**Technical Support – Work Order Specification**

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| **Title: UK HPR1000 Generic Design Assessment – Independent Review of PSA Submissions** |
| 1. Background to the project

In January 2017 the UK Government formally asked ONR and EA to begin the GDA of the UK HPR1000. The UK HPR1000 is a reactor design proposed for deployment at Bradwell-on-Sea, Essex. General Nuclear System LTD (GNS) is a UK-registered company that was established as the Requesting Party (RP) to implement the GDA on the UK HPR1000 reactor on behalf of three joint requesting parties, i.e. China General Nuclear Power Corporation (CGN), EDF and General Nuclear International (GNI).The GDA process calls for a step-wise assessment of the RP’s safety and security submissions with the assessments increasing in detail as the project progresses. Step 1 of the UK HPR1000 GDA commenced in January 2017 and Step 2 finished in November 2018. Step 3 commenced thereafter and will last for approximately 13 months. Step 4 is currently planned to last for 24 months, starting in December 2019.To support its assessment, ONR requires a meaningful review of the submitted body of work related to PSA. Considering the size and number of the methodologies, models and analysis reports, ONR needs to be supported by external contractors of suitable qualification and experience in PSA.The RP has begun to submit a body of work addressing the probabilistic safety analysis (PSA) topic area including methodologies, models and analysis reports. This body of work will address:* internal events Level 1 PSA
* internal events Level 2 PSA
* spent fuel pool PSA
* internal fire PSA
* internal flooding PSA
* external hazards PSA

ONR will assess the evidence by conducting in-depth reviews, on a sampling basis, of the PSA models, data, documentation and supporting analyses, to get confidence that the claims and arguments are underpinned by robust evidence, that the PSA meets ONR’s regulatory expectations and that it has been used to appropriately inform the design.The purpose of this contract is therefore to provide ONR with an independent view on the adequacy, or otherwise, on a sample of the submitted body of work in PSA for the UK HPR1000 against relevant ONR and international standards and guidance. This is expected to be undertaken in two phases:* Phase 1: Based on the RP’s submitted body of work, responses to regulatory questions and the contractor’s own knowledge and experience; conduct a review of the methods, selection of initiating events and success criteria against relevant good practice.
* Phase 2: Using the results of Phase 1’s review, conduct a thorough review of selected aspects of version 1 of the UK HPR1000 PSA against relevant good practice, based upon a scope of review agreed with ONR.
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| 1. SCOPE OF THE SERVICES REQUIRED

SCOPE of WorkONR is seeking technical service resources of a small team of PSA experts for steps 3 and 4 of GDA, who are experienced in Risk Spectrum, have expertise and experience in all areas of PSA including hazards PSA and are familiar with PWR PSAs to review the UK HPR1000 PSA and provide advice to ONR of shortfalls found against relevant good practice (RGP) and international PSA standard methods. ONR is not seeking a review of the design or the results/insights of the UK HPR1000 PSA.ONR has received or will shortly be receiving the ‘Version 0’ Risk Spectrum PSA models, PSA methodologies and analysis reports for all operating conditions including low power and shutdown for the following areas:* Level 1 internal events PSA;
* Level 2 PSA;
* internal fire PSA;
* internal flooding PSA;
* spent fuel pool (SFP) PSA
* seismic PSA (methodology during Step 3, models in Step 4); and
* external hazard PSA.

The work will be performed in two phases.**Phase 1**During phase 1, the TSC will review the PSA methodologies, selection of initiating events (IEs) and success criteria via sampling each of the above PSA areas and comparing against RGP. The sample reviewed will be of sufficient breadth and depth such that they reflect a full review of all aspects of the PSA, while still being efficient and not an exhaustive review of the entire PSA. ONR will designate a portion of the areas to review and will expect the TSC to propose a portion to review. The portions to be reviewed will be agreed with ONR and cover a range of operating states. This decision will be completed at the initial meeting after the contract is awarded. Phase 1 is expected to last for approximately one year, and cover most of GDA Step 3, although it may overlap the beginning of Step 4.The advice provided to ONR after the TSC has reviewed the submitted body of work will be used to inform what areas will be reviewed in more detail during Phase 2.For Phase 1, the scope of the TSC services include review of the following deliverables, culminating in a final report summarising the scope of the review, the areas of strength and weakness of the RP’s submissions against the expectations set out in ONR and international guidance, an indication of the safety/risk significance of these findings, and advice to ONR on areas to focus regulatory attention:* Level 1 PSA:
* selection of the initiating events;
* the Level 1 PSA methodologies (including validity of data used); and
* the Level 1 success criteria.
* Level 2 PSA:
* the Level 2 PSA methodology;
* the Level 2 selection of phenomenon assessed; and
* the definition of the release categories and assumptions.
* SFP PSA:
* Selection of the initiating events;
* SFP PSA methodology; and
* SFP PSA success criteria.
* Fire PSA, flooding PSA, seismic and external hazard PSA:
* the methodologies for each type of PSA;
* specific areas of hazard PSA initial approaches such as designation and modelling of fire areas, modelling of flood levels and zones, etc. These will be discussed in the initial meeting with the TSC and agreed with ONR ; and
* the success criteria.

**Phase 2**During Phase 2, the TSC will conduct in depth review of five samples of the L1/L2 PSA and 2 samples each of the fire, flood, external hazard, SFP and seismic PSAs against RGP. The fifteen samples will be determined based on the conclusions of the Phase 1 final report and agreement with ONR. The TSC’s in depth review will review each sample (e.g. starting at an IE in an event tree (ET) and then reviewing all parts of the ET, associated fault trees (FTs), human reliability analysis (HRA), common cause failures (CCFs), assumptions, success criteria, modelling approach, accuracy of modelling, etc.). At the conclusion of Phase 2, a formal report will be required, summarising the scope of the review, the areas of strength and weakness of the RP’s submissions against the expectations set out in ONR and international guidance, an indication of the safety/risk significance of these findings, and advice to ONR on areas to focus regulatory attention. Phase 2 is expected to start at the beginning of 2020 and conclude by April 2021 in time for input to the Step 4 assessment report for PSA. For Phase 2, the scope of the TSC services include review of:* Level 1 PSA:
* five event trees from initiating event through to plant damage states; and
* five system fault trees.
* Level 2 PSA:
* five Level 1 – Level 2 link event trees,
* five containment event trees; and
* five of the Level 2 PSA system analysis fault trees.
* SFP PSA:
* two event trees from initiating event through to fuel damage states; and
* two system fault trees.
* Fire PSA, flooding PSA, seismic and external hazard PSA:
* Two sampled areas of each hazard PSA models - to be determined prior to start of Phase 2 with input from TSC (eight samples total).

**OUT OF SCOPE**The following areas are considered out of scope for this contract:* review of UK HPR1000 design
* review of PSA insights or results identified by the RP
* comparison of PSA results with the ONR SAP numerical targets
* decision on whether the design is ALARP
* how PSA has informed the design
* independent PSA confirmatory modelling
* review the transient analysis that has been used to produce PSA success criteria (however the success criteria used in the PSA models are not out of scope)

**WORK BREAKDOWN**The work will be completed in two phases over Steps 3 and 4 of GDA. In Phase I, the contractor is required to:* On a sampling basis, perform a wide review of the submitted version 0 PSA body of work based on the contractors own knowledge and experience, and to provide advice to ONR on the adequacy of the selection of initiating events, methodologies and success criteria in all areas of the PSA. The purpose of the review is to assist ONR in making a judgement of the adequacy of the submissions against relevant ONR and international standards and guidance, for example:
* ONR NS-TAST-GD-030
* ONR SAPs
* IAEA Specific Safety Guide, SSG-3 (2010)
* IAEA Specific Safety Guide, SSG-4 (2010)
* IAEA TECDOC 1511, etc.
* Participate in meetings as described below.
* Raise requests for additional information and documentation from the RP (via ONR), and review the responses. Assume a minimum of 6 weeks for a response from the RP to any requests for additional information.

In Phase 2, the contractor is required to:* Perform deep review of the outlined sections of the version 1 of the PSA as described above. The selection of which areas to be reviewed will be decided via agreement between the ONR PSA inspector and the contractor. The findings of the Phase 1 final report will be used as input into the selection decision. The purpose of the Phase 2 review is to assist ONR in making a judgement of the adequacy of the submissions against relevant ONR and international standards and guidance, as outlined above.
* Participate in meetings as described below.
* Raise requests for additional information and documentation from the RP (via ONR), and review the responses. Assume a minimum of 6 weeks for a response from the RP to any requests for additional information.

**INPUTS*** The documentation will be available to the contractor in electronic format. The reports are in .pdf format and the PSA models are Risk Spectrum files. In addition, some parts of the PCSR will be supplied if necessary, but the PSA documentation is considered self –sufficient for this contract.

**DELIVERABLES*** Along with the standard monthly progress reports required to show the work progress each month, a monthly update of the PSA findings log. This should be discussed during the monthly progress meetings. The findings log should be a live document that is regularly updated and records all findings that the contractor observes. The PSA inspector will use this information during monthly meetings with the RP.
* A summary workshop of one day to discuss the preliminary findings of the shortfalls and key findings for Phase 1 will be required by the end of July, 2019. The findings presented will be used as input in the PSA inspector’s Step 3 summary report for the end of Step 3.
* A summary workshop of two days to discuss the preliminary findings of the shortfalls and key findings for Phase 2 will be required by the end of April, 2021. The findings presented will be used as input in the PSA inspector’s Step 4 assessment report.
* A formal report summarising the key findings from review of all of the PSA submissions will be required at the end of each phase of work. The report for phase 1 will be used as input to selecting those areas to perform deep review during phase 2. The report for phase 2 will be used as input to the PSA inspector’s Step 4 assessment report. The Phase 2 report will also require a risk gap assessment included to provide context to the contractor understanding of the significance of findings and shortfalls. These reports will undergo one round of comments from ONR and be released to the RP.
* In addition to the formal reports, the contractor can raise technical questions with the RP (via ONR), which can be used to request additional information or documentation to support the review.

**TIMESCALES*** The following timescales can be assumed:
	+ Start of contract: 04/19
	+ Phase 1 review: 01/04/19 until 01/09/19
	+ Phase 1 preliminary findings meeting: end of July, 2019
	+ Phase 1 draft final report due: 31/09/19
	+ Phase 1 final report due: 31/11/9
	+ Phase 2 review: 01/12/19 until 31/12/20
	+ Phase 2 preliminary findings meeting: end of February, 2021
	+ Phase 2 draft final report due: 28/02/21
	+ Phase 2 final report due: 30/04/21
* The key project milestones and delivery dates will be agreed and fixed when the contract is awarded.

**MEETING REQUIREMENTS*** ONR expect a kick-off meeting to be held on contract award. This should include an introduction of the contractor’s team and background/experience in the different PSA topics. This meeting will take place either at the ONR offices, or the contractor offices.
* Monthly progress meetings should also be assumed between the contractor and ONR for the duration of the contract. These should be assumed to be by teleconference or videoconference.
* At the end of July, 2019, a one day summary meeting will be required for the contractor to present key findings and shortfalls for Phase 1. This meeting will take place either at the ONR offices, or the contractor offices.
* At the end of February, 2021, a two day summary meeting will be required for the contractor to present key findings and shortfalls for Phase 2. This meeting will take place either at the ONR offices, or the contractor offices.
* During the course of the review there may be the need to attend meetings with the RP. This could be face-to-face in Liverpool or London, or via videoconference. For planning purposes assume five separate half-day meetings in Phase 1 and ten separate half-day meetings in Phase 2 on a monthly basis with the RP during the course of the contract to attend in person. The TSC is also expected to accompany ONR at one week-long workshop late in Step 3, and one week-long workshop in mid-Step 4 in China where questions can be discussed directly with CGN.
* A close-out meeting will be held upon completion of the contract. This meeting will take place either at the ONR offices in Cheltenham, or the contractor offices. Videoconference facilities are also available if necessary.
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| 1. OBJECTIVES

In summary, the required outcomes of this work are for two formal reports at the end of each phase of work which will document the findings and conclusions from an independent technical review of evidence presented by the RP. Ultimately the contractor should provide their view on whether the PSA is adequate against UK regulatory expectations and international good practice, and identify any shortfalls and their significance.The objectives of the work for this contract are for Step 3s and 4 of the GDA. For Step 3 the review of the PSA is intended to be a wide review of the PSA, focused on methodologies and key aspects of the PSA that will provide advice for an in-depth sample of important areas to be performed during Step 4. During Step 4 a risk gap assessment of the findings will be expected to provide the contractors’ independent opinion on the significance of the findings. |
| 1. CONSTRAINTS

The following constraints will apply:* The work is expected to start and conclude in accordance with the overall timescales given above, and a project programme will be agreed with the contractor upon contract award.
* ONR will provide the latest versions of any relevant documentation submitted by the RP. Further information will need to be identified and requested by the contractor through technical questions (via ONR). The timescales for both of these processes are largely outside of ONR’s direct control and therefore delays to the receipt of information may occur. Similarly the quality of any response cannot be guaranteed. A pragmatic and flexible approach will need to be adopted by the contractor to deal with this, both technically and contractually.
* It is expected that the successful contractor will also draw upon their experience, resources and publically available information to perform this work.
* All information received from the RP will need to be treated in accordance with the ONR Technical Support Contact Framework agreement and non-disclosure agreement. The information or a certificate of destruction will need to be returned to ONR at the end of the contract.
* The arrangements for security vetting and IT security established in the Technical Support Contract framework agreement will need to be followed. No information with a security marking above UK OFFICAL - SENSITIVE is anticipated as part of this contract. Most information will carry the RP’s commercial marking.
* The contractor and where applicable, its sub-contractors, will need to provide assurances that it has, or is able to obtain, all necessary export control licenses, where required to transfer relevant information out of the UK and return it.
* The transmittal of all documents between ONR and the contractor will be through ONR's Joint Programme Office (JPO). This will be through encrypted DVDs, regardless of the security marking (unless the documents are publically available on the internet).
* Any conflict of interest should be declared. Where a potential conflict exists, the contractor should describe how this will be managed.
* The aim of this work package is to inform and advise ONR. However, it is ONR’s intention to brief the RP on the conclusions of the work. The RP will be provided with copies of any reports produced for information and will be invited to comment on their factual accuracy.
* It is not ONR’s intention to publish the final report or memos produced through this contract. However, it is likely they will be referenced in publically available reports and therefore subject to freedom of information requests. This should not constrain or limit the produced reports but should be taken into account with the style and format.
* Any constraints in relation to completing this work should be declared. Where such constraints exist, the contractor should describe how these will be managed. Examples of such constraints, include, but are not limited to, constraints imposed by code developers/owners on the use of their codes or the availability or use of third-party information.
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| 1. CONTRACT MANAGEMENT

ONR will require to be kept updated about progress and delivery of the required work in accordance with the Framework arrangements. This should include monthly meetings and a contract start-up meeting at ONR’s offices, or the contractors’ offices.  |
| **TECHNICAL RESPONSE** |
| 1. Response

The Technical Response should demonstrate a clear understanding of the work required.Please provide: * a description of how you will deliver the scope of work (methodology) and the proposed delivery team you will use, clearly signposting to relevant sections within your Capability Prospectus where appropriate/relevant ;
* a description of proposed deliverables and/or outputs
* an outline of anticipated engagement (project meetings & management)
* details of proposed cost and associated effort assumptions
* a project delivery plan showing activities and milestones
* a planned invoice schedule
* details of any assumptions or constraints
* details of the team expertise in all areas of PSA including Level 1, Level 2, SFP, internal hazards, external hazards, seismic PSA, and in Risk Spectrum
* details of your familiarity with PWR PSA
* experience working with nuclear regulators, in the UK or internationally
* experience developing PSA models and reviewing PSA models developed by other organisations
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