient for use in the safety case and meet ONR's regulatory expectations.*

Description of planned work:

For this action, the following steps will be taken to demonstrate the validity of the HRA methods used in the Internal Events Level 1 PSA model.

a) An analysis will be performed to compare the HRA methods (Accident Sequence Evaluation Program (ASEP) for Type A, Technique for Human Error Rate Prediction (THERP) for Type B and Standardized Plant Analysis Risk Human Reliability Analysis (SPAR-H) for Type C) to justify that they meet the requirements set out in ASME/ANS RA-Sb-2013 (Ref. 2). This

analysis will be made up of the following aspects:

1) Identification;
2) Recovery factor analysis;
3) Qualitative analysis;
4) Quantification;
5) Dependency analysis.

b) An evaluation of the Performance Shaping Factors (PSF) following industry-accepted practices on Human-Computer Interaction.

c) An update the *Methodology of Human Reliability Analysis* (Revision B) will be performed in order to include the analyses performed in steps a) and b) (to be submitted in February 2020).

d) Provide traceable links of the HRA inputs used in the Internal Events Level 1 PSA to demonstrate that these inputs are suitable and sufficient.

In response to this Regulatory Observation Action, the RP will provide the following documents:

1) *Methodology of Human Reliability Analysis*, Revision B (to be submitted in February 2020);
2) *Human Reliability Analysis for Internal Events Level 1 PSA*, Revision A (to be submitted in February 2020).

RO-UKHPR1000-0018.A2 – Demonstrate the Validity of the HRA Quantification

The Regulatory Observation Action 2 states that:

- *General Nuclear System Limited should provide adequate substantiation to demonstrate that the quantification of the human error probabilities used in the UK HPR1000 PSA is transparent, has been performed correctly, is underpinned by proportionate task decomposition and analysis is in accordance with justified HRA method/s selected by the RP and quality checked.*

Description of planned work:

For this action, the RP's response is:

a) For Type A

For all the modelled Type A human actions, four recovery factors are identified by the system

designer and will be provided as input to do HRA Quantification.

All Type A human error probabilities will be calculated using the ASEP method.

b) For Type B

The HEP of each subtask or action will be calculated by combining the HEPs (calculated using THERP) for errors of omissions, commissions and recovery.

All Type B human error probabilities will be calculated according to THERP method.

c) For Type C

Type C human error probabilities will be quantified using the SPAR-H method, this will include the following steps:

Step 1: Perform a qualitative analysis for each of the Type C human action.

Step 2: Perform a proportionate Tabular Tasks Analysis to highlight the major steps involved in the task and estimate the duration of the task.

Step 3: Chose some sample accident senarios to validate the task duration using the simulator.

Step 4: Document and evaluate the PSF multipliers based on the SPAR-H methodology and supplementary criterion.

Step 5: Perform a quantification of the HEP.

Step 6: To make a detailed dependency analysis.

Except for the Step 3, the above process and information are contained in the new version of *Human Reliability Analysis for Internal Events Level 1 PSA* (to be submitted in February 2020).

For Step 3, "Risk significant HBSCs HF V&V reports" will be issued to validate the task durations on the FCG3 simulator. (Revision A, to be submitted in October 2020).

Impact on the GDA Submissions

The updated information will be incorporated into the following documents:

- To be added in the submission list:

  1) *Methodology of Human Reliability Analysis*, Revision B, 28/02/2020

  2) *Risk significant HBSCs HF V&V reports*, Revision A, 30/10/2020 (Human Factor discipline)

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- Already in the submission list:

  1) *Human Reliability Analysis for Internal Events Level 1 PSA*, Revision A, 28/02/2020

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.

Reference

[1] *Internal Events Level 1 PSA*, GHX00650001DOZJ02GN, Rev. A, CGN, October 2018, CM9 Ref. 2018/350941

[2] *ASME, Addenda to ASME/ANS RA-S 2008, Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications, ASME/ANS RA-Sb–2013, 2013*

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APPENDIX A RO-UKHPR1000-0018 Gantt Chart

Task and Schedule	2019			2020												2021	
	30-Sep	30-Nov	31-Dec	31-Jan	29-Feb	31-Mar	30-Apr	31-May	30-Jun	31-Jul	31-Aug	30-Sep	31-Oct	30-Nov	31-Dec	31-Jan	28-Feb
RO Action 1																	
Development of deliverable-[Methodology of Human Reliability Analysis]																	
Submission of deliverable-[Methodology of Human Reliability Analysis]					▲												
Development of deliverable-[Human Reliability Analysis for Internal Events Level 1 PSA]																	
Submission of deliverable-[Human Reliability Analysis for Internal Events Level 1 PSA]					▲												
RO Action 2																	
Development of deliverable-[Human Reliability Analysis for Internal Events Level 1 PSA]																	
Submission of deliverable-[Human Reliability Analysis for Internal Events Level 1 PSA]					▲												
Development of deliverable-[Risk significant HBSCs HF V&V reports]																	
Submission of deliverable-[Risk significant HBSCs HF V&V reports]													▲				
Assessment																	
Regulatory Assessment																	
Target RO Close Date																	▲