

Assessing new nuclear reactor designs

Generic Design Assessment Quarterly Report
February 2016 – April 2016

Contents

1	INTRODUCTION AND BACKGROUND	4
2	GDA of the UK ABWR	6
2.1	Progress update	6
2.2	Meetings in period	6
2.3	Public and stakeholder engagement and communications	6
2.4	Enhanced collaborative working – Hitachi-GE and Horizon Nuclear Power	7
2.5	Technical Support Contracts	7
2.6	Summary of Regulator Charges	8
2.7	Metrics Summary	10
2.8	Metrics Detail	14
	Civil Engineering	14
	External Hazards	14
	Internal Hazards	14
	Mechanical Engineering	15
	Structural Integrity	15
	Security	16
	Probabilistic Safety Assessment (PSA)	16
	Severe Accident Analysis (SAA)	17
	Fault Studies	17
	Control and Instrumentation (C&I)	18
	Electrical Engineering	18
	Fuel and Core Design (F&C)	18
	Human Factors	19
	Reactor Chemistry	20
	Radiation Protection	21
	Management of Safety and Quality Assurance (MSQA) Arrangements	21
	Management of Radioactive Wastes	22
	Decommissioning	22
	Management of Spent Fuel	23
	Environmental	23

Conventional Safety	24
Fire Safety	24
2.9 Forward look	24
3 GDA of the AP1000	25
3.1 Progress update	25
3.2 Meetings in period	26
3.3 Public and stakeholder engagement and communications	26
3.4 Technical Support Contracts	26
3.5 Summary of regulator charges	26
3.6 Metrics Summary	27
3.7 Metrics Detail	30
Civil Engineering	30
External Hazards and Site Characterisation	30
Internal Hazards	30
Mechanical Engineering	31
Structural Integrity	31
Electrical Engineering	32
Control and Instrumentation	32
Fault Studies	33
Fuel and Core	33
Human Factors (HF)	33
Probabilistic Safety Assessment (PSA)	34
Reactor Chemistry	34
Radiological Protection	35
GI-AP1000-CC-01 Limits and conditions	35
GI-AP1000-CC-02 PCSR to support GDA	35
GI-AP1000-CC-03 lessons learned from the Fukushima event	36
3.8 Forward look	36
4 WIDER GDA	36
4.1 International Work	36



1 INTRODUCTION AND BACKGROUND

- 1 This report provides information on the work that we have been carrying out in our Generic Design Assessment (GDA) programmes during the period February 2016 to April 2016. There are currently two reactor designs going through the GDA process, Hitachi-GE's UK Advanced Boiling Water Reactor (UK ABWR) and Westinghouse's AP1000[®] reactor design, currently in the closure phase.
- 2 As we reported in our last update, for the UK ABWR project this is a period of intensive assessment as we progress through ONR's Step 4. We continue to consider the project stable overall, and although there are technical issues that continue to emerge, they are being appropriately managed. We remain focused on identifying any further design changes and safety case developments that may be required (in addition to those already made), to enable Hitachi-GE to address them within the current programme timescales.
- 3 The Environment Agency is continuing to carry out its assessments and is working towards beginning consultation on its findings so far later this year. Natural Resources Wales is also working towards this consultation.
- 4 Overall the regulators consider that a design acceptance confirmation (DAC) and a statement of design acceptability (SoDA) in December 2017 is achievable.
- 5 For the AP1000 project, we highlighted our concerns with the progress of the project and the lack of technical convergence in some topic areas in our last update. This period has seen some progress, particularly around convergence and there is therefore only one area where discussions continue. In terms of the closure programme, Westinghouse has revised and extended its schedule and it now seeks to complete the GDA process in March 2017.
- 6 We have seen an improvement overall in the Westinghouse approach to GDA closure, as a result of its Executive level interventions and revised project governance. However we remain concerned over the volume of work to be delivered, and judge that our planned 'health check' review scheduled for July 2016 will be important in informing the level of confidence we have in the revised closure programme.
- 7 There were no interactions between regulators and the proposed requesting party for the HPR1000 GDA in the period. However we have developed 'entry criteria' to provide transparency on the factors that underpin our decision on readiness to commence GDA. This is important as regulators are required to advise DECC on whether a potential requesting party is ready to start GDA. China General Nuclear (CGN) and EDF as the potential requesting party are working on providing the material required against each criterion, which will be discussed at a meeting in June 2016.
- 8 In March 2016, following conclusion of the techno-economic assessment, the Department of Energy and Climate Change (DECC) announced a competition to identify the best value Small Modular Reactor (SMR) design for the UK. As it is clear that government is progressing work in this area, the regulators have started to think about what challenges technology of this nature may present to the

current regulatory regime. We also consider that our knowledge of reactor technology may be helpful to DECC in the design and implementation of the competition, and will provide assistance if requested.

- 9 We welcome comments on this report. Please send them to us at new.reactor.build@onr.gov.uk.
- 10 To find out more about GDA and ask a question or make a comment about reactor designs visit <http://www.onr.org.uk/new-reactors/>
- 11 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

- 12 As we anticipated in our last update this has largely been a stable period of business as usual, as our inspectors get into the detail of their assessments.
- 13 In addition to this routine assessment, we are focusing on trying to identify any new significant issues that may require safety case developments or design changes (in addition to those already agreed), to give Hitachi-GE as much programme time as possible to address them. Within this period there has been a focus on seismic modelling methodology and the design and safety case for spent fuel export. Both of these issues have required enhanced attention from both parties and discussions are ongoing.
- 14 At this time we remain confident that a DAC and Statement of Design Acceptability (SoDA) are achievable in December 2017, should Hitachi-GE continue with the spirit with which it has started Step 4. We are intending to undertake a project health check in May 2016, and this will provide additional information to further underpin our confidence in the status of the project.
- 15 Updates on the existing two Regulatory Issues are provided in the 'metrics detail' section of this report.
- 16 120 Regulatory Queries (RQs) and three Regulatory Observations (ROs) issued have been issued during this period. Major ROs have been closed in topics including mechanical engineering and reactor chemistry; as have 25 RO actions. Hitachi-GE has also responded to 119 RQs on programme.

2.2 Meetings in period

- 17 In total 71 meetings have taken place, 10 of which were project focused and 61 technical.

2.3 Public and stakeholder engagement and communications

- 18 Within the period there were sixteen comments posted on the Hitachi-GE comments website, bringing the total number submitted to 63 at the end of April 2016, all of which have now been responded to. There were no repeated questions in this period.
- 19 We have continued to promote the comments process to our stakeholders and communities at conferences, events and meetings. We have also used our websites and e-bulletins to drive our stakeholders to the comments process website. The Environment Agency and Natural Resources Wales are developing plans for their consultation later this year. These plans are being informed by our Sciencewise project and by talking to stakeholders in areas where Horizon propose to construct a UK ABWR.

20 Our Sciencewise project was completed at the end of March 2016 and all documents have now been published on the Sciencewise website.

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

21 During this period the tripartite way of working in safety case matters, including Hitachi-GE, Horizon and the regulators has continued, with a progress meeting held in March 2016. The tripartite meetings continue to be productive, informative and they foster cooperation and clear understanding of regulatory expectations across the GDA and licensing projects.

22 Strong collaboration has continued between Hitachi-GE and Horizon via the Joint Safety Case Office (JSCO) to deliver good quality safety cases. Hitachi-GE and Horizon have jointly agreed the contents of the Wylfa Newydd site-specific pre-construction safety report (PCSR) and captured these in detailed PCSR chapter specifications. These specifications reflect (adapted as appropriate) the developing final version of the GDA UK ABWR PCSR. Significant resource has been used by both organisations, including a number of joint workshops in the UK and Japan, to ensure the quality and completeness of these specifications which will form the bases of the UK ABWR and Wylfa Newydd PCSRs.

23 During this period, Hitachi-GE has issued its UK ABWR Nuclear Safety and Environmental Design Principles (NSEDp), which are fully aligned with Horizon’s Nuclear Safety and Environmental Principles (NSEP) although, naturally, more design-focused. This has been an important milestone as the UK ABWR NSEDps represent Hitachi-GE’s top level standards being met in the design of the UK ABWR.

2.5 Technical Support Contracts

24 Between 1 February 2016 and 31 March 2016 the regulators let the following technical support contracts (TSC) relating to the UK ABWR project. There were no contracts let in April 2016.

Contractor	Topic Area	Project Title	Contract Value
GRS	Fault Studies	Provision of Embedded Technical Support to Assist with ONR's Assessment of UK ABWR Fault Studies and Severe Accident Analysis Submissions - GRS	£357,120.00

Contractor	Topic Area	Project Title	Contract Value
AMEC	Fault Studies	Provision of Embedded Technical Support to Assist with ONR's Assessment of UK ABWR Fault Studies and Severe Accident Analysis Submissions - AMEC	£241,904.40
GRS	Fault Studies	Provision of Technical Support to Perform Independent Confirmatory Analysis on the UK ABWR - ATHLET Model	£979,200.00
AMEC	Fault Studies	Provision of Technical Support to Perform Independent Confirmatory Analysis on the UK ABWR - Severe Accident Model	£218,005.73
GRS	Fault Studies	Provision of Technical Support to Assess the Adequacy of Transient Analysis Codes Used for UK ABWR Design Basis Analysis (Model V&V)	£116,400.00
CRA	L1&L2 PSA	Embedded Support for PSA	£189,840.00
Frazer Nash	Essential Electrical	Confirmatory Electrical Systems Studies	£199,949.52
Arup	Civil Engineering	Step 4 Assessment of the UK ABWR Civil Engineering	£715,399.20
Studsvik	Reactor Chemistry	Provision of Support on Sampling Systems for GDA of UK ABWR	£68,808.00

2.6 Summary of Regulator Charges

UK ABWR

Office for Nuclear Regulation:

- Charges for the period January 2016 – March 2016 - £ 2,006,407
- Cumulative charges - £ 16,904,709

Environment Agency:

- Charges for the period January 2016 – March 2016 - £213,243
- Cumulative charges - £3,065,806

Natural Resources Wales

- Charges for the quarter January 2016 – March 2016 - £ 23,235
- Cumulative charges - £ 89,769

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/revise 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><u>Grey</u> – No submissions received during the period.</p>
<p>Category 3 (Quality of interactions)</p>	<p>Category 4 (Regulatory Observations/Issues progress)</p>
<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</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>

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

<p>parties' intentions</p>	<p style="text-align: right;">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: right;">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: right;">OR</p> <p>The RO/RI has been closed</p>
----------------------------	---

	Civil Engineering			External Hazards			Internal Hazards			Mechanical Engineering			Structural integrity			Conventional Safety			Fire Safety			PSA			Reactor Chemistry					
Category 1 - Programme	Green	Green	Yellow	Green	Green	Green	Green	Green	Green	Yellow	Yellow	Yellow	Green	Yellow	Yellow	Green	Green	Green	Green	Green	Green	Yellow	Yellow	Yellow	Green	Yellow	Green			
Category 2 - Submissions	Green	Green	Green	Yellow	Yellow	Yellow	Green	Green	Green	Yellow	Yellow	Yellow	Green	Green	Green	Green	Green	Green	Green	Green	Green	Yellow	Yellow	Yellow	Green	Yellow	Green			
Category 3 - interactions	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green			
Category 4 - Existing Issues	Green	Green	Green	Green	Green	Green	Green	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Green	Green	Green	Green	Green	Green	Yellow	Yellow	Yellow	Yellow	Yellow	Red			
Category 5 - Emerging Issues	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	N		N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y			
	F	M	A	F	M	A	F	M	A	F	M	A	F	M	A	F	M	A	F	M	A	F	M	A	F	M	A	F	M	A
	Radiation Protection			Human Factors			MSQA			Rad Waste			Decommissioning			Spent Fuel Interim Store			Severe Accident			Fault Studies			C&I					
Category 1 - Programme	Green	Green	Green	Green	Yellow	Yellow	Green	Green	Green	Green	Yellow	Yellow	Green	Yellow	Yellow	Green	Yellow	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green			
Category 2 - Submissions	Green	Green	Green	Yellow	Green	Yellow	Green	Green	Green	Green	Yellow	Yellow	Green	Yellow	Yellow	Green	Yellow	Green	Green	Green	Green	Green	Green	Green	Yellow	Yellow	Yellow			
Category 3 - interactions	Green	Green	Green	Green	Yellow	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Yellow	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green			
Category 4 - Existing Issues	Green	Green	Green	Green	Green	Green	Green	Green	Green	Yellow	Yellow	Yellow	Green	Green	Green	Grey	Yellow	Grey	Green	Green	Green	Green	Green	Green	Yellow	Green	Green			
Category 5 - Emerging Issues	N	N	N	Y	N	N	N	N	N	N	N	N	Y	Y	Y	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y			
	F	M	A	F	M	A	F	M	A	F	M	A	F	M	A	F	M	A	F	M	A	F	M	A	F	M	A	F	M	A
	Electrical Engineering			Fuel & Core Design			Security			Environmental																				
Category 1 - Programme	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green																		
Category 2 - Submissions	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green																		
Category 3 - interactions	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green																		
Category 4 - Existing Issues	Green	Green	Green	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue																		
Category 5 - Emerging Issues	N	N	N	Y	N	N	N	N	N	Y	N	Y																		
	F	M	A	F	M	A	F	M	A	F	M	A																		

2.8 Metrics Detail

Civil Engineering

- 25 During this period, the Hitachi-GE 'basis of safety case' documents have been received for assessment. These will inform the assessment of the supporting documents by an ONR TSC during GDA Step 4. The TSC contract with Ove Arup & Partners is in place.
- 26 A number of the supporting documents relating to seismic analysis have been placed on hold by Hitachi-GE. We believe this could represent a potential regulatory shortfall and therefore it has been identified in a draft RO.
- 27 (POST REPORT NOTE – we have received a revised delivery schedule on seismic analysis which we are reviewing)

External Hazards

- 28 Hitachi-GE continues to meet the programme and the quality of the submissions is adequate overall. The Resolution Plan for RO-ABWR-067 has been received and is acceptable overall, with some minor residual issues that will be addressed via RQs. Hitachi-GE explained their approach to heating ventilation and air conditioning (HVAC). ONR have asked for Generic Site Envelope (GSE) ambient air temperatures to be considered, and Hitachi-GE has agreed to provide to provide an update in June. It has been noted as an emerging issue on the metrics.
- 29 ONR has engaged ABS Consulting as its TSC for the Step 4 External Hazards assessment.

Internal Hazards

- 30 ONR assessment work has focussed on Hitachi-GE's documentation regarding the possibility of turbine disintegration and potential impact with key buildings. Early indications suggest that further regulatory focus is required on this scenario, including the involvement of a number of other technical disciplines within ONR.
- 31 ONR has requested that Hitachi-GE considers whether it would be possible to reduce the number of submissions for step 4, and/or align the topic reports with supporting documents, to ensure that we can target our work and undertake a more efficient assessment.
- 32 There was an internal hazards workshop in Japan from 19-22 April 2016. This included cross-cutting meetings with civil engineering, external hazards, electrical engineering, Control & Instrumentation (C&I), mechanical engineering and chemistry. The outcome of the workshop was positive as it provided assurance that Hitachi-GE is progressing with the development of the internal hazards topic

reports and with the closeout of all ROs in this area. These interactions have also demonstrated continuing willingness on the part of Hitachi-GE to consider further solutions in this area (in addition to those already agreed). A number of RQs have been raised as a result of the interactions.

- 33 Internal Hazards has taken the lead in the ONR assessment of spent fuel export involving several technical disciplines. RO-ABWR-0056 was raised to clarify ONR's expectations for optioneering the removal of spent fuel from the reactor building, which would form part of the overall as low as reasonably practicable (ALARP) justification for the UK ABWR fuel route. In that respect, the response to RO-ABWR-0056 should be used or referenced as part of the broader requirements of RO-ABWR-0011 for a complete safety case for the UK ABWR. An important aspect of demonstrating that risks have been reduced so far as is reasonably practicable (SFAIRP) is to use a rigorous optioneering process which has considered the full range of practicable solutions. ONR expects that a safety case should include an evaluation of the risks arising from faults in facilities by using the techniques of design basis analysis, probabilistic safety analysis, and, if appropriate, severe accident analysis.
- 34 Hitachi-GE's response included an optioneering report on removal of fuel from the Spent Fuel Pool. ONR raised concerns with this report and a number of technical interactions have taken place. In response, Hitachi-GE has updated the optioneering study and is further progressing a relevant RQ. Hitachi-GE proposed to further update the optioneering study later in the year, and further regulatory intervention may be required.
- 35 ONR has a greater understanding of the claims Hitachi-GE is making with respect to the Reactor Building Crane, canister, impact limiter and transport cask. Hitachi-GE has provided three reports to substantiate the claims made.

Mechanical Engineering

- 36 Hitachi-GE has made progress in mechanical engineering against the planned submissions, ROs, ROAs and RQs.
- 37 During this period we undertook a useful technical workshop, and our assessment has focused on cross cutting topics including the UK ABWR spent fuel export sequence and Hitachi-GE's approach to embedded pipework.
- 38 Assessment has also targeted Hitachi-GE's evidence to prepare and implement adequate arrangements to close out its eight open mechanical engineering ROs. During the reporting period, RO-ABWR-0052 has been formally closed.

Structural Integrity

- 39 Meetings were held with Hitachi-GE in both early March (UK) and in late April (Japan); these latter meetings also included interdisciplinary meetings. Good progress has been made in the area of defect tolerance assessment for the main

steam line and main steam isolation valves. There have been some difficulties in the area of technical justification of weld inspection, and although Hitachi-GE has been proactive in reworking these submissions this may affect the delivery schedule.

- 40 Hitachi-GE provided new resolution plans for RO-ABWR-002 to RO-ABWR-004 following revisions.
- 41 RO-ABWR-059, on provision of water cooling for the reinforced concrete containment vessel drywell head, has been addressed by Hitachi-GE and will be closed out.
- 42 RO-ABWR-0035 is progressing well and a structured understanding of ALARP being developed by Hitachi-GE. Materials degradation reports were provided by Hitachi-GE at the end of the period and ONR has provided comments.
- 43 The quality of documentation from Hitachi-GE in this quarter has been noticeably poorer than in previous quarters and this will need to be addressed as a priority.

Security

- 44 ONR has received a draft of Revision C of the UK ABWR Conceptual Security Arrangements which is currently being assessed. There has been continued engagement with Hitachi-GE to understand the application of design basis threats in order to identify those systems, structures and components, their locations and the requirements for protection. Engagement has also focussed on protection of systems from cyber threats and Hitachi-GE continues to work on these arrangements. There are no new or emerging issues in this topic area.

Probabilistic Safety Assessment (PSA)

- 45 During this period ONR's PSA team held a workshop with Hitachi-GE in March 2016 to discuss the outcomes of our review of the internal events PSA and hazards prioritisation. During the workshop Hitachi-GE demonstrated good technical knowledge and understanding of the regulatory expectations to address the identified shortfalls, and committed to evaluate their impact on the risk through sensitivity analyses. In addition, Hitachi-GE will provide an updated internal events PSA, prioritization of hazards and revised containment performance analyses in June 2016. Hitachi-GE also agreed to provide, evidence of how the PSA is used to support the design changes identified during GDA in September 2016.
- 46 ONR's PSA team has reviewed the outcome of the sensitivity analyses that were submitted in April 2016. Based on the outcomes of the review ONR considers that an additional model update, or at least a more complete best estimate sensitivity analysis, should be provided. This information is necessary to understand the combined impact on the risk of some identified shortfalls. This issue is currently under discussion with Hitachi-GE.

- 47 Hitachi-GE continues the development of the remaining areas of the PSA (e.g. non-reactor faults, uncertainty and sensitivity analyses for shutdown and spent fuel pool, fuel route and dropped loads PSA, internal fire and flood PSAs etc.) broadly in line with the PSA programme. The seismic PSA was submitted to ONR's PSA team at the end of April 2016 and is currently under regulatory review.
- 48 ONR continues to progress the detailed review of the internal events PSA. This, as well as the review of the remaining submissions and additional work committed by Hitachi-GE, will determine whether the PSA ROs and RI-ABWR-002 can be closed. Overall, on the basis of the outcomes of the ongoing review, the work submitted up to date and the technical discussions during the PSA workshop in March 2016, ONR's PSA team has confidence that Hitachi-GE is moving in the right direction to provide an adequate response to the PSA ROs and RI-ABWR-002.

Severe Accident Analysis (SAA)

- 49 ONR now has embedded TSC resource providing support to our SAA team and we are working closely with the PSA team on aspects related to the Level 2 PSA (for example corium behaviour following core melt). An external contractor has started work to develop an independent severe accident model of the UK ABWR and this will be used later in Step 4 to provide insights into the adequacy of Hitachi-GE's analysis.
- 50 We note that Hitachi-GE has already made significant progress in providing submissions to support the severe accidents safety case and they continue to be updated as the analysis evolves. For example, further modelling of hydrogen in the reactor building is planned and this will be the subject of regulatory attention moving forward. A key focus for ONR's SAA team is to secure progress on outstanding areas of the safety case and closure of the associated RO.
- 51 Additionally, Hitachi-GE's severe accident analysis and associated safety case is subject to the outcome of assessment activities led by other areas, particular Level 2 & Level 3 PSA and chemistry. ONR continues to work across disciplines on these aspects and also on Hitachi-GE's Fukushima response and follow-up queries.

Fault Studies

- 52 ONR's Fault Studies team has been supplemented by embedded TSC expertise and we have issued contracts requiring specialist skills and analysis capabilities. This expanded capability has allowed ONR to increase the pace in its assessment of the major submissions provided by Hitachi-GE at the start of Step 4.
- 53 Hitachi-GE has undertaken a significant amount of work to provide both new and updated submissions in the fault studies area. Generally the submissions are of a

good standard, and although there are some gaps against ONR's expectations, these will be addressed as part of routine business.

- 54 The ONR Fault Studies team has identified uncertainty associated with the assumptions and methodology used by Hitachi-GE to estimate the radiological consequences of reactor faults. Hitachi-GE will need to provide additional information in this area.

Control and Instrumentation (C&I)

- 55 In this period we have raised an RQ on the clarity and linkage of safety case claims, arguments and evidence in the Plant Control System Basis of Safety Case (BSC) and an associated technical report. Hitachi-GE has also notified ONR that it has adopted an indicative example manufacturer of Class 2 smart devices, to facilitate progress around qualification.
- 56 The ONR C&I team attended C&I and cross-cutting meetings with Hitachi-GE in Japan. These covered C&I aspects of use of the reactor building crane in spent fuel export, and discussions on the PSA model.
- 57 Additionally, the ONR C&I team has collaborated with security inspectors at a workshop on cyber security and the conceptual security arrangements for the UK ABWR. At a workshop with Hitachi-GE a draft document relating to cyber security design basis threat was presented. The C&I assessors have subsequently drafted comments on additional items to be addressed within this document.

Electrical Engineering

- 58 Hitachi-GE is progressing according to the schedule in this area and its submissions are generally adequate overall. However, there is an emerging issue concerning the adequacy of power transformer ratings, which is being considered by Hitachi-GE.

Fuel and Core Design (F&C)

- 59 In this period Hitachi-GE has provided ONR with more information on its management of fuel failure. It is anticipated that the exact means of storing failed fuel will be decided after GDA, provided that options are not precluded.
- 60 Additionally, Hitachi-GE has proposed that a set of action levels relating to monitoring coolant and off-gas activity are to be developed. These arrangements meet ONR expectations although it should be noted that the levels have yet to be finalised. A cross-cutting meeting with ONR's reactor chemistry team and Hitachi-GE is proposed for the end of July.
- 61 For reactivity faults Hitachi-GE propose to include a criterion for fuel failure and also one for core degradation (the latter being essentially redundant). ONR's F&C

team do not regard the core degradation criterion as sufficiently well substantiated for design basis analysis (DBA) but accept that it could be used for severe accident analysis.

62 In terms of consequences of cask failure, Hitachi-GE has provided useful information on fuel degradation, but our view is that they currently appear to overestimate the time needed for air to enter the cask.

63 Hitachi-GE has presented information on its core monitoring system which is used to check certain core conditions. We identified that the initial argument presented by Hitachi-GE; that this system does not need to be safety classified, was not consistent with the system functions. A cross-cutting meeting is planned with Hitachi-GE to enable them to present further information on the hazard(s) associated with core monitoring system failure and potential mitigations.

Human Factors

64 During this period ONR's Human Factors (HF) team has worked with Hitachi-GE to ensure that it can put forward a credible programme with competent personnel, to address ONR HF concerns about the existing level and justification of Error of Commission analysis submitted against RO-ABWR-0024.

65 Additionally, RO-ABWR-0069 has been issued by ONR requiring:

- Provision of a strategy for the post-fault use of the different user interface systems in the main control room and elsewhere, in the face of process and interface system failures, i.e. the design basis for interface systems use.
- Identification of the potential for cognitive error in interface systems' user interactions.
- A demonstration that the design of user interface systems (at the GDA stage) should not impose any requirements to undertake secondary tasks within the main control room, which will adversely affect the execution of primary tasks relevant to nuclear safety.

66 ONR is aware that Hitachi-GE has a major planning exercise underway for verification and validation (V&V) of its Step 4 design. Hitachi-GE has provided the presentations on this at Level 4 meetings and its written submission in late June for formal assessment is awaited by ONR. Also, ONR's HF team have reviewed a Hitachi-GE submission on HF input to the design and are generally satisfied with the level and quality of input described. Minor clarifications are being sought via an RQ.

67 ONR's HF team have attended three L4 progress meetings within the period and two special L4 meetings (one cross cutting) to discuss RO-ABWR-0069. Despite the difficult issues that have been encountered, the interactions at these meetings have been positive.

Reactor Chemistry

- 68 In-line with Hitachi-GE's baseline programme, the pace of the reactor chemistry assessment has increased significantly during this quarter. Hitachi-GE has made submissions in a number of key areas, including: producing justifications (i.e. ALARP demonstrations) for chemistry control during commissioning, start-up and shutdown operations, numerous reports containing evidence to support the operating chemistry choice and a submission justifying the design of a number of key UK ABWR systems which deliver a chemistry control function. Assessment of submissions against RO-0044 and other related Hitachi-GE documentation justifying the safety and design of the UK ABWR off-gas system, has also been progressed.
- 69 Our initial assessment of this tranche of submissions has identified several areas that ONR will be targeting moving forward.
- 70 Work continues to resolve RO-0034, which although is not strictly limited to chemistry, has been led by this topic, to date. Hitachi-GE has demonstrated that its focus is in the right areas and ONR will commence formal assessment of the final deliverable during the next quarter.
- 71 Assessment of all major deliverables against RI-0001 has been completed, which has generated a substantial number of RQs, which Hitachi-GE has been responding to. This has led to the chemistry team working closely with fault studies colleagues to address a concern with the adequacy of Hitachi-GE's methodology to define the source terms associated with fuel-failures. Hitachi-GE is aware of ONR's position and is focussing its attention in the right areas to resolve the matter. It is likely this will lead to important changes to Hitachi-GE's approach to developing this aspect of the UK ABWR safety case, including changes to the definition of a number of source term values.
- 72 There has also been some good progress in the 'accident chemistry' topic. ONR has accepted the resolution plan for RO-0066 and Hitachi-GE's revised resolution plan for RO-0043. Although formal assessment of submissions against these ROs hasn't been undertaken during this quarter, interactions with the requesting party have demonstrated they understand regulatory expectations and continue to develop these aspects of the UK ABWR safety case, in-line with the agreed resolution plans.
- 73 Steps have also been taken to secure the services of TSCs which will be necessary to complete the remainder of the Step 4 reactor chemistry assessment. This has included extending two contracts already let during Step 3, commencement of support on chemistry sampling systems and commencement of a competitive tender exercise for a further four work packages.

Radiation Protection

- 74 Hitachi GE continues to deliver in line with the baseline plan, including responses to RQs and ROs. RO-ABWR-0014 submissions have been assessed and ONR is closing this observation. ONR has identified a gap in meeting our expectations for the design of arrangements to control access to high dose rate areas. We are therefore revising RO-ABWR-0064 to include additional actions related to Hitachi-GEs plans in this area.
- 75 We have reviewed of a number of documents in this period (including worker dose evaluation, shielding assessment reports, contamination control philosophy and source term reports) and this has led to a number of RQs, including clarification on the use of operational experience in worker dose ALARP demonstration.
- 76 A further area of regulatory scrutiny has been identified; potential conventional safety issues and operational radiation exposures, within dry well areas of the reactor during inspection activities at start up and shut down. This is due to the inerting of the UK ABWR containment atmosphere with nitrogen during periods at power.
- 77 ONR has recently appointed a TSC to provide assessment input into specific aspects of the Radiological Protection submissions issued by Hitachi GE.

Management of Safety and Quality Assurance (MSQA) Arrangements

- 78 During this period we undertook a two day joint ONR/ EA inspection of MSQA arrangements at Hitachi-GE works in Japan. The focus of the inspection was to:
- Test the effectiveness of the safety case production improvements made by Hitachi-GE.
 - Assess the technology transfer arrangements implemented to move the safety case into the operating regime.
 - Assess the arrangements for controlling design changes after the design reference point.
- 79 The inspection concluded that the processes are documented, implemented and largely meet regulatory expectations. Two particular positives were noted:
- ABWR-RO-0058 relating to provision of UK specific legal, environmental and safety case training given to the Hitachi-GE safety case development team is now considered to be closed.
 - The new arrangements for capturing 'requirements and assumptions' have improved the traceability of the claims/arguments/evidence trail through the safety case and supporting documentation, although it has not yet been applied to many sections of the safety case.
- 80 Some minor shortfalls were identified, for example:

- The Design Reference Point change process (the 'six step process') does not include adequate justification for the selected change category. This means that ONR will need additional evidence to gain confidence in the process.
 - Although UK specific training has been provided to Hitachi-GE staff, the uptake of the training was found to be inconsistent. This is not considered a barrier to closing ABWR-RO-0058; however Hitachi-GE may choose to review its refresher training arrangements.
- 81 In addition to the targeted inspection, there has also been regular engagement to help Hitachi-GE develop its arrangements for moving the safety case into the operating regime. Overall it remains the ONR view that MSQA submissions (consisting of the MSQA procedures and processes) have been sufficient to demonstrate that Hitachi-GE has a suitable management system for producing and managing its GDA submissions.

Management of Radioactive Wastes

- 82 During this quarter Hitachi-GE made all its submissions on the management of radioactive wastes according to plan and participated in Level 4 meetings with ONR, the Environment Agency and Radioactive Waste Management Limited.
- 83 Hitachi-GE accepts it needs to complete a significant amount of further work in a timely manner in order to address the requirements of RO-ABWR-36 within Step 4 and has mobilised a significant UK team to help deliver this.

Decommissioning

- 84 During this quarter Hitachi-GE submitted a topic report on design for decommissioning; participated in Level 4 meetings with ONR and the Environment Agency and continued to develop five further topic reports in accordance with the Step 4 plan.
- 85 ONR believes that a robust demonstration of design for decommissioning is a very important part of Hitachi-GE's safety case in GDA, as this will directly influence the scale of risks needing to be addressed at the end of the station's operational life. Hitachi-GE has recently:
- stated that it understands ONR's expectation that the UK ABWR reference design should be challenged in order to reduce the risks of decommissioning to ALARP;
 - progressed the UK ABWR design in line with ONR's guidance to requesting parties including the optimisation of the design for safe decommissioning. given a commitment to present the totality of its ALARP case for decommissioning in summer 2016, and;

- revised its programme of submissions to enable outputs from a topic report (on the safety assessment) to inform updates of other relevant decommissioning topic reports.
- 86 If Hitachi-GE delivers on the above points in a timely manner, ONR believes decommissioning can be addressed appropriately within the current GDA programme.

Management of Spent Fuel

- 87 During this quarter Hitachi-GE participated in Level 4 meetings with ONR and provided responses to RQs dealing with:
- containment during fuel drying;
 - provision of cooling to loaded casks during movements in the vicinity of the spent fuel pool, and;
 - recoverability from certain faults should they occur within the interim spent fuel store.
- 88 ONR is considering the adequacy of these responses on a multi-disciplinary basis.
- 89 ONR has established a system of meetings with the United States Nuclear Regulatory Commission (US NRC) to enable benchmarking of international good practices in the dry storage of spent fuel.
- 90 Hitachi-GE has also made progress with its submissions dealing with management of damaged fuel.
- 91 These recent developments have provided improved confidence that Step 4 can be completed successfully for this topic on the current timescales.

Environmental

- 92 Hitachi-GE submitted revision E of the Generic Environmental Permit (GEP) in February this year. The Environment Agency has been undertaking assessment of these submissions during this period.
- 93 As part of the assessment of these submissions we have raised several RQs which are currently being responded to by Hitachi-GE. The Environment Agency has also raised two ROs, which relate to requiring an improved understanding of non-radioactive discharges to surface waters (RO-ABWR-070) and additional discharges to atmosphere from the turbine gland steam via the ventilation system (RO-ABWR-071). The Environment Agency is holding regular technical discussions with Hitachi-GE, who are working towards the resolution of the ROs.
- 94 The Environment Agency is currently producing assessment reports and working towards the consultation on its findings so far, which is expected later this year.

Conventional Safety

- 95 A number of positive engagements have taken place with Hitachi-GE during the reporting period to discuss its UK ABWR ‘open top’ construction and modular build methodology. ONR has identified areas where it requires further understanding of how construction risks will be considered during design. ONR’s suggestion is that Hitachi-GE sets out its reasoning and evidence as part of its GDA safety case submission, which may reduce regulatory risks later in the project. However, ONR recognises that the evidence may be submitted as part of the detailed design phase. ONR has therefore issued an RQ inviting Hitachi-GE to consider a number of ONR expectations. Hitachi-GE has been asked to identify those expectations that will be set out in its GDA safety case, and to provide its rationale and reasoning for any topics considered out the scope of GDA.

Fire Safety

- 96 Hitachi-GE continues to make very good progress on the protection of life from fire, for buildings on the nuclear island. The submissions meet UK expectations for fire safety building design, through a managed combination of code compliance and fire engineered ALARP justifications for design features that depart from prescriptive codes of practice. Work is now focusing on developing a fire safety strategy for the underground service tunnels.

2.9 Forward look

- 97 Over the coming months we will continue to progress our detailed assessment of Hitachi-GE’s submissions and prepare the Environment Agency’s assessment reports to support consultation. We will also undertake a series of cross cutting meetings in July.

3 GDA of the AP1000

3.1 Progress update

- 98 Westinghouse presented its revised governance and programme to regulators at a senior level meeting in April 2016. We highlighted in our last update that we had requested Westinghouse to undertake a 'deep-dive' programme review; this was completed and has resulted in a slight extension to the closure period to March 2017. Our view is that this new date remains challenging when considering the volume of work remaining and the scheduling of deliverables to the regulators in some areas.
- 99 This period has been one of intensive management activity on the part of both Westinghouse and the regulators. All parties have been focused on resolving technical issues and understanding in detail the programme impact of the remaining volume of work.
- 100 Of particular concern is the PCSR, which is the last deliverable very late in the programme. This needs to be right first time and delivered on time (as do all remaining deliverables) for the project to complete on time. We have an inspector dedicated to managing this issue, and we will undertake a further programme deep-dive to inform our confidence in the revised GDA closure date overall.
- 101 The regulators are also developing a very detailed end-stage programme to determine where further management intervention should be focused, and to determine efficiencies or mitigation we can put in place.
- 102 We are beginning to see a positive impact of the changes that have been made by Westinghouse to its UK team and approach to GDA, and the exposure to senior Executives of programme and technical issues seems to have helped recover its position to some extent.
- 103 Westinghouse has made progress on technical convergence with ONR, and there is only one GDA issue where discussions are ongoing (reactor chemistry GDA Issue-02). ONR has sought independent opinion on our regulatory position in this area and we hope to be able to agree a way forward over the next quarter.
- 104 Progress has been made in mechanical engineering, where technical convergence was reached and a revised programme was developed through a series of meetings and workshops, involving ONR's Head of Profession in this area.
- 105 There is an emerging technical 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. This has very recently come to light and we are working with Westinghouse to understand the implications. We will provide further information in our next quarterly update.
- 106 Within the period the regulators have issued 89 RQs.

3.2 Meetings in period

107 There were 133 meetings in the period. 126 of a technical nature and seven non-technical.

3.3 Public and stakeholder engagement and communications

108 There have been no public queries received in this period via the AP1000 website. We are working with Westinghouse's communications manager to promote the comments process to stakeholders and communities, particularly in Cumbria where NuGEN propose to construct this design. The comments process remains open until around four months before we make our decision on the acceptability of the AP1000.

3.4 Technical Support Contracts

109 No AP1000 TSC contracts have been let during this period.

3.5 Summary of regulator charges

AP1000

Office for Nuclear Regulation:

- Charges for the quarter January 2016 – March 2016 £1,331,245
- Cumulative charges £28,778,605

Environment Agency:

- Charges for the quarter January 2016 – March 2016 £ 63,155
- Cumulative charges £ 2,621,079

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)
<p>Red – Communications and interactions have been significantly</p>	<p>Red - Submissions are not addressing the GDA Issue and immediate</p>

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

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	Red	Red	Green	Green	Green	Yellow	Yellow	Green	Red	Red	Red	Yellow	Yellow	Green	Green	Green	Green	Red	Red	Yellow	Green	Green	Green
Category 2 - Submissions	Yellow	Yellow	Yellow	Green	Green	Green	Yellow	Yellow	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Red	Red	Yellow	Green	Green	Yellow
Category 3 - Interactions	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Category 4 - GDA Issue 1	Yellow	Yellow	Yellow	Green	Green	Green	Yellow	Yellow	Green	Red	Red	Red	Green	Yellow	Green	Blue	Green	Blue	Red	Red	Yellow	Green	Green	Green
Category 4 - GDA Issue 2	Green	Green	Green	Green	Green	Green	Yellow	Yellow	Green	Yellow	Yellow	Yellow	Green	Yellow	Green	Green	Green	Green	Yellow	Yellow	Yellow	Yellow	Yellow	Red
Category 4 - GDA Issue 3	Yellow	Yellow	Yellow	Green	Green	Green	Yellow	Yellow	Green	Yellow	Yellow	Yellow	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Category 4 - GDA Issue 4	Yellow	Yellow	Yellow	Green	Green	Green	Yellow	Yellow	Green	Yellow	Yellow	Yellow	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Category 4 - GDA Issue 5	Yellow	Yellow	Yellow	Green	Green	Green	Yellow	Yellow	Green	Yellow	Yellow	Red	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Category 4 - GDA Issue 6	Yellow	Yellow	Yellow	Green	Green	Green	Yellow	Yellow	Green	Yellow	Yellow	Yellow	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Category 4 - GDA Issue 7	Yellow	Yellow	Yellow	Green	Green	Green	Yellow	Yellow	Green	Yellow	Yellow	Yellow	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Category 4 - GDA Issue 8	Green	Yellow	Yellow	Green	Green	Green	Yellow	Yellow	Green	Yellow	Yellow	Yellow	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Category 4 - GDA Issue 9	Yellow	Yellow	Yellow	Green	Green	Green	Yellow	Yellow	Green	Yellow	Yellow	Yellow	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Category 4 - GDA Issue 10	Yellow	Yellow	Green	Green	Green	Green	Yellow	Yellow	Green	Yellow	Yellow	Yellow	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Category 5 - Emerging Issues	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N		N	N	Y	N	Y	Y	Y
	F	M	A	F	M	A	F	M	A	F	M	A	F	M	A	F	M	A	F	M	A	F	M	A

	PSA			Electrical Engineering			Rad Protection			Human Factors			Cross Cutting 1			Cross Cutting 2			Cross Cutting 3		
Category 1 - Programme	Green	Green	Green	Red	Red	Yellow	Green	Green	Green	Yellow	Yellow	Yellow	Green	Green	Green	Green	Green	Green	Green	Green	Green
Category 2 - Submissions	Green	Green	Green	Red	Red	Yellow	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Category 3 - Interactions	Green	Green	Green	Red	Red	Yellow	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Category 4 - GDA Issue 1	Green	Green	Green	Red	Red	Yellow	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Category 4 - GDA Issue 2	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Category 4 - GDA Issue 3	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Category 4 - GDA Issue 4	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Category 4 - GDA Issue 5	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Category 4 - GDA Issue 6	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Category 4 - GDA Issue 7	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Category 4 - GDA Issue 8	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Category 4 - GDA Issue 9	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Category 4 - GDA Issue 10	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Category 5 - Emerging Issues	N	N	N	N	N	N	Y	Y	N	N	N	N	N	N	N	N	N	N	Y	Y	Y
	F	M	A	F	M	A	F	M	A	F	M	A	F	M	A	F	M	A	F	M	A

3.7 Metrics Detail

Civil Engineering

- 110 During this period, all deliverables and requested supporting references were submitted on schedule. The assessment work is now progressing well.
- 111 A Level 4 meeting was held between ONR, our TSC and Westinghouse to discuss comments on concrete and steel materials, leak detection and the steel-concrete (SC) construction modules.
- 112 The civil engineering aspects of the metrication GDA issue (MM-02) have been reviewed again to provide further feedback and guidance to the Westinghouse authors of its ALARP assessment in this area.
- 113 The way forward in assessing the fire resistance of the SC units has been agreed.

External Hazards and Site Characterisation

- 114 PCSR chapters on site characterisation and external hazards are being assessed, and our early view is that they appear to meet regulatory expectations.

Internal Hazards

- 115 Following agreement between ONR and Westinghouse on the technical way forward for GDA Issues IH-02 (internal flooding) and IH-03 (pressure part failure), Westinghouse has revised all internal hazards resolution plans (IH-01 to IH-06).
- 116 In the last quarter, ONR raised concerns on the overall clarity and coherence of the documents being issued. In particular:
- to clarify the suitability and sufficiency of the methodologies being used;
 - undertake sensitivity analysis where appropriate;
 - consider cross-cutting impacts, take account of any operational experience or new learning from global incidents;
 - clarify the basis of design, define and justify claims and arguments and supporting evidence; and
 - provide a hazard schedule.
- 117 With regard to the claims being made, information relevant to categorisation and classification of the identified systems, structures and components (SSCs), including substantiation of the penetrations (doors, cables and pipes) appears limited.
- 118 During the last period, Westinghouse has reacted positively and has undertaken further analysis for internal fire, internal explosion and turbine disintegration using

different modelling techniques and assumptions. Westinghouse also made progress with its work in the areas of internal flooding and dropped loads.

- 119 In pressure part failure, Westinghouse submitted a revised methodology and criteria, and our discussions are on-going in this area. Westinghouse also proposed to include three bounding examples in the topic report with the remaining high energy lines to be address post GDA. These lines are part of the generic design and do not depend on site specific input. ONR has therefore requested clarity on the risk gap.

Mechanical Engineering

GI-AP1000-ME-01: Squib Valves

- 120 A number of meetings were held with Westinghouse this quarter to discuss the claims, arguments and evidence being developed to justify that the design meets the safety case requirements. A key meeting (workshop) was held in April 2016 where a number of ONR inspectors discussed with Westinghouse its approach, and identified a number of steps required to satisfy regulatory requirements and improve the quality of submissions. This area is now improving and our confidence in Westinghouse's ability to deliver is increasing.

GI-AP1000-ME-02: Metrication

- 121 Westinghouse submitted a revised metrication strategy document to ONR in February 2016. Assessment of this was undertaken in March and April and we concluded that there are quality issues and a lack of arguments and evidence presented. A meeting is scheduled for May 2016 and will be reported on in the next quarterly report.

Structural Integrity

- 122 Westinghouse provided a draft re-baselined programme covering fracture avoidance (SI-01 GDA Issue) and assessment of the steam generator vertical support integrity under a postulated reactor coolant pump bowl missile as part of the classification work (SI-06 GDA Issue). The re-baselined programme was agreed at the working level and includes proposals to manage the technical risks relating to reconciliation between the fracture assessments and inspection plans for SI-01. The re-baselined programme also includes a defined timetable of activities, with options being pursued in parallel to close-out the reactor coolant pump bowl missile/steam generator support interaction work for SI-06. This work is also technically challenging, and with the outcome of the analyses uncertain, optioneering in parallel rather than sequence provides time to consider potential design changes within the GDA.
- 123 Progress is being made in the assessment of ASME III Class 1 pipework fatigue analyses (SI-02 GDA Issue) and the structural integrity assessment of the reactor coolant pump bowl (SI-03 GDA Issue). However, ONR's assessments work for the

fracture assessment of the containment vessel (SI-04 GDA Issue) and the classification work (SI-06 GDA Issue) was temporarily delayed while we secured additional resource in this area. There is an emerging technical issue relating to structural integrity GDA Issue SI-05, around Westinghouse's demonstration that the main vessels in the AP1000 (e.g. reactor pressure vessel and pressuriser) which are classified by Westinghouse as high safety significance (equivalent to highest reliability in the SAPs) are compliant with ASME III design criteria. This has recently come to light and we are working with Westinghouse to establish the technical and programme implications for the structural integrity and other GDA disciplines. We will provide further information in our next quarterly update.

Electrical Engineering

- 124 ONR's has received proposals on how the AP1000 complies with the UK Grid Code, and how this will be demonstrated in the safety case. A draft programme for closure of the GDA Issue has been received but this can only be confirmed once the adequacy of the technical submission has been assessed.

Control and Instrumentation

- 125 During this period Westinghouse has confirmed that they will undertake a significant design change in order to provide Class 1 displays and controls in the Remote Shutdown Room of the AP1000. This commitment addresses a long-standing point of non-convergence on the CI-10 GDA Issue, and has resulted from an optioneering study by Westinghouse that was prompted by ONR. The safety justification of the new design will be assessed following its submission in July 2016.
- 126 There have been eight technical and three progress meetings between ONR and Westinghouse in the C&I topic area since the beginning of April.
- 127 With regard to overall progress, although Westinghouse is meeting its re-baselined plan, we still have concerns on its ability to deliver high quality timely submissions. We have also been informed that Westinghouse intends to defer a number of supporting submissions. Furthermore, although there have been some signs of progress, ONR is yet to see a significant improvement in the quality of submissions. The documents to be submitted in the coming months, and the forthcoming ONR 'health check' will be key factors in determining confidence in the overall programme of work.
- 128 The Westinghouse schedule for C&I highlights a 'bow wave' of submissions, and this will be a significant assessment challenge for ONR and our TSC. However our greatest concern is the C&I chapter of the PCSR. A number of meetings have been held on this topic and draft/skeleton documents have been shared with us. However the date of submission of Revision 1 of the document (31 January 2017), which should include relevant information from submissions made to ONR during summer 2016, is very late in the closure programme schedule.

Fault Studies

- 129 A major meeting was held with Westinghouse in April 2016 at its Cranberry offices. ONR considers that Westinghouse is generally in a good position for all eight fault studies GDA issues. There are no areas of technical uncertainty or disagreement and good quality submissions have been provided to date. However, there is a significant amount of work for Westinghouse to do to summarise its safety case in an updated version of its PCSR. The timescales to update the PCSR are likely to influence the timing of formal closure of the eight GDA issues, but it should not be a challenge to the overall project timescales in this area.

Fuel and Core

- 130 During this period Westinghouse has provided ONR with an updated version of the PCSR chapters. There has been some improvement but the safety claims are not always substantiated by supporting evidence, or the arguments presented in the supporting material are not explained in sufficient detail in the PCSR chapter.
- 131 Assessment of the proposed design changes is underway and there are currently no significant issues to report.
- 132 Additionally, during this period Westinghouse has presented information on the results of the analysis of blow-down forces associated with a cold leg break of the primary pipework. In the case of the equilibrium core, fuel spacer-grid buckling is restricted to assemblies on the core edge; where this is likely to be benign. In the first core, one row of one assembly inboard buckled. We await more detail to confirm that this approach is acceptable.
- 133 Westinghouse has also presented the results of its ALARP study for use of BEACON. Some good progress has been made but there are a number of areas where further work will be needed; particularly on the issue of shutdown margin. However this is achievable in the remaining GDA timescales.

Human Factors (HF)

- 134 During this period good progress has been made on HF-01 and Westinghouse is on programme to deliver the analysis needed to close out this GDA issue. Westinghouse has responded well to feedback from ONR on early drafts of the analysis and quality has progressively improved. Also, the HF aspects of the PCSR are on schedule.
- 135 Importantly, the level of Westinghouse's HF integration has significantly improved over this quarter and its team has actively promoted the need for a robust HFI process to support the closure of other GDA issues.

Probabilistic Safety Assessment (PSA)

- 136 During this period we have progressed our assessment of the Westinghouse internal events at-power risk model.
- 137 We have also completed our assessment of the Level 1 PSA accident sequences to core damage represented by the event tree models, and its consistency with the success criteria analysis. This is been supplemented by completing the assessment of the Plant Damage States (PDS) and the Level 2 PSA accident sequences that represent the routes to fission product releases. Underlying this work is the physical accident analysis modelling work for which Westinghouse has used the MAAP computer code. The assessment of the MAAP modelling work is nearing completion.
- 138 A sample assessment of the AP1000 protection systems has been completed using the Protection and Safety Monitoring System (PMS) and its actuation of the squib valves. The latter assessment was developed to risk inform the C&I and mechanical engineering assessments of the PMS and squib valves respectively.
- 139 Additionally, during this period we have continued our assessment of GDA Issue PSA-02 (Fire PSA). Assessment work has concentrated on the approach used by Westinghouse to partitioning the AP1000 plant into fire compartments, the approach used to identify the important safety equipment impacted by fires to incorporate into the fire risk model, and the frequency of significant fires throughout the plant.
- 140 Arranging the assessment of the fire risk model and the cable fire analysis is being pursued by ONR. This requires a visit to the Westinghouse Cranberry offices to access the required information.

Reactor Chemistry

- 141 Westinghouse has continued engagement with ONR on its work to resolve GDA Issue RC-01 over the period, and has recently delivered its first submission on this issue. We have commenced our assessment of this and submission of the final deliverables to address this GDA issue remains on target.
- 142 Similar to the last reporting period, most of the interactions over the period have been related to resolution of GDA Issue RC-02 and the design of the sampling system for AP1000. We have continued engagement on the content and approach taken by Westinghouse to resolve this issue and the final deliverable has recently been submitted to ONR for assessment, which is ongoing. On the basis of the limited assessment conducted to date, we have identified a number of areas where further justification and evidence will be necessary to underpin the conclusions reached by Westinghouse. In some instances, ONR judges that this work may be significant and the reactor chemistry inspectors will be discussing this with Westinghouse to agree a suitable way forward.

- 143 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.
- 144 Westinghouse has provided a partial response to ONR queries relating to the chemistry chapter of the PCSR, and has committed to further work to address the remainder. Although we are encouraged by the progress made to date, we believe that significant work will be necessary to produce an adequate PCSR from a chemistry perspective.

Radiological Protection

- 145 All submissions relating to GDA Issue RP-01 have been received on schedule. Westinghouse has modified its ALARP position since the last quarterly report to include a design change to address the issue, and increased the spent fuel pool cooling time (relative to the previous ALARP proposal). The design change proposal and ALARP position paper are both being progressed by Westinghouse. Assessment of this ALARP position and related RQs is ongoing.

GI-AP1000-CC-01 Limits and conditions

- 146 Westinghouse has now provided all the deliverables set out in its resolution plan for this Issue. This includes a set of generic Technical Specifications covering the safety related limits and conditions for the plant, and an amendment to Chapter 5 of the draft generic PCSR. ONR is considering these documents and will provide feedback to Westinghouse in due course. Currently, there are no indications that this issue cannot be satisfactorily closed before the end of this year.

GI-AP1000-CC-02 PCSR to support GDA

- 147 All of the revised chapters of the generic PCSR have been submitted. These constitute Revision 0A of the PCSR; which completes one of the actions needed to resolve this issue. ONR is providing feedback to Westinghouse on the adequacy of these revisions, and it is recognised by ONR and Westinghouse that for some of the more complex technical chapters there will need to be a further revision (i.e. Revision 0B). Ultimately, Westinghouse will submit a consolidated PCSR at Revision 1, which will form the basis of a DAC, once all issues are satisfactorily resolved. We consider that Westinghouse's target for providing Revision 1 will be challenging, particularly for some chapters, although we acknowledge the considerable efforts that Westinghouse's technical teams are expending in order to achieve this.
- 148 Westinghouse is updating the Environment Report in response to GDA Issue CC-02. The Environment Agency provided substantial comments on Revision 5A of the Environment Report in February. The Environment Agency comments highlighted the need to ensure that any final Environment Report in support of

GDA reflects changes to relevant legislation, policy and organisational designations since the iSoDA was issued in 2011. The regulatory understanding remains that resolution of the outstanding nuclear safety GDA issues is unlikely to significantly impact the claims, arguments and evidence in the Environment Report against which the iSoDA was issued, although the Environment Agency will review this as the GDA Issues are closed, and when the final Environment Report is submitted.

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

- 149 Overall, the performance of Westinghouse so far indicates that this GDA issue can be closed by the agreed date.
- 150 A report into the lessons learned has been assessed and it is expected that resolution of regulatory comments will be achievable. Regulatory queries have been raised in the areas of fault studies and human factors, civil engineering and control & instrumentation. A further regulatory query will be raised regarding spent fuel pool level indication. The report into the international lessons learned was delivered by Westinghouse in March 2016. This has been assessed and is deemed to be adequate following discussions.

3.8 Forward look

- 151 The next period will focus on progressing assessment and undertaking a further project deep-dive or health check overall, and specific to the PCSR and Environment Report cross cutting GDA Issue.

4 WIDER GDA

4.1 International Work

- 152 The ABWR Working Group (ABWRWG) within the Multinational Design Evaluation Programme (MDEP) held its fifth meeting, as well as the third meetings of its Technical Expert Sub-groups on Severe Accident and Instrumentation and Control from 25 to 28 April 2016. The meetings were hosted by the US NRC at its Headquarters in Rockville, Maryland. The trip included a visit to Toshiba's ABWR simulator in Charlotte, where a few fault scenarios were demonstrated. During the meetings updates were provided on the status of the ABWR projects; regulatory assessments in each member country and any significant issues that are currently being addressed. Of particular relevance to ONR's UK ABWR GDA was an initial discussion on seismic evaluations for boiling water reactors; this matter will be followed-up in detail during the next ABWRWG meeting in September 2016.
- 153 During this period MDEP's "ABWR common position paper addressing issues related to the Fukushima Dai-ichi accident" has undergone factual accuracy

review by relevant industry stakeholders. The stakeholders' comments were sanctioned during the April meeting and the final report is currently being prepared to be submitted to MDEP's Steering Technical Committee for approval and subsequent publication.

- 154 During the period, we have held discussions with SSM (Swedish Radiation Safety Authority, the Swiss Federal Nuclear Safety Inspectorate, the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety and the US NRC on the management of spent fuel. We have addressed topics such as loading and conditioning of fuel into dry casks, long-term management, and regulatory oversight of spent fuel facilities and their safety. We are planning to continue these discussions in the coming months focusing on specific topics of interest.
- 155 Discussions with SSM have commenced to also address boiling water reactor radiation protection matters relevant to our UK ABWR assessment.
- 156 In relation to the AP1000, during this period we have continued bilateral engagement with the US NRC, in particular focusing on the areas of mechanical engineering (squib valves) and structural integrity.