

Assessing new nuclear reactor designs

Generic Design Assessment Periodic Report
May 2016 – October 2016

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1 INTRODUCTION AND BACKGROUND

1. This report provides information on the work that we have been carrying out on our Generic Design Assessments (GDA) of Hitachi-GE's UK Advanced Boiling Water Reactor (UK ABWR) and Westinghouse's AP1000® reactor for the period May – October 2016. The period of this report has been extended as we have been reviewing the format and content, in light of the current readership and development time. For future editions we will provide a report focused on the GDA metrics with a reduced narrative. We will also continue to publish our assessment reports, Regulatory Observations (ROs), Regulatory Issues (RIs) and their resolution plans and operate the public comments process.
2. For the UK ABWR project we continue with intensive assessment, and with a year remaining in our anticipated schedule are moving towards finalising any significant safety case issues and identifying any final matters that may require additional work and / or design enhancements. There are technical issues outstanding and a large volume of work remaining; however Hitachi-GE continues to respond well and at this juncture we consider the project stable overall, and are confident in Hitachi-GE's projected completion date of December 2017.
3. Of note this period is the closure of Regulatory Issue RI-01 (identification and justification of source terms), which represents the completion of new analyses and clarity on the hazard. This is a commendable achievement by Hitachi-GE and will help Horizon Nuclear Power in the future stages of the project.
4. The Environment Agency is continuing to carry out its assessments and starting consultation on its findings so far on 12 December 2016. Natural Resources Wales (NRW) is also working towards this consultation. The Environment Agency and NRW considers that a statement of design acceptability (SoDA) in December 2017 is achievable.
5. For the AP1000 project, we are seeing the results of Westinghouse's revised management arrangements for the UK GDA project. In all areas there is agreement on the technical scope of work required to address the GDA issue. The improved oversight is helping to progress matters and to secure and maintain the resource it needs to deliver the project. Overall submissions are improving however there are instances where further revisions are needed to meet regulatory expectations.
6. There are concerns about the volume of work still to be assessed by ONR in the remaining time. Westinghouse has submitted first revisions of documents in all areas and multiple revisions in some areas. However, there are technical issues arising from our assessments and in some areas, the compression of the schedule is a significant challenge to us.
7. For the HPR1000 GDA, we have met with General Nuclear Systems (GNS) as the potential GDA Requesting Party (RP) a number of times in the period. GNS is a joint venture between China General Nuclear (CGN) and EDF, developed to deliver the Bradwell project. Our interactions have focused on ensuring that the

RP is ready to commence the GDA and has met the 'pre-requisites' identified in our 'Guidance to Requesting Parties' <http://www.onr.org.uk/new-reactors/ngn03.pdf>.

8. Our view is that the potential RP is in a good position to commence GDA, and we await a request from Government to commence the process.
9. ONR has part-time seconded a principal inspector to the Department of Business, Energy, Infrastructure and Strategy (BEIS), to provide technical and regulatory input to its development of a competition to identify the best value small modular reactor design for the UK.
10. If you have any comments on this report, please send them to us at new.reactor.build@onr.gsi.gov.uk.
11. To find out more about GDA, ask a question or make a comment about reactor designs visit <http://www.onr.org.uk/new-reactors/>
12. To receive the latest news and information on GDA, subscribe to our e-bulletin by visiting www.onr.org.uk/newreactors/ebulletin.htm

2 GDA of the UK ABWR

2.1 Progress update

13. This period has been one of intensive regulatory assessment as the project progresses through Step 4. Our focus is now on trying to finalise major safety case developments and/or design changes, to try to ensure that Hitachi-GE can address the issues in the remaining programme time.
14. Hitachi-GE has made commendable progress in the period. It continues to deliver and is maintaining a high pace of work. To date over 1900 submissions have been made to the regulators.
15. Of note during this period is the closure (in October) of RI-01 relating to the identification and justification of source terms. This is the culmination of a large amount of new work by Hitachi-GE, which has provided clarity on the hazard and is key to both Hitachi-GE and Horizon developing the safety submissions going forward.
16. The issue of seismic modelling methodology that we highlighted in our last report has been resolved. Good progress has also been made in mechanical engineering, with a number of the earlier ROs reaching conclusion and now due for closure.
17. The spent fuel export issue also highlighted in our last report continues, although some progress has been made. Hitachi-GE has submitted the final versions of its as low as reasonably practicable (ALARP) and optioneering studies and we are currently assessing them. We have engaged additional technical expertise to provide input to our assessment, and we expect to be able to reach a conclusion and discuss our findings with Hitachi-GE in November 2016.
18. Within this period we have received the majority of the major submissions in probabilistic safety assessment (PSA). Some of the PSA results are not what we expected and we are working with Hitachi-GE to understand these. Aligned to this we are interested in better understanding hydrogen management relating to severe accident conditions in the spent fuel pool and during shutdown. We are working with Hitachi-GE to resolve these issues.
19. In June 2016 we undertook a project wide review, which aimed to ensure that all major technical issues and challenges are identified and understood with clear resolution in place. In addition we considered the viability of meeting the December 2017 closure date. Twelve key questions were posed to the lead inspectors in each technical area, and a red, amber, green (RAG) status was allocated to each question. There is a project report detailing the outcome of this review. In summary, 69% of all questions across the topic areas were awarded a green status, 30% amber and 1% red (which was later determined to be anomalous). The topics/questions allocated amber have been analysed further and the root causes addressed.
20. A follow-up inspection to the review was undertaken in October, to examine the adequacy of management system arrangements (including procedures and



monitoring arrangements) and their implementation at both a corporate level and for a sample of topic areas. This inspection concluded that there were no widespread process deficiencies. ONR did note that Hitachi-GE could benefit from some enhancements in the way they deal with expectations outside Japanese experience; although we recognise that significant effort has been made in this area.

21. Our delivery confidence for this project is green/amber, which means that successful delivery remains probable, however constant attention from both Hitachi-GE and the regulators is required to ensure that risks do not materialise into major issues threatening delivery. Hitachi-GE shares our view of delivery confidence. Overall we are confident that completion of the GDA by the end of December is achievable.
22. An update on the one outstanding issue (RI-02 relating to PSA) is provided in the 'metrics detail' section of this report.
23. 280 Regulatory Queries (RQs) and six ROs have been issued during this period and no RIs.
24. Six ROs and one RI have been closed during this period.

2.2 Meetings in period

25. In total 146 meetings have taken place; 23 of which were project focused and 123 technical.

2.3 Public and stakeholder engagement and communications

26. Within the period there were three comment posted on the Hitachi-GE comments website. The total number submitted to the end of October is 64; 63 of which have been responded to at the end of October.
27. We have continued to promote the comments process to our stakeholders and communities at conferences, events and meetings, including its closure date of 15 August 2017. We have also used our websites and e-bulletins to drive our stakeholders to the comments process website. The Environment Agency and NRW are consulting on their assessment findings so far from 12 December 2016 to 3 March 2017. The consultation plans were informed by our Sciencewise project and by talking to stakeholders in areas where Horizon propose to construct UK ABWRs.

2.4 Enhanced collaborative working – Hitachi-GE and Horizon Nuclear Power

28. During this period the tripartite way of working on safety case matters, involving Hitachi-GE, Horizon and the regulators, has continued, with progress meetings held in May, July and September 2016. The tripartite meetings continue to be productive and informative, and they foster cooperation and understanding of

regulatory expectations across both projects (UK ABWR GDA and Wylfa Newydd licensing).

29. A tripartite workshop was held in July 2016 for Hitachi-GE and Horizon to present to the regulators the work that they have done to develop individual pre-construction safety report (PCSR) chapter specifications for the generic GDA, and Wylfa Newydd site-specific PCSRs (we had reported in the previous quarterly report that this collaborative work was ongoing). Both sets of specifications have now been shared with ONR.
30. The Joint Safety Case Office (JSCO) continues supporting PCSR production and alignment between the GDA and Wylfa Newydd site specific PCSRs. The current focus is on human factors, decommissioning, emergency preparedness and operations and maintenance. A joint safety case steering group has been established as a combined (Hitachi-GE and Horizon) advisory body on safety case strategy and delivery.
31. Three-way keep-in-touch meetings are held every two weeks with participation of Hitachi-GE’s subject matter experts in Japan, Hitachi-GE’s GDA project managers and safety case leads in the UK, and Horizon’s technical topic leads and PCSR chapter leads. These meetings address resolution of technical matters key for the completion of GDA and integration with Wylfa Newydd site-specific safety case.
32. Horizon’s technical topic leads and PCSR chapter leads are scheduled to undertake a mid-term review of the updated draft GDA PCSR in November 2016. This will be coordinated by the JSCO.

2.5 Technical Support Contracts

33. Between 1 May 2016 and 31 October 2016, the regulators awarded the following technical support contracts (TSC) relating to the UK ABWR project.

Contractor	Topic	Project Title	Contract Value
NNL	Reactor Chemistry	Additional Work on Iodine and Fission Product Chemistry	£28,113.60
ABS Consulting	External Hazards	Assessment Support for External Hazards	£208,984.00
TUV SUD Nuclear Technologies	Radiation Protection	Step 4 Review of Radiological Protection of the Hitachi-GE UK ABWR	£212,312.23
AMEC	PSA	Provision of Containment Structural Analysis – ABWR Level 2 PSA	£128,921.40

Contractor	Topic	Project Title	Contract Value
Frazer Nash	Structural Integrity	Provision of TSC Support for Review of UK ABWR SI Topics During Step 4	£197,821.76
CRA	Human Factors	Assessment of Step 4 Human Based Safety Claims and Reliabilities for the UK-ABWR	£144,955.20
Altran	C&I	Step 4 C&I Assessment Support (Embedded Contractor)	£669,272.40

2.6 Summary of Regulator Charges

Office for Nuclear Regulation:

- Charges for the period May 2016 – October 2016 - £4,907,093.28
- Cumulative charges - £21,769,779

Environment Agency:

- Charges for the period May 2016 to October 2016 - £752,982
- Cumulative charges - £3,818,788

Natural Resources Wales

- Charges for the period May 2016 to October 2016 - £ 78,141
- Cumulative charges - £ 167,910

2.7 Metrics Summary

GDA Metrics Definitions

Category 1 (Programme)	Category 2 (Quality of submissions)
<p>Red – Significant slippage against the baseline programme has occurred, with delays highly unlikely to be recoverable. Successful completion of the step in accordance with the regulators Baseline Programme will require the programme to be re-baselined and the target dates changed (via Change Control).</p> <p>Amber – Some slippage against the baseline programme has occurred, with delays capable of being recovered. Prompt action is required to ensure that there is an improvement in delivery in order to successfully complete the step in accordance with the regulators Baseline Programme.</p> <p>Green – Activities are generally on plan to successfully deliver the current step in accordance with the regulators Baseline Programme.</p> <p>Blue – Activities are ahead of plan to successfully deliver the current step in accordance with the regulators Baseline Programme.</p>	<p>Red - For the current Step, submissions are significantly below expectations in terms of scope and/or quality. The regulators will require significantly improved submissions to support their assessment.</p> <p>The regulators should explain what is required to meet their expectations.</p> <p>Amber - For the current Step, submissions are below expectations in terms of scope and/or quality. The regulators will require submissions to be updated/revised to support their assessment.</p> <p>The regulators should explain what is required to meet their expectations.</p> <p>Green - For the current Step, submissions have generally met the expected scope and quality.</p> <p>Blue - For the current Step, submissions have exceeded the expected scope and quality.</p> <p>Grey – No submissions received during the period.</p>
Category 3 (Quality of interactions)	Category 4 (Regulatory Observations/Issues progress)

<p>Red – Communications and interactions have been significantly below expectations, in terms of clarity, openness, or technical content. This has resulted in a high degree of ambiguity and/or a lack of confidence in the other parties’ intentions. The values in the Regulatory Nuclear Interface Protocol (RNIP)¹ have been compromised.</p> <p>Amber - Communications and interactions have been below expectations in terms of clarity, openness, timeliness or technical content, This has resulted in a degree of ambiguity and a lack of confidence in the other parties’ intentions. Some aspects of the RNIP have been challenged</p> <p>Green - Communications and interactions have met expectations, resulting in confidence in the other parties’ intentions.</p> <p>Blue – Communications and interactions have exceeded expectations, resulting in a high degree of confidence in the other parties’ intentions</p>	<p>Red - Submissions are not addressing the Regulatory Observation / Regulatory Issue (RO/RI) and immediate action is required to ensure the successful completion of the RO/RI.</p> <p>There is a high risk that further RO/RI or associated Actions may be raised or transferred to a GDA Issue(s)</p> <p style="text-align: center;">OR</p> <p>The draft RO/RI Res Plan cannot be agreed even after several discussions and revisions of drafts</p> <p>Amber - Submissions are not fully addressing the RO/RI and action may be required to ensure the successful completion of the RO/RI.</p> <p>There is a risk that further RO/RI or associated Actions may be raised or transferred to a GDA Issue(s)</p> <p style="text-align: center;">OR</p> <p>The draft RO/RI Res Plan is under development but will require further revisions to enable agreement</p> <p>Green - The RO/RI is likely to be closed; Submissions are addressing the RO/RI</p> <p style="text-align: center;">OR</p> <p>The draft RO/RI Res Plan is under development and is on track to be agreed</p> <p>Blue - No RO/RI Issued</p> <p style="text-align: center;">OR</p> <p style="text-align: center;">The RO/RI has been closed</p>
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¹ The Regulatory Nuclear Interface Protocol (RNIP) and the associated ways of working, is a standard protocol that has been introduced to maximise the effectiveness of ONR, Environment Agency, licensee, and requesting party relationships

	Civil Engineering						External Hazards						Security						Internal Hazards						Mechanical Engineering						Structural Integrity											
Category 1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						
Category 2	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						
Category 3	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						
Category 4	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						
Category 5 - Emerging Issues	N	N	Y	N	N	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N						
	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O
	Fault Studies						Fuel Design						Human Factors						C&I						PSA						Severe Accident											
Category 1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						
Category 2	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						
Category 3	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						
Category 4	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						
Category 5 - Emerging Issues	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	Y	N	N	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	N						
	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O
	Conventional Safety						Fire Safety						Radiation Protection						Rad Waste						Decommissioning						Spent Fuel Interim Storage											
Category 1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						
Category 2	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						
Category 3	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						
Category 4	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						
Category 5 - Emerging Issues	N	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N						
	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O
	Reactor Chemistry						MSQA						Chemical Engineering						GEP						Electrical Engineering						Rad Cons											
Category 1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						
Category 2	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						
Category 3	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						
Category 4	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y						
Category 5 - Emerging Issues	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	Y	N	Y	N	N	N	N	N	N	N	N	N						
	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O

2.8 Metrics Detail

2.8.1 Civil Engineering

34. During this period Hitachi-GE focussed on resolving RO-ABWR-0068 (RO-68). RO-68 records ONR's concern on the use of lumped mass beam models to determine the effects of Soil Structure Interaction (SSI) on seismically qualified structures. Two Hitachi-GE reports on seismic design methodology and validation were submitted to ONR in October and we are currently assessing them. ONR has agreed in principle to a revised 'two-step' finite element analysis approach that Hitachi-GE has proposed.
35. We are working to resolve the matters in RO-68, before progressing the civil design work for all affected structures. Hitachi-GE has revised the scope of civil engineering GDA submissions following changes to its programme. The bulk of ONR assessment work will now take place between November 2016 and April 2017. The final ABWR GDA completion date remains achievable.
36. Our assessment of the Aircraft Impact Assessment (AIA) submissions are unaffected by RO-68 and it continues to progress. There has been a minor issue on the AIA work due to revised impact profiles and the requirements for an additional load case. The full implications of the omission are yet to be established.

2.8.2 External Hazards

37. Hitachi-GE continues to meet its programme and the quality of the submissions is adequate overall.
38. Hitachi-GE continues to work on RO-ABWR-0067 on the subject of the treatment of beyond design basis (BDB) hazards. We have assessed a submission on BDB external flooding and have no further issues on it. We are assessing a submission on electro-magnetic interference (EMI) for the generic site envelope and have raised a corresponding RQ. Meetings have also been held to discuss and agree an additional intentional aircraft crash load case; and work on this case is being undertaken by Hitachi-GE.
39. External hazards and cross-cutting meetings took place the week beginning 26 September in Japan. Topics discussed included enthalpy, EMI, combinations of hazards and aircraft impact assessment.

2.8.3 Internal Hazards

40. Hitachi-GE has issued several topic reports in a number of technical areas. There are some gaps and a number of detailed RQs have been raised. Hitachi-GE is working to improve the evidence that underpin a number of its topic reports.

41. ONR's assessment work has focused on Hitachi-GE's documentation in the areas inside the reinforced concrete containment vessel; exceptions to segregation and the case on turbine disintegration and potential impact with key buildings (two draft ROs have been developed).
42. Hitachi-GE has further reviewed its planned document submissions with the aim of reducing the number of submissions. It has also reviewed and confirmed the suitability and sufficiency of its internal hazards resources to deliver the Step 4 submissions. This should improve the efficiency and effectiveness of the ONR assessment process.
43. Two workshops in Japan in June and September included cross-cutting meetings with civil engineering, external hazards, fault studies, control and instrumentation (C&I), mechanical engineering, structural integrity and reactor chemistry. These highlighted the progress made by Hitachi-GE on a large number of cross-cutting topics such as barrier substantiation; application of the single failure criterion; service tunnels; the link between fault studies and internal hazards; combined events and turbine disintegration.
44. Internal hazards is the lead in the ONR assessment of spent fuel export case involving several technical disciplines. RO-ABWR-0056 was raised in order to make clear ONR expectations regarding the demonstration of optioneering for the removal of spent fuel from the reactor building, which would form part of the overall ALARP justification for the UK ABWR fuel route.
45. A number of technical interactions including workshops took place during the period and ONR issued a letter in May on the suitability and sufficiency of the optioneering study. Hitachi-GE updated the optioneering study and re-issued it together with an ALARP justification in September 2016. These documents are currently being considered by ONR.
46. ONR has been delayed in securing additional TSC support, which is why the relevant metric deteriorated in October.

2.8.4 Mechanical Engineering

47. During the reporting period Hitachi-GE has made reasonable progress in mechanical engineering; providing ONR with a high volume of Step 4 submissions for assessment. A number of submissions in response to ROs and RQs have been received throughout September and October, which we are assessing.
48. Assessment has been targeted on Hitachi-GE's progress in developing adequate arrangements to close out its open mechanical engineering ROs. At the beginning of the reporting period, concerns were raised regarding the quality of submissions in support of RO closure. Hitachi-GE has since prepared a status report against each open RO providing a clear route map of activities to achieve closure. Hitachi-GE explained its proposed report structure and contents at the last technical

workshop, which provided a level of assurance that it now understands expectations.

49. In support of RO-ABWR-0051 closure, Hitachi-GE submitted a number of equipment qualification plans. Although strong in some areas there were gaps and Hitachi-GE has committed to update them to align with UK relevant good practice.
50. During this reporting period ONR attended a technical workshop in Japan, which resulted in a number of topics converging towards closure.
51. A technical workshop took place to discuss spent fuel export from the fuel storage pond and subsequently a revised submission was received. ONR required further clarification from Hitachi-GE on the use of the reactor building crane to lower a fuel flask 21m; particularly if it contains damaged fuel. ONR set out the UK expectations for Hitachi-GE's ALARP optioneering submission.

2.8.5 Structural Integrity

52. RO-0059 was closed in the period. Closure documentation for selected actions from RO-002 to 004 has been received and is being assessed.
53. RO-0034 and RO-0035 are continuing to progress with Hitachi-GE producing a large amount of documentation. There are some gaps in the information provided against ONR's expectations, which are being addressed via interdisciplinary meetings with the reactor chemistry discipline.
54. Structural integrity continues to be involved in the assessment of canister and impact limiter concept design for spent fuel export. ONR considers that the concept design presented is adequate to demonstrate that the structural integrity of the canister can be maintained through the spent fuel export process. Optioneering and ALARP decisions are continuing in this area for related disciplines.
55. ONR has appointed a structural integrity technical support contractor. The TSC is now reviewing selected documents to aid the ONR assessment process.

2.8.6 Security

56. During the reporting period, Hitachi-GE's draft of revision C of the conceptual security arrangements has been assessed and feedback provided. RQs have been raised in areas of access control and concept of security operations, to clarify and seek further explanation of Hitachi-GE's understanding of some concepts and standards. Meetings have been held to determine Hitachi-GE's understanding and interpretation of cyber threats and to examine its arrangements to mitigate these threats. Assessment has been undertaken with C&I inspectors to understand Hitachi-GE's philosophy for determining a bounding

case for a design basis cyber threat, and their approach to cyber threat assessments.

57. In September, Hitachi-GE submitted the final version of Revision C of the conceptual security arrangements. Our initial assessment indicates that Hitachi-GE has responded positively to the feedback provided on the draft version. This assessment will continue. There have been no new or emerging issues during the period.

2.8.7 Probabilistic Safety Assessment (PSA)

58. During this period, Hitachi-GE has submitted revised versions of the internal events PSA for the reactor and the spent fuel pool, prioritisation of hazards and containment performance analysis. These revisions should address the shortfalls identified by ONR's initial review of the January 2016 submissions. Hitachi-GE has also submitted a fuel route and dropped loads PSA and a probabilistic assessment of tornado missile and turbine missile. The submission of the revised seismic PSA, internal fire and flooding PSAs was delayed to August 2016. In addition, Hitachi-GE has presented a process to review the impact of design changes in the PSA.
59. ONR has completed most of the review of the January 2016 internal events PSA, prioritisation of hazards and seismic PSA. ONR has also reviewed the information presented in the containment performance analysis submission. The outcomes of the review were shared with Hitachi-GE in August/September 2016. A workshop was held in October 2016 to discuss what additional work is required in GDA to address outstanding issues and to close the PSA ROs and RI-ABWR-002 in the coming months. For many of the technical issues discussed, Hitachi-GE provided valid arguments during the workshop that ONR will need to verify by reviewing the June 2016 PSA, or the additional information and sensitivity analysis committed by Hitachi-GE. There are outstanding issues in all the technical areas of the PSA, of different levels of importance. The issues that could potentially be more significant are a containment performance analysis for the UK ABWR and a demonstration that the risks are ALARP. Further discussion with Hitachi-GE regarding the ALARP demonstration is planned for November 2016.
60. Hitachi-GE is working on a programme of additional PSA documentation updates and submissions between October 2016 and the end of GDA, including a demonstration that the UK ABWR risk is ALARP, and the impact analysis of outstanding issues on the risk profile. The additional work committed by Hitachi-GE will be submitted to ONR at the end of January/February 2017.
61. ONR's review of the internal fire and flooding PSA is ongoing and a workshop with Hitachi-GE is planned in November 2016 to discuss the review outcomes.
62. Overall, on the basis of the outcomes of the ongoing reviews, the work submitted to date and the technical discussions during progress meetings and workshops

with Hitachi-GE, ONR has confidence that Hitachi-GE is moving in the right direction to provide an adequate response to the PSA ROs and RI-ABWR-002.

2.8.8

Severe Accident Analysis (SAA)

63. A key submission assessed by ONR has been an update to the hydrogen management strategy for design basis faults and severe accidents. This includes consideration of severe accident events involving the spent fuel pool and the reactor during certain shutdown modes. This will be subject to further assessment during the next quarter.
64. In addition, Hitachi-GE has delivered an update to the Fukushima Dai-ichi learning report (RO-ABWR-0039) to identify any further observations and lessons arising from the International Atomic Energy Agency (IAEA) Director General's report. Work is progressing to address queries raised by ONR in Hitachi-GE's responses to the stress test findings and chief nuclear inspector's recommendations.
65. ONR's TSC is developing an independent model of the UK ABWR using the MELCOR severe accident code.

2.8.9 Fault Studies

66. The focus this period has been on assessment of submissions covering a number of outstanding ROs. A programme of work to address outstanding matters has been agreed.
67. ONR's TSC is developing an independent transient analysis model of the UK ABWR, which is to be used to provide confirmatory analysis for a range of reactor faults within the design basis. The TSC is also reviewing the technical basis of a number of key transient analysis codes used in Hitachi-GE's safety case. These activities will provide ONR with valuable insights on the overall adequacy of Hitachi-GE's design basis safety case.
68. Since the last report, ONR has gained more confidence in Hitachi-GE's assessment of radiological consequences for design basis faults. This is a key aspect to ONR's assessment of containment venting during station blackout events and, if progress is maintained, should help to support closure of a related RO.
69. Generally, engagement with Hitachi-GE during this period has been positive, including a week long fault studies and severe accident analysis technical workshop in Japan in June, which covered discussions on a wide range of assessment areas.

2.8.10 Control and Instrumentation (C&I)

70. ONR has participated in two workshops related to optioneering and design substantiation for the reactor building crane 20 metre lift associated with spent fuel export.
71. ONR has appointed a TSC who has attended a technical meeting and started planning and assessment work.
72. During this period there were face to face technical meetings in Japan in June and in the UK in September, and two progress meetings. ONR identified an issue in the clarity of safety property claims and linkage from the fault schedule, which affects C&I and other topic areas. Hitachi-GE agreed with this and has proposed an approach to improve this.
73. We consider that progress in the C&I area for this period has been good, with most deliverables on time, and of adequate quality.

2.8.11 Electrical Engineering

74. Hitachi-GE continues to submit documents in accordance with the Step 4 programme and these are generally of adequate quality for ONR assessment..
75. There was a delay in the submission of the results of electrical system transient stability studies, although we have now received these and are assessing the study results to confirm that they demonstrate the adequacy of the electrical distribution system to support nuclear safety functions.
76. In addition Hitachi-GE has proposed a design change to increase power transformer ratings, which addresses ONR concerns from our assessment of the initial system study results.

2.8.12 Fuel and Core Design (F&C)

77. The main issues being addressed by ONR are:
 - Calculation of fuel cladding temperatures in the event of clad ballooning.
 - Clad stress in power distribution faults.
 - Core monitoring to maintain the core conditions within safe operating limits.
78. Discussions between ONR and Hitachi-GE are in the early stages on these topics.

2.8.13 Human Factors

79. RO-ABWR-0024, on misdiagnosis and errors of commission has been closed; predicated on some residual issues being addressed by Hitachi-GE.

80. RO-ABWR-0069, on human-machine interface strategy, cognitive error and workload now has an accepted resolution plan, and ONR is content with the methods proposed to address cognitive error and cognitive workload.
81. In response to RQ-ABWR-0861, ONR has sought clarification on Hitachi-GE's proposed level of design maturity that is expected for GDA as the basis for human factors assessment at the end of step 4.

2.8.14 Reactor Chemistry

82. ONR's has undertaken a significant amount of assessment work during this period and all of the topics identified in the reactor chemistry step 4 assessment plan have now been assessed. Given the reduced scope of the step 3 assessment, where ONR received the minimum amount of information required, this is a significant milestone in this topic.
83. The outcome of the latest tranche of assessment work formed the basis of a comprehensive 'health check' workshop, which ONR conducted with Hitachi-GE in Japan at the end of July. One of the main aims was to identify priority areas where gaps still remain and further regulatory scrutiny in the reactor chemistry topic will be required as step 4 progresses. Some of the key findings were:
 - Materials selection will receive increased regulatory scrutiny moving forward. As part of RO-ABWR-0035, ONR has identified several gaps in the application of Hitachi-GE's methodology to justify materials selection decisions for some systems, structures and components (SSCs). In addition, there is a gap within Hitachi-GE's safety submissions to be able to justify the risk from materials degradation threats is tolerable and ALARP.
 - More information is required to justify the likely behaviour of UK ABWR with respect to the generation and transport of radioactivity, including the impact of key materials selection decisions.
84. The most significant development in the topic over this period is the completion of all assessment work against, and closure of RI-0001. ONR concluded Hitachi-GE has submitted suitable and sufficient evidence to meet the intent of the RI, to enable the RI to be formally closed. The assessment report outlining the basis for ONR's decision to close the RI will be published in due course.
85. Other key developments throughout the period have included the production of two new ROs. One on the topic of commissioning chemistry (RO-0072), and the other, led by chemistry, but joint with other ONR disciplines and the Environment Agency, on the adequacy of the design and ALARP demonstration for the off-gas system (RO-0073). In addition, the final submission against RO-0034 has been received and initial assessment work, joint with several other ONR disciplines has commenced.

86. We are also in the final stages of securing the services of TSCs which will be necessary to complete the remainder of the step 4 reactor chemistry assessments. The delay in procuring this support is why the relevant metric has deteriorated to red.

2.8.15 Radiation Protection

87. In this topic area Hitachi-GE has generally continued to deliver in line with baseline plan, although there has been some adjustment of deliverables including responses to RQs and ROs, with resources and assessment provision adjusted accordingly.
88. ONR completed its assessment of Hitachi GE's response to RO-ABWR-0014 and agreed this RO could be closed. Hitachi-GE continues to provide submissions in line with the Resolution Plans for RO-ABWR-0064 and RO-ABWR-0065, which are currently being assessed by ONR. In general these submissions are in line with ONR expectations.
89. Assessment continues of a number of documents in support of heating ventilation and air conditioning, stand-by gas treatment and atmosphere control systems as part of the wider radiological protection and cross cutting design aspects. Other cross cutting areas currently being assessed include activities on equipment located within the reactor dry well and reactor pressure vessel head removal and re-instatement.
90. An ongoing area of interest has been on the appropriateness of the inclusion of the 'bottom drain line', which is a specific design feature of the UK ABWR and has been retained from previous BWR designs. Our interest is in the justification for retaining this noting a number of other BWRs, internationally, have been operated without these, and it is seen as an area which if not adequately justified will lead to additional exposure to workers and may add risk with respect to loss of coolant accidents.

2.8.16 Management of Safety and Quality Assurance (MSQA) Arrangements

91. Overall, Hitachi-GE has continued to demonstrate that their management system arrangements (consisting of the MSQA procedures and processes) are suitable and sufficient for producing and managing its GDA submissions.
92. In particular, Hitachi-GE has responded well to the findings from last period's inspection and has made improvements in the design reference point change process to better focus on the safety significance of proposed modifications.
93. Interactions during this period have focused on the implementation of technology transfer arrangements (to ensure that key operational parameters are clearly identified to the future licensee), and the processes used internally to Hitachi-GE to monitor performance and learn from experience.

94. One challenge faced by Hitachi-GE during this period relates to the identification by regulators of a previously unidentified discharge route through the turbine steam gland (this was a very low level discharge to the environment). Hitachi-GE responded promptly by investigating the problem to identify the underlying cause, carrying out an extent of scope assessment to determine whether there were any other discharge routes concealed by the same cause (one additional very low level route was identified), and undertaking remedial work to formally assess the new discharge routes in accordance with their safety and environmental arrangements. This response was judged to be suitable, comprehensive and timely.
95. In June 2016, ONR undertook a 'health check' of the status, quality and progress of the GDA. The conclusions were that the majority of technical disciplines indicated a reasonable level of confidence in the progress of the ABWR GDA. There were a few topic areas that expressed some issues; therefore we undertook an inspection of the GDA control processes including:
- Management of the Hitachi-GE GDA delivery programme and JSCO review programme.
 - Hitachi-GE internal challenge, verification and approvals process.
 - Hitachi-GE arrangements for managing cross-cutting arguments.
96. The inspection took place from 17-20 October 2016 and included a representative from the Environment Agency. The outcome was successful for both the regulators and Hitachi-GE.

2.8.17 Management of Radioactive Wastes

97. ONR's priorities for this topic area are:
- Demonstration of ALARP.
 - Delivery of a holistic safety case that covers all the steps in the waste management process.
 - Ensuring a fit-for-purpose level of information is provided within GDA.
 - Integration and oversight of the design work needed to complete Step 4.
98. During this period Hitachi-GE issued submissions on the management of radioactive wastes according to plan. Hitachi-GE continued to progress a significant volume of design work to ensure that all the various strands of the management of radioactive wastes are adequately integrated.
99. ONR assessed a number of major reports, issued eight RQs on the management of radioactive wastes and contributed to others raised by related technical disciplines.

2.8.18 Decommissioning

100. ONR's priority for this topic area is to ensure that the UK ABWR complies with the established international principles of 'design for decommissioning'. ONR has provided detailed feedback, advice and guidance on a number of submissions and raised a number of RQ's.
101. During this period Hitachi-GE has used an adapted HAZOP methodology to systematically and comprehensively challenge the UK ABWR to ensure that the principles of design for decommissioning will be met. When the review was completed, ONR participated in a workshop held in Japan where Hitachi-GE summarised the output of this work. The workshop succeeded in demonstrating that Hitachi-GE has progressed its case in this area. ONR is now in the process of assessing the formal documentation.

2.8.19 Spent Fuel Interim Storage

102. During this period, assessment focused on Hitachi-GE's safety case for wet storage of spent fuel within the spent fuel pond for 10 years, followed by on-site dry cask storage for up to 140 years after the reactor ceases its 60 year design life.
103. ONR continues to seek an adequate proof of concept in this area, which should include the management of casks in the event of a number of failure scenarios. Progress continues to be made in this area.
104. In order to support our assessment of Hitachi-GE's proposals for spent fuel dry storage and to review international good practice, information exchanges took place with the US Nuclear Regulatory Commission (US NRC) and representatives of the Swiss Nuclear Safety Inspectorate (ENSI) and plant operators.
105. These recent developments have provided improved confidence that step 4 can be completed successfully for this topic on the current timescales.

2.8.20 Environmental

106. Additional information was requested from Hitachi-GE via two ROs raised on non-radioactive discharges to surface waters and discharges to atmosphere from the turbine gland steam system. This information has now been received as part of an updated submission of the Generic Environmental Permit (GEP) received in July 2016.
107. This GEP submission has been assessed throughout July and August and our documentation for the public consultation is being prepared.
108. The GDA public consultation starts on Monday 12 December 2016, running for 12 weeks, ending on Friday 3 March 2017.

2.8.21 Conventional Safety

109. Engagements continue with Hitachi-GE regarding UK ABWR 'open top' construction and modular build methodology, and ONR expectations in this area.

2.8.22 Fire Safety

110. There have been no conventional fire safety interactions with Hitachi-GE over the period May – October 2016.
111. Fire safety in the ABWR service tunnels remains an outstanding issue that ONR will assess when a fully developed strategy is produced in the next period.

2.9 Forward look

112. For the ABWR GDA, in the coming months we will start to plan for the closure phase, although there will be a significant amount of technical work on going well into the New Year. We aim to close a large number of RO actions into the New Year and will then be focusing on finalising outstanding technical and safety case matters and preparing to write up our Step 4 reports in some areas. This does not however preclude the potential for further emerging and/or significant technical issues, as this is the nature of regulatory assessment.
113. The Environment Agency and Natural Resources Wales will be consulting on their assessment findings so far from 12 December to 3 March. Information about the consultation, including a stakeholder seminar and public events, can be found in the consultation plan.

3 GDA of the AP1000

3.1 Progress update

114. Over this period Westinghouse has improved its position on GDA overall, and we are seeing the benefits of the changes they made earlier in the year. There is an agreed way forward for all GDA issues and some difficult technical issues have been resolved in this period; some of which have resulted in design enhancements (e.g. Reactor Chemistry Issue-02). This delivery focus and commitment is helping Westinghouse move forward.
115. Of note this period is the agreement to close three GDA issues (ME-03; RP-01 and CC-03). These issues will be formally closed once our inspectors complete their reports. This is a good step forward and marks the start of project closure.
116. Both the Westinghouse and ONR management teams are concentrating on the fine detail of the closure programme, and providing additional support where required in terms of resource or further technical assistance for example. We have also reviewed again the scope of work required for closure with the ONR heads of profession, to make sure that the work is appropriate for a generic PCSR and is targeted and proportionate.
117. The earlier lack of progress by Westinghouse in C&I has resulted a very compressed schedule in this topic area; with work continuing to the final stages of the project. This area is on the critical path for completion of the project in March. In June/July Westinghouse submitted a large number of documents for regulatory assessment and ONR is working at a considerable pace to try to meet what is a very challenging programme. We have increased resource in this area, but even with this we are concerned at the volume of work remaining. Furthermore our assessments are revealing technical queries that require addressing and incorporating into a further revision of the majority of documents. This is a normal part of assessment and we have discussed with Westinghouse their responses to the technical queries; however for C&I it means that it will be November/December when we expect to have complete documents for final assessment.
118. In the last report we highlighted an emerging issue relating to structural integrity GDA Issue-05; around Westinghouse's demonstration that major vessels in the AP1000 (reactor pressure vessel and pressuriser) are compliant with American Society of Mechanical Engineering (ASME) III design criteria. ONR found evidence of potential non-compliance with the code, which could have safety implications for AP1000 plants in construction.
119. This issue has been the focus of our structural integrity inspectors in the preceding months, as we have worked to establish the safety implications in close cooperation with the US NRC. Westinghouse has stated that the non-compliances do not present a safety issue and they will provide documentation to support this. In addition we have assessed the various Westinghouse root cause analyses, as we have sought assurance that the problems are contained and not systemic

affecting all technical topic areas. These interventions have also been supplemented by an inspection focused on the Westinghouse technical quality assurance processes and project governance, which resulted in a largely positive outcome.

120. We are completing our work on this issue now and expect to be able to return to routine assessment at the end of this year. Our intervention on this has however resulted in delays to the structural integrity programme and we are working to try to maintain assessment pace and recover time. This area is also affecting the final stages of the project programme as the scheduled has been compressed. More information is presented in the 'metrics detail' section of this report.
121. Our delivery confidence for this project is amber/red, which means that successful delivery of the project is in doubt with major risks or issues apparent in a number of key areas.
122. We acknowledge that Westinghouse has made progress since that start of the year and its commitment is welcome; however there are only five months remaining and a very large amount of assessment to complete with issues still emerging. We will undertake a project deep dive at the end of this year, when we expect to have a clear view on the viability of completion and closure at the end of March 2017.
123. Within the period the regulators have issued 175 RQs.

3.2 Meetings in period

124. There have been 223 meetings in the period of which 205 were technical and 18 non-technical

3.3 Public and stakeholder engagement and communications

125. There have been no public queries received in this period via the AP1000 website.
126. The public comments process for the AP1000 will close on 30 November 2016. During the final months of the comments process the regulators have been promoting opportunities to comment at stakeholder events and through social media. Westinghouse is running a digital media campaign through October and November to encourage comments and questions and explain GDA to its stakeholders and communities in West Cumbria.

3.4 Technical Support Contracts

127. The following AP1000 TSC contract was awarded during this period.

Contractor	Topic Area	Project Title	Contract Value
CEPN	Radiological Protection	Membership of International System on Occupational Exposure (ISOE)	£2,106.87

3.5 Summary of regulator charges

Office for Nuclear Regulation:

- Charges for the period May 2016 – October 2016 £2,905,174.48
- Cumulative charges £32,083,848

Environment Agency:

- Charges for the period May 2016 – October 2016 £77,330
- Cumulative charges £2,698,409

3.6 Metrics Summary

GDA Metrics Definitions	
Category 1 (Programme)	Category 2 (Quality of submissions)
<p>Red – Significant slippage against the baseline programme has occurred, with delays highly unlikely to be recoverable. Successful completion of the closure phase in accordance with the regulators Baseline Programme will require the programme to be re-baselined and the target dates changed (via Change Control).</p> <p>Amber – Some slippage against the baseline programme has occurred, with delays capable of being recovered. Prompt action is required to ensure that there is an improvement in delivery in order to successfully complete the closure phase in accordance with the regulators Baseline Programme.</p> <p>Green – Activities are generally on plan to successfully deliver the closure phase in accordance with the regulators Baseline Programme.</p> <p>Blue – Activities are ahead of plan to successfully deliver the closure phase in accordance with the regulators Baseline Programme.</p>	<p>Red - For the closure phase, submissions are significantly below expectations in terms of scope and/or quality. The regulators will require significantly improved submissions to support their assessment.</p> <p>Amber - For the closure phase, submissions are below expectations in terms of scope and/or quality. The regulators will require submissions to be updated/revised to support their assessment.</p> <p>Green - For the closure phase, submissions have generally met the expected scope and quality.</p> <p>Blue - For the closure phase, submissions have exceeded the expected scope and quality.</p> <p>Grey – No submissions received during the period.</p>
Category 3 (Quality of interactions)	Category 4 (GDA Issues progress)

Red – Communications and interactions have been significantly below expectations, in terms of clarity, openness, or technical content, This has resulted in a high degree of ambiguity and/or a lack of confidence in the other parties' intentions. The values in the RNIP have been compromised.

Amber - Communications and interactions have been below expectations in terms of clarity, openness, timeliness or technical content, This has resulted in a degree of ambiguity and a lack of confidence in the other parties' intentions. Some aspects of the RNIP have been challenged

Green - Communications and interactions have met expectations, resulting in confidence in the other parties' intentions.

Blue – Communications and interactions have exceeded expectations, resulting in a high degree of confidence in the other parties' intentions

Red - Submissions are not addressing the GDA Issue and immediate action is required to enable closure. There is a high risk that further GDA Issue Actions or GDA Issues may be raised.

Amber - Submissions are not fully addressing the GDA Issue and action may be required to enable closure. There is a risk that further GDA Issue Actions or GDA Issues may be raised.

Green - Submissions are addressing the GDA Issue and closure appears likely.

Blue - Submissions have addressed the GDA Issue and the GDA Issue has been closed.

	C&I						Fault Studies						Internal Hazards						Structural integrity						Civil Engineering						Fuel & Core Design						Mechanical Engineering						Reactor Chemistry											
Category 1 - Programme	[Red]						[Green]						[Green]						[Red]						[Yellow]						[Green]						[Green]						[Green]											
Category 2 - Submissions	[Yellow]						[Green]						[Yellow]						[Green]						[Green]						[Green]						[Yellow]						[Green]											
Category 3 - Interactions	[Green]						[Green]						[Green]						[Green]						[Green]						[Green]						[Green]						[Green]											
Category 4 - GDA Issue 1	[Yellow]						[Green]						[Yellow]						[Red]						[Green]						[Blue]						[Yellow]						[Green]											
Category 4 - GDA Issue 2	[Yellow]						[Green]						[Green]						[Green]						[Green]						[Green]						[Green]						[Green]											
Category 4 - GDA Issue 3	[Yellow]						[Green]						[Green]						[Green]						[Green]						[Green]						[Green]						[Green]											
Category 4 - GDA Issue 4	[Yellow]						[Green]						[Green]						[Green]						[Green]						[Green]						[Green]						[Green]											
Category 4 - GDA Issue 5	[Yellow]						[Green]						[Green]						[Green]						[Green]						[Green]						[Green]						[Green]											
Category 4 - GDA Issue 6	[Yellow]						[Green]						[Green]						[Red]						[Green]						[Green]						[Green]						[Green]											
Category 4 - GDA Issue 7	[Yellow]						[Green]						[Green]						[Green]						[Green]						[Green]						[Green]						[Green]											
Category 4 - GDA Issue 8	[Yellow]						[Green]						[Green]						[Green]						[Green]						[Green]						[Green]						[Green]											
Category 4 - GDA Issue 9	[Yellow]						[Green]						[Green]						[Green]						[Green]						[Green]						[Green]						[Green]											
Category 4 - GDA Issue 10	[Green]						[Green]						[Green]						[Green]						[Green]						[Green]						[Green]						[Green]											
Category 5 - Emerging Issues	N	N	Y	N	N	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	N	N	N		Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	N	N							
	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O
	PSA						Electrical Engineering						Radiological Protection						Human Factors						Cross Cutting 1						Cross Cutting 2						Cross Cutting 3																	
Category 1 - Programme	[Yellow]						[Yellow]						[Green]						[Green]						[Green]						[Green]						[Green]																	
Category 2 - Submissions	[Green]						[Green]						[Green]						[Green]						[Green]						[Green]						[Green]																	
Category 3 - Interactions	[Green]						[Green]						[Green]						[Green]						[Green]						[Green]						[Green]																	
Category 4 - GDA Issue 1	[Green]						[Green]						[Green]						[Green]						[Green]						[Green]						[Green]																	
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Category 4 - GDA Issue 10	[Green]						[Green]						[Green]						[Green]						[Green]						[Green]						[Green]																	
Category 5 - Emerging Issues	N	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y												
	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O	M	J	J	A	S	O						

3.7 Metrics Detail

3.7.1 Civil Engineering

128. During this period, Westinghouse continued to submit its technical responses to the four civil engineering GDA Issues (CE.01-CE.04) in accordance with its schedule, and our assessment is in progress.
129. There has been regular engagement between Westinghouse, ONR and ONR's TSC to progress resolution of the outstanding issues. In addition to weekly progress meetings, supplementary ad-hoc workshops were held between all parties to discuss technical topics.
130. Westinghouse's responses to RQs are being provided in a timely manner. The only outstanding RQs relate to the fire assessment of the SC modules being undertaken for CE.01 and CE.02, and we expect this to be resolved soon.
131. Following ONR feedback on civil engineering aspects of the metrication issue (ME.02), Westinghouse took an action to rewrite elements of its ALARP assessment of the issue. The revised ALARP report was submitted in September 2016 and provided satisfactory responses to the civil engineering comments that were previously raised.
132. ONR undertook a 'health check' on all chapters of the PCSR as part of the cross-cutting issue (CC.02). Feedback for the civil engineering chapter of the PCSR was primarily positive, with the only technical concern being insufficient evidence to substantiate some of the claims being made. Westinghouse has acknowledged the feedback and will provide an updated PCSR civil engineering chapter in November 2016.

3.7.2 External Hazards and Site Characterisation

133. During the period, PCSR chapters on site characterisation and external hazards have been reviewed. Both are expected to be adequate following revision by Westinghouse in light of comments raised.

3.7.3 Internal Hazards

134. Westinghouse has continued to undertake further analysis in the areas of internal fire, internal flooding, pressure part failure, internal explosions, internal missile, turbine disintegration and dropped loads using different modelling techniques and assumptions.
135. Westinghouse has submitted a number of documents related to the above and responded to a number of RQs, which are currently being assessed.
136. ONR continues to raise concerns on the overall clarity and coherence of the claims and arguments presented in the documents being issued (e.g. internal fire,

- pressure part failure, dropped load), as well as the level of evidence being presented.
137. Information relevant to categorisation and classification of systems, structures and components (SSCs), including substantiation of the penetrations (doors, cables and pipes), appears limited. This may relate to the different classification system in use within the USA.
 138. In the area of pressure parts failure, Westinghouse submitted a revised methodology and criteria and a topic report. A number of pipe lines that had been initially excluded from the analysis due to 'leak before break' arguments, are now being considered with 'gross failure' consequences. However, Westinghouse proposed to include three representative and 'bounding' examples in the topic report, with the remaining high energy lines to be addressed post GDA. However, the remaining lines are part of the generic design and do not depend on site specific input. ONR requested clarity on the risk gap, and has issued a letter stating its expectations and the need to provide analysis to demonstrate that no major design changes will be necessary to meet UK expectations, for the direct and indirect consequences of gross pipe failures. A number of RQs have been raised in this area.
 139. There was one internal hazards workshop in UK in May 2016, and one in the USA in July 2016. The scope of the workshops covered all internal hazards GDA Issues and included cross-cutting discussions with structural integrity (on pressure part failure), civil engineering (on internal fire and dropped loads) and fault studies (on hazard and fault schedule).

3.7.4 Mechanical Engineering

GI-AP1000-ME-01: Squib Valves

140. During the period work has continued on the squib valve concept and design substantiation. Following conclusion of the most recent testing of squib valve initiators by Westinghouse and its suppliers, ONR was informed of a finding that the aged initiators showed signs of reduced pressure output when fired. ONR held discussions with Westinghouse during May and June 2016 to discuss this. In addition, ONR held discussions with the US NRC to discuss proposed changes to the initiators and to share information.
141. Further submissions were provided through May, June and July 2016 to support the squib valve safety case submission. A series of meetings were held with Westinghouse to discuss ONR comments on the submissions.
142. Westinghouse submitted the two ME-01 main submissions for closure of the GDA issue in August 2016. Westinghouse has not yet provided a robust justification for not using safe-arm devices in the design of the squib valve pyrotechnic chain, and with the consequences of spurious actuation of the valves at full system pressure.

This latter issue is also shared within ONR's PSA, structural integrity and internal hazards topic areas, and an RQ was raised by the PSA inspector.

143. ONR has also raised issues with the potential difficulty in removal of the eight-inch squib valves for maintenance or replacement. Westinghouse has agreed to undertake an assessment of this and provide further arguments and evidence that this is achievable, and that the design reduces risk so far as is reasonably practicable.
144. Westinghouse will re-submit its squib valve safety case in November 2016.

GI-AP1000-ME-02: Metrication

145. During the period work has continued on GI-AP1000-ME-02 regarding metrication of mechanical equipment and civil structural steelwork connections. Meetings were held in May and June to discuss regulatory comments made upon a draft of the metrication report and expectations for resolution. The final document is scheduled for submission in November 2016.

GI-AP1000-ME-03: Pipework Design

146. To address ME-03, Westinghouse has developed three reports covering freeze seals, isolations for examination, inspection, maintenance and testing and drainage. ONR held a number of meetings with Westinghouse to clarify regulatory expectations and discuss improvements to its three draft reports. Westinghouse has satisfactorily addressed all of ONR's concerns, and the final issue of all three pipework design reports has been submitted.
147. ONR has now agreed that Westinghouse has provided sufficient evidence to allow ME-03 to be closed. A number of assessment findings will require formulating as a result of ME-03 closure.

3.7.5 Structural Integrity

148. ONR is working to a re-baselined programme for the fracture avoidance demonstration (SI-01 GDA Issue) and the assessment of the steam generator vertical support integrity under a postulated RCP bowl missile (SI-06 GDA Issue). Westinghouse provided a significant number of deliverables over the period and ONR has undertaken considerable assessment work, with support from a TSC and additional ONR resource. There are key technical challenges for SI01, SI05, and SI06 for Westinghouse to address over the next period.
149. For GDA Issue SI-01, ONR has engaged a TSC to undertake comparative fracture assessments for a sample of welds in the highest safety significant components. These semi-independent R6 calculations are in progress.
150. Resolution of the demonstration of design code compliance for a sample of the highest reliability components under GDA Issue SI-05 has proved problematic.

ONR, with support from a TSC reviewed a sample of the updated design calculations for the reactor pressure vessel and the pressuriser. These are classified by Westinghouse as highest safety significance and should comply with an established nuclear design code. The review concluded that there were errors and inconsistencies in the methods used which introduced uncertainty as to whether the components were code compliant. There were additional concerns relating to the adequacy of Westinghouse's arrangements for the production of design documentation to demonstrate design code compliance.

151. In response, Westinghouse undertook initial engineering evaluation work and concluded that the components potentially affected are code compliant. Westinghouse also initiated its corrective action and lessons learnt process, which includes causal analyses. ONR also undertook an inspection of Westinghouse's processes for their initial engineering evaluation, causal analyses and design document verification/approval. The inspection resulted in a largely positive outcome and ONR is reviewing the evidence collated to form a view on the significance for closure of SI-05 GDA issue, other disciplines and the GDA programme. ONR has informed the US NRC and the Chinese Nuclear Regulator, through Multinational Design Evaluation Programme (MDEP).

3.7.6 Electrical Engineering

152. Westinghouse has submitted the updated basis of safety case and grid code compliance documentations. ONR has assessed the adequacy of these documents and we are generally content with the submissions. ONR has requested clarification from Westinghouse on the approach to the use of smart devices on the electrical system in conjunction with the C&I team, and this requires final resolution. Updates are required on the PCSR electrical chapter to ensure consistency with other document submissions
153. The resolution of these outstanding issues is expected to support closure of the GDA issue in accordance with the closure programme.

3.7.7 Control and Instrumentation (C&I)

154. Whilst Westinghouse has broadly delivered to their re-baselined plan, the re-profiling of the C&I submissions has created a situation whereby the volume of work still to be undertaken presents a significant challenge to all parties. In particular, there is concern around the delivery schedule for the second submissions of the principal documents. The potential for significant technical issues to emerge from the assessment of the submissions also presents a risk to overall timescales.
155. During this reporting period ONR and our TSC have commenced the assessment of a significant number of the initial submissions of the principal C&I documents and raised several RQs. ONR intend to further reflect on delivery confidence in

November when the majority of these assessments will be complete, and a view on their quality and the scale of any outstanding work may be determined.

156. There have been a number of technical and progress meetings in the period, and inspections of the evidence to support the safety justification of smart devices for use in safety applications. These inspections have contributed to the overall assessment of the new arrangements developed by Westinghouse to address this issue.

3.7.8 Fault Studies

157. During this period, Westinghouse completed the majority of its analyses and supporting documentation required to address the fault studies GDA issues. These now need to be assessed by ONR. Regular communications have been maintained during the production of the submissions and no technical concerns or challenges to the overall schedule are anticipated.
158. The major outstanding challenge in the fault studies area is for Westinghouse to review and update the relevant sections of the PCSR to reflect the outcomes of the GDA Issue closure work and other necessary changes.

3.7.9 Fuel and Core

159. Submissions have been received from Westinghouse in relation to the BEACON core monitoring system and will be assessed by ONR in the near future.
160. In respect of the depressurisation forces in a large loss of coolant accident, ONR has asked detailed questions and received plausible arguments. Evidence to support the arguments is expected from Westinghouse soon.

3.7.10 Human Factors

161. During this period ONR has completed a preliminary review of Westinghouse's PCSR human factors chapter and its submission against HF-01. Both submissions will require some level of revision. The PCSR chapter is reasonable in scope, but fails to reflect to current state of the design and is aspirational in tone. It needs to reflect that the design is not yet complete.
162. Whilst the human error analysis represents a significant effort on Westinghouse's part, it does not present sufficient evidence to allow close out of GDA issue HF-01. The analysis lacks clarity and appears unnecessarily time consuming to generate. We consider that sufficient evidence exists, and that the issue lies in how it is documented.

3.7.11 Probabilistic Safety Assessment (PSA)

163. Assessment work is nearing completion for both the PSA-01 and PSA-02 projects. The Sciencetech and EPM TSCs have completed the MAAP analysis review work

for the PSA-01 project, and the fire PSA cable analysis review work for the PSA-02 project. This was completed during a visit to the Westinghouse Cranberry offices in the USA.

164. Face-to-face discussions have taken place on the PSA and the squib valve safety case during a meeting in the UK in September.
165. Cross-cutting work continues with the PSA supporting other technical areas. Support to the C&I and mechanical engineering Inspectors has continued with further information requested from Westinghouse on the risk sensitivity of spurious safety system actuations. Discussions continue with Westinghouse on the reliability claims made in the PSA for operator actions underpinned by the main control room simulator trials, and the reliability claims for the PMS, blocker and DAS designs.

3.7.12 Reactor Chemistry

166. Westinghouse submitted deliverables to resolve GDA Issue RC-01 over the period and our assessment has commenced.
167. Our focus has been on resolution of GDA Issue RC-02 and the design of the sampling system for AP1000. Following a convergence workshop with ONR, Westinghouse has submitted an improved ALARP optioneering report proposing design changes to the sampling system. These changes have addressed the majority of ONR's concerns, and other residual queries have been captured by RQ. This GDA issue is now on target for closure.
168. The final submission for GDA Issue RC-03 has been the subject of RQs, for which responses have now been received and assessed as adequate. ONR is therefore confident that this GDA issue can be closed in the near term.
169. Westinghouse has provided a further update to the chemistry chapter of the PCSR to address ONR comments. Assessment has determined further work is required, in particular in relation to limits and conditions. RQs have been raised to capture these remaining gaps.

3.7.13 Radiological Protection

170. GDA Issue RP-01 was closed in principle in this period.

3.7.14 GI-AP1000-CC-01 Limits and conditions

171. ONR is satisfied that the submissions from Westinghouse in response to this issue are sufficient. Further discussions in relation to this issue are required on mechanical engineering and reactor chemistry, to determine whether additional text is needed within the PCSR to clarify how the safety case allows all relevant generic limits and conditions to be identified. ONR expects that this issue can satisfactorily closed by the target date.

3.7.15 GI-AP1000-CC-02 PCSR to support GDA

172. During this period ONR has provided feedback to Westinghouse on the revised versions of key chapters of the draft PCSR. Further revisions to each of the chapters are being provided, with every chapter being revised to at least version 0B, with additional revisions likely for some of the more complex chapters. ONR will provide feedback to Westinghouse on these revised chapters to allow final amendments before they are submitted as part of the consolidated Revision 1 of the whole PCSR.
173. In general, progress on the various chapters of the PCSR is satisfactory, although there are some key chapters where significant changes are likely to be necessary. Providing Westinghouse can meet its delivery targets for acceptable versions of these key chapters, ONR expects that the final version of the PCSR will provide an acceptable basis for a DAC.
174. The Environment Agency provided substantial comments on Revision 4A of Westinghouse's Environment Report for the AP1000 in February. Westinghouse provided the updated revision 4B of the Environment Report on 7 October 2016, which addressed these comments and included relevant design changes since the previous issue. The final version 5 of the Environment Report, which will address any comments on revision 4B and verify impact on the final design reference point revision 9, is due in December 2016.
175. The Environment Agency maintains its view that resolution of the GDA issues is unlikely to significantly impact the case that was presented to the Environment Agency in 2011, and against which the iSoDA was issued.

3.7.16 GI-AP1000-CC-03 lessons learned from the Fukushima event

176. GDA issue CC-03 was closed in principle in this period.
177. A report into the lessons learned has been received and assessed, and we expect that comments will be resolved. Regulatory queries have been raised in the areas of fault studies and human factors, civil engineering, C&I and spent fuel pool level indication; these have been resolved with one assessment finding resulting. The report into the international lessons learned was delivered by Westinghouse in March 2016. This has been reviewed and is deemed to be adequate following discussions. The ONR assessment report is in preparation.

3.7.17 Forward look

178. The next period will focus intensively on completing our assessments, report writing and progressing the governance required to reach a decision on issue of a DAC and SoDA at the end of March 2017.
179. We will review our project wide delivery confidence in the New Year.

4 WIDER GDA

4.1 International Work

180. The ABWR Working Group within MDEP held its sixth meeting, as well as the fourth meetings of its technical expert sub-groups on severe accidents and instrumentation and control from 26 to 28 September 2016 in Paris. The key outcomes from these meetings were:
- Recognition that the Fukushima common position was issued to and received with interest by MDEP's steering technical committee. The paper was approved in September 2016 and is now available online (https://www.oecd-nea.org/mdep/common-positions/cp-abwrwg-01-fukushima_daiichi_accident.pdf).
 - The sharing of regulatory issues from the ABWR GDA with fellow regulators, including the UK approach to managing them.
 - A forward work programme of information sharing.
 - An agreement to hold the next meeting in Japan in May 2017.
181. In June 2016, ONR participated in the 13th meeting of the MDEP AP1000 Working Group held in Paris. This provided an opportunity for participating regulators to discuss the design, construction and regulation of the AP1000. Featuring prominently in the discussions were matters related to in-containment refuelling water storage tank (IRWST) condensate return, squib valve testing and reliability and ASME code compliance associated with the structural integrity of metal components. This cooperation has been valuable to ONR and has supported our progress with related GDA issues. Building upon the multilateral cooperation established at the Paris meeting, regular communication has been maintained during this period with the US regulators on the topics of squib valves and ASME code compliance.
182. ONR has engaged with the Japanese Nuclear Regulation Authority (NRA) to gain an understanding of the seismic issues relating to the restart of Kashiwasaki Kariwa's ABWR Units 6 and 7. In September 2016, NRA presented their Kashiwasaki Kariwa's findings at the ABWR MDEP.