

Assessing new nuclear reactor designs

Generic Design Assessment Quarterly Report
November 2015 – January 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 | Engagement | 6 |
| 2.4 | Enhanced collaborative working – Hitachi-GE and Horizon Nuclear Power | 7 |
| 2.5 | International work | 7 |
| 2.6 | Technical Support Contracts | 8 |
| 2.7 | Summary of Regulator Charges | 8 |
| 2.8 | Metrics Summary | 9 |
| 2.9 | Metrics Detail | 13 |
| | Civil Engineering | 13 |
| | External Hazards | 13 |
| | Internal Hazards | 13 |
| | Mechanical Engineering | 14 |
| | Structural Integrity | 14 |
| | Security | 15 |
| | Probabilistic Safety Assessment (PSA) | 15 |
| | Severe Accident Analysis | 16 |
| | Fault Studies | 16 |
| | Control and Instrumentation (C&I) | 16 |
| | Electrical Engineering | 17 |
| | Fuel and Core Design | 17 |
| | Human Factors | 18 |
| | Reactor Chemistry | 18 |
| | Radiation Protection | 19 |
| | Management of Safety and Quality Assurance (MSQA) Arrangements | 19 |
| | Management of Radioactive Wastes | 19 |
| | Decommissioning | 20 |
| | Management of Spent Fuel | 20 |

| | |
|--|----|
| Environmental | 20 |
| Conventional Safety | 21 |
| Fire Safety | 21 |
| 2.10 Forward look | 21 |
| 3 GDA of the AP1000 | 22 |
| 3.1 Progress update | 22 |
| 3.2 Meetings in period | 23 |
| 3.3 International work | 23 |
| 3.4 Engagement | 23 |
| 3.5 Technical Support Contracts | 23 |
| 3.6 Summary of regulator charges | 24 |
| 3.7 Metrics Summary | 25 |
| 3.8 Metrics Detail | 28 |
| Civil Engineering | 28 |
| Internal Hazards | 28 |
| Mechanical Engineering | 29 |
| Structural Integrity | 29 |
| Electrical Engineering | 30 |
| Control and Instrumentation | 30 |
| Fault Studies | 31 |
| Fuel and Core | 31 |
| Human Factors | 31 |
| PSA | 32 |
| Reactor Chemistry | 32 |
| Radiological Protection | 33 |
| GI-AP1000-CC-01 Limits and conditions | 33 |
| GI-AP1000-CC-02 PCSR to support GDA | 33 |
| GI-AP1000-CC-03 lessons learned from the Fukushima event | 34 |
| 3.9 Forward look | 34 |



1 INTRODUCTION AND BACKGROUND

- 1 This report provides information on the work that we have been carrying out on the Generic Design Assessment (GDA) process during the period November 2015 to January 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 This period has marked the start of significant assessment work on the UK ABWR GDA project with the start of ONR's Step 4. Our focus is on trying to identify any further design or safety/security case changes that may be required, as early in this Step as possible. As a result we expect to see an increase in the number of Regulatory Questions (RQs) and Regulatory Observations (ROs) raised, as we undertake the detailed assessment of the design. There are no new, significant technical issues to highlight.
- 3 The Environment Agency has had continued regular interactions with Hitachi-GE on a range of on-going topics during this period, in preparation to receive an updated environment submission during February. Once this submission has been received, the Environment Agency will carry out its detailed assessment and will also focus on identifying any further design or submission changes that may be required. During the autumn, the Environment Agency is planning to publish its preliminary findings and commence its GDA consultation.
- 4 Overall, the regulators consider that the project is stable and progressing as we would expect at this stage.
- 5 For the AP1000 project, there has been an increase in management attention from the regulators and Westinghouse during this period. There has been closure programme slippage and a lack of technical convergence in some areas. This means that we have still to agree with Westinghouse the full extent of the work required to close out all of the GDA issues. This lack of progress and agreement on the way forward in specific areas is disappointing so far into the closure phase. In an effort to resolve technical differences of opinion, address topics of concern and to move the project forward, we undertook a technical convergence workshop with Westinghouse in December 2015. We also requested that Westinghouse Senior Executives attend a meeting to discuss the on-going viability of its closure programme and expected date for achieving a Design Acceptance Confirmation (DAC) and Statement of Design Acceptability (SoDA). This increased focus has improved the situation, but important areas of non-convergence remain. We are concerned about the closure programme schedule and await the results of Westinghouse's programme review.
- 6 Following the announcement made by the UK and Chinese Governments in October 2015, as reported in our last quarterly update, we attended a three day workshop in China with EDF and China General Nuclear Corporation (CGN). This inaugural workshop provided an opportunity for us to present at a high level, the UK regulatory framework and the GDA process and requirements. Similarly CGN presented an overview of the HPR1000 technology and its developing project structure and governance arrangements. We consider that the proposed

Requesting Party is in a good position to begin GDA; its preparations to date, knowledge of the regulatory framework and appreciation of expectations and requirements was notable. We are ready to commence the GDA when requested by government. In meantime we will continue to provide regulatory advice to EDF and CGN to further aid their preparations for entry.

- 7 On Wednesday 25 November, as part of the Spending Review / Autumn Statement 2015, the Chancellor of the Exchequer announced “a major commitment to small modular nuclear reactors¹”. This may involve the regulators in earlier work than expected.
- 8 DECC is undertaking a techno-economic assessment (TEA) for small modular reactor (SMR) technology deployment in the UK. This concludes in March 2016 and will be followed by a competition phase to identify the technology(ies) to be taken forward.
- 9 To date ONR has hosted a SMR workshop as part of the TEA, to identify regulatory areas of interest and to explore regulatory strategies for design assessment and nuclear site licensing. Additionally, the Environment Agency has met with DECC to discuss design assessment and permitting of SMRs. The regulators will also provide regulatory input into the competition phase.
- 10 We welcome comments on this report. Please send them to us at new.reactor.build@onr.gsi.gov.uk.
- 11 To find out more about GDA 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

¹ Full text from spending review: As part of this, the Spending Review and Autumn Statement invests at least £250 million over the next 5 years in an ambitious nuclear research and development programme that will revive the UK’s nuclear expertise and position the UK as a global leader in innovative nuclear technologies. This will include a competition to identify the best value small modular reactor design for the UK. This will pave the way towards building one of the world’s first small modular reactors in the UK in the 2020s. Detailed plans for the competition will be brought forward early next year.

2 GDA of the UK ABWR

2.1 Progress update

- 13 This period has marked the start of ONR's Step 4 and the detailed technical assessment phase of GDA. For the Environment Agency, there have been continued regular interactions with Hitachi-GE, in preparation to receive an updated environment submission during February. The rescheduling of the end of ONR's Step 3 by Hitachi-GE has helped it to enter ONR's Step 4 in a strong position. There is a great deal to do but we remain encouraged by Hitachi-GE's commitment and responsiveness. We expect a period of business as usual for some time now as our Inspectors begin their assessment of a large number of complex documents, which provide the evidence underpinning the safety case claims and arguments considered in earlier GDA steps.
- 14 The GDA 4 Step process aims to identify significant issues early on; hence we would not expect major issues to be emerging at this stage. However due to the nature of regulatory assessment and our sampling approach, this cannot be ruled out. It is our intention to identify any design or safety/security case issues as early in Step 4 as we can, to enable Hitachi-GE to address them within the remaining programme time.
- 15 We note the continued increase in resource, and in particular resource with UK safety case and regulatory experience. This is positive and builds our confidence in the likelihood of right first time submissions and the completion of GDA in December 2017.
- 16 Updates on the existing two Regulatory Issues are provided in the 'metrics detail' section of this report.
- 17 11 ROs and a total of 65 RO actions (ROAs) have been successfully closed to date.

2.2 Meetings in period

- 18 Within the period there were 71 technical meetings and nine non-technical project meetings.

2.3 Engagement

- 19 Within the period there were four comments posted on the Hitachi-GE comments website bringing the total number submitted to 47 at the end of January 2016, all of which have now been responded to. There were no repeated questions although two questions on a similar theme were asked by the same individual.

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

- 20 During this period the tripartite way of working on safety case matters (involving Hitachi-GE, Horizon and the regulators) has continued, with two progress meetings held in November 2015 and January 2016. All organisations involved agree that these tripartite meetings are productive, informative and encourage cooperation, and therefore should continue.
- 21 During this period we have seen further activity of the Hitachi-GE – Horizon Joint Safety Case Office (JSCO), which is currently developing the GDA safety case documentation for the service building and the tunnels (amongst its other activities). We have also seen further development of the JSCO arrangements, including its ‘tasking’ procedure and a clear role definition for its joint steering group.
- 22 In this period ONR carried out an inspection on various aspects of the JSCO. The inspection concluded that although it is early days, the JSCO is being established very well and has high potential to influence a successful GDA safety case. This case can be transferred to the future licensees for proposed new UK ABWR plants at Wylfa Newydd and Oldbury.

2.5 International work

- 23 During this period ONR has continued bilateral engagement with the US Nuclear Regulatory Commission (NRC).
- 24 We have discussed seismic margins analysis with US NRC’s specialists in support of our assessment of the UK ABWR. More recently we have had initial contact with NRC to start discussions on regulation of spent fuel storage facilities, also in support of our UK ABWR GDA.
- 25 During this period the ABWR Working Group (ABWRWG) within the Multinational Design Evaluation Programme (MDEP) has completed drafting the ABWR common position paper addressing issues related to the Fukushima Dai-ichi accident, which is now ready for factual accuracy review by ABWR industry stakeholders. This is an important milestone for MDEP’s ABWRWG. The paper provides discussions about how the various ABWR designs address a number of relevant aspects (evolutionary improvement in safety, external hazards, reliability of safety functions, accidents with core melt, emergency preparedness in design, spent fuel pools, and safety analysis) and statements of the common position, among the international regulators, for each of those aspects. This is in line with similar post-Fukushima position papers MDEP has published or is developing for other reactor designs.
- 26 During this period we attended a meeting of the Digital Instrumentation and Control (I&C) Working Group (DICWG) within MDEP. The group continued to develop common position papers on I&C hazard identification and control, and I&C spurious actuation. Once completed these papers will be published on MDEP’s web site. We use MDEP’s common positions to inform our Technical

Assessment Guides (TAGs) and Safety Assessment Principles (SAPs) and our understanding of relevant good practice, all relevant to our GDA work.

2.6 Technical Support Contracts

- 27 Between November 2015 and January 2016 the regulators did not let any technical support contracts relating to the UK ABWR project.
- 28 Going forward, letting TSCs will be a major focus of activity across many topic areas, and we are confident that this can be delivered to support GDA completion by end December 2017.

2.7 Summary of Regulator Charges

UK ABWR

Office for Nuclear Regulation:

- Charges for the period October 2015 – December 2015 £ 1,587,632
- Cumulative charges: £ 14,898,302

Environment Agency:

- Charges for the period October 2015 – December 2015 £ 151,333
- Cumulative charges: £ 2,642,308

2.8 Metrics Summary

| GDA Metrics Definitions | |
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| 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> |

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| | <p>Grey – 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)² 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> |

² 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

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| <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><u>Green</u> - 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><u>Blue</u> - No RO/RI Issued</p> <p style="text-align: right;">OR</p> <p>The RO/RI has been closed</p> |
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| | Civil Engineering | | | External Hazards | | | Internal Hazards | | | Mechanical Engineering | | | Structural integrity | | | Conventional Safety | | | Fire Safety | | | PSA | | | Reactor Chemistry | | |
|------------------------------|------------------------|---|---|--------------------|---|---|------------------|---|---|------------------------|---|---|----------------------|---|---|--------------------------|---|---|-----------------|---|---|---------------|---|---|-------------------|---|---|
| Category 1 - Programme | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 2 - Submissions | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 3 - interactions | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 4 - Existing Issues | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 5 - Emerging Issues | Y | N | Y | Y | Y | N | Y | Y | Y | Y | N | Y | N | N | N | N | Y | Y | N | N | N | Y | Y | Y | Y | Y | Y |
| | N | D | J | N | D | J | N | D | J | N | D | J | N | D | J | N | D | J | N | D | J | N | D | J | N | D | J |
| | Radiation Protection | | | Human Factors | | | MSQA | | | Rad Waste | | | Decommissioning | | | Spent Fuel Interim Store | | | Severe Accident | | | Fault Studies | | | C&I | | |
| Category 1 - Programme | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 2 - Submissions | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 3 - interactions | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 4 - Existing Issues | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 5 - Emerging Issues | Y | N | N | Y | Y | Y | N | N | N | Y | N | N | N | N | Y | Y | N | N | Y | Y | N | | | Y | Y | Y | Y |
| | N | D | J | N | D | J | N | D | J | N | D | J | N | D | J | N | D | J | N | D | J | N | D | J | N | D | J |
| | Electrical Engineering | | | Fuel & Core Design | | | Security | | | Environmental | | | | | | | | | | | | | | | | | |
| Category 1 - Programme | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 2 - Submissions | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 3 - interactions | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 4 - Existing Issues | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 5 - Emerging Issues | N | N | N | N | N | Y | N | N | N | Y | N | N | | | | | | | | | | | | | | | |
| | N | D | J | N | D | J | N | D | J | N | D | J | | | | | | | | | | | | | | | |

2.9 Metrics Detail

Civil Engineering

- 29 During this period, the review of the Hitachi-GE civil engineering document submissions has continued with support from a Technical Support Consultant and several iterations of draft comments have been shared with Hitachi-GE. Face-to-face technical meetings between ONR and Hitachi-GE have continued with the ONR Technical Support Consultant providing assistance. Formal issue of the assessment comments is expected at the end of February 2016.
- 30 During December an additional contract for civil engineering technical support during GDA Step 4 was issued for tender. Tenders were received in January and a moderation panel to select a suitable Technical Support Consultant was held. The contract is expected to be awarded in late February / March.
- 31 Hitachi-GE has advised ONR that a revision of the Reactor Building and Reinforced Concrete Containment Vessel (RCCV) Design Report will be delayed by 2½ months, due to changes Hitachi-GE has proposed in its approach to the loadings under Loss of Coolant Accident (LOCA) conditions.
- 32 ONR has questioned the methodology used for the seismic assessments when compared to relevant good practice. A meeting has been arranged to agree the way forward.

External Hazards

- 33 During the current period, Hitachi-GE has met the programme and the quality of the submissions is adequate overall. The exception to this is the treatment of beyond design basis events, including external flooding within GDA. Hitachi-GE has committed to provide additional justification and to provide evidence during GDA Step 4. Therefore, RO-ABWR-0067 has been raised and discussed with Hitachi GE. Hitachi GE has committed via letter to addressing these issues and work is now underway.

Internal Hazards

- 34 Hitachi-GE has issued a number of Topic Reports. The quality of the documents has not been in line with ONR's regulatory expectations and a number of RQs have been raised.
- 35 ONR assessment work has paid particular attention to Hitachi-GE's documentation regarding turbine disintegration and potential impact with key buildings. This will continue to require regulatory attention in the near future, involving a number of technical disciplines within ONR.
- 36 Internal Hazards has taken the lead in the ONR assessment of spent fuel export 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. 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. 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. However, it is not sufficient for Hitachi-GE to simply show compliance with identified risk targets and limits. 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.

- 37 The response by Hitachi-GE has included an optioneering report on removal of fuel from the Spent Fuel Pool. ONR had concerns with this report and a number of useful discussions took place (including a detailed workshop) in November 2015.
- 38 As a result of the technical interactions, ONR now has a greater understanding of the claims Hitachi-GE is making with respect to the Reactor Building Crane (RBC), canister, impact limiter and transport cask. Hitachi-GE will now provide the evidence to substantiate the claims made.
- 39 Hitachi-GE has also proposed a document route map reflecting the cross-cutting nature of this area and capturing the various ROs raised by various technical disciplines. The Fuel Route Schedule is being updated to take account of the revised deliverables. A revised Resolution Plan for RO-ABWR-0056 has also been submitted by Hitachi-GE.

Mechanical Engineering

- 40 Assessment has targeted Hitachi-GE progress to prepare and implement adequate arrangements to close the nine issued Mechanical Engineering ROs. During the reporting period RO-ABWR-0049 has been formally closed. In addition, no new specific Mechanical Engineering ROs have been raised.

Structural Integrity

- 41 During the current period, there have been issues with quality of documentation in the Technical Justification of inspections. However, Hitachi-GE has put in place a remediation strategy and the first of the revised documents was delivered on time, in accordance with the new schedule, at the end of January. A revised submission schedule is awaited for the inclusion of new topic reports; these will be on components covering a spread of different plant areas, ensuring that the GDA scope can be covered comprehensively. The progress against RO-ABWR-0002 to 0004 has been good; however, ONR does not consider it appropriate to close

out these observations at present. ONR has addressed this by adding new Actions to the RO and these are under review. The attitude of Hitachi-GE remains proactive and cooperative with regard to progressing Structural Integrity issues.

Security

- 42 Assessment of Revision B of the Conceptual Security Arrangements (CSA) has continued. Hitachi-GE has demonstrated a sound understanding of “defence in depth” principles. Positive engagement has continued to take place with Hitachi-GE to understand their methodologies in applying design basis threats to the design in order to develop appropriate security arrangements. There are some areas where the level of detail requires expanding and some terminology needs reviewing. However, these areas are expected to be addressed through further engagement and the development of the CSA document. There are no new or emerging issues in this topic area.

Probabilistic Safety Assessment (PSA)

- 43 In November 2015, Hitachi-GE announced changes in the PSA programme (RI-ABWR-0002) to accommodate enhancements to their internal PSA development processes, which led to the need for longer timescales. Upon ONR request, Hitachi-GE took a broader look at its schedule for PSA to identify whether a general re-baseline of the programme was needed. As a result, Hitachi-GE has deferred the delivery of internal fire and flood PSA to June 2016 and the seismic PSA to May 2016. ONR is able to accommodate these changes in the Step 4 assessment plan as they have been identified early enough.
- 44 Hitachi-GE submitted the ABWR containment performance analyses in December 2015 (response to RO-ABWR-0046) and a prioritisation of hazards for the PSA (response to RO-ABWR-0040 and 41) in January 2016. The internal events Level 1 and Level 2 PSA for the reactor and the spent fuel pool (SFP) was submitted in December 2015 and January 2016 respectively. The latter included an update of the reactor Level 1 PSA submitted in September 2015, which Hitachi-GE considers addresses the issue related to convergence of the level 1 PSA as well as other queries raised by ONR in October 2015. Hitachi-GE has also proposed a plan to assess loss of ultimate heat sink and external flood, based on PSA sensitivities. The scope of the sensitivity analyses and how they are going to be used to inform the design need further clarification. During this period, Hitachi-GE has also submitted internal fire and flood task plans and seismic fragility related documentation.
- 45 ONR has started the review of the submissions provided in December 2015 and January 2016. A workshop with Hitachi-GE is planned in March 2016 to discuss initial review outcomes, which include: 1) further work is needed to provide a realistic estimate of the containment structural capability under various pressure

and temperature challenges (to meet regulatory expectations in ONR's PSA TAG and in response to RO-ABWR-004; and, 2) ONR's request that Hitachi-GE provide further information necessary for ONR's review of the success criteria analyses, for the Level 1 PSA.

- 46 ONR has also identified that Hitachi-GE should clarify the scope and approach of the probabilistic assessment of faults that lead to low dose releases. ONR expects Hitachi-GE to provide further information in March 2016.

Severe Accident Analysis

- 47 Hitachi-GE has delivered its planned submissions in the severe accident area. ONR has completed a tendering exercise for an independent confirmatory analysis of Hitachi-GE's severe accident modelling, and a contract will be awarded shortly. Further technical support is planned to assist with ONR's Step 4 detailed assessment work. Recently, ONR's assessment effort has focused on reviewing the status of RO-ABWR-0023 actions (Severe Accident Safety Case), prior to discussions with Hitachi-GE which are planned for the next quarter. Ongoing work in related areas continues to be monitored where this could impact on the severe accident analysis and consideration of severe accident measures, for example suppression pool chemistry and Level 2 PSA. Topics such as containment performance analysis and Spent Fuel Pool severe accidents are being progressed in conjunction with PSA. On Fukushima learning, ONR has asked Hitachi-GE to extend its response to RO-ABWR-0039 to include lessons from the report by the IAEA's Director General on The Fukushima Daiichi Accident.

Fault Studies

- 48 During this early stage of Step 4, ONR has been looking at revised fault studies from Hitachi-GE containing updated and new analyses for postulated UK ABWR accidents. ONR's focus has been on assessing the submitted documentation, to judge whether these contain sufficient evidence to close out the extant fault studies ROs, and to get a greater appreciation of the requirements of the UK ABWR to vent its containment in some accident scenarios.
- 49 Also during this period, ONR has been undertaking a competitive tendering process within its Technical Support Framework arrangements to obtain external fault studies support for a number of assessments tasks.

Control and Instrumentation (C&I)

- 50 Hitachi-GE delivered a number of planned submissions in the quarter however, there were a few scheduled submissions that were delayed by a few weeks. ONR has commenced its assessment of these submissions and discussed them with Hitachi-GE at technical meetings in November 2015 and January 2016.

- 51 ONR assessment relating to submissions for RO-ABWR-0027 (Hardwired C&I) is focussed on Hitachi-GE's plans for technology selection and the provision of sufficient information to ONR to show that common cause failures have been precluded. With regard to RO-ABWR-0028 (SSLC Class 1 HMI), ONR was informed that Hitachi-GE's Human Factors (HF) team will now support the design, given the chosen option on the Class 1 Human Machine Interface (HMI), to ensure risks from human error are managed in line with the principles of ALARP. For the RPV instrument connections (RO-ABWR-0061), a number of cross-cutting discussions between ONR's C&I and PSA assessors took place with Hitachi-GE C&I and PSA Subject Matter Experts (SMEs) this quarter. Hitachi-GE provided ONR with updates on progress with the analysis findings and on-going activities, including forthcoming option studies. ONR agreed to a delay in the planned Hitachi-GE response dates on Actions 2 and 3 so the C&I team could reference the outcome of the analysis to the PSA findings.

Electrical Engineering

- 52 There are no issues to report. The scope of Step 4 submissions has been agreed and initial Step 4 submissions have been delivered to programme and are adequate. There are no emerging issues.

Fuel and Core Design

- 53 Hitachi-GE continues to deliver documentation to plan and ONR's assessment is proceeding satisfactorily.
- 54 ONR has completed an assessment of the method used by Hitachi-GE to predict steam explosions in the event of molten fuel entering water. The method is considered adequate to support the design of the containment building and associated systems. ONR's assessment of the reactor physics methods for the UK ABWR is now complete and ONR has concluded that the analysis methods used to support ABWR core design are adequately supported. An assessment report is in preparation.
- 55 A review of the updated Pre Construction Safety Report (PCSR) has led to further examination of the substantiation of fuel design criteria for a fault where cooling of the fuel pins is impaired. A request for further information has been made to Hitachi-GE and a response is expected in March. ONR's assessment has also identified a need to better define a set of operating rules to ensure adequate protection of the fuel pins against thermal stress. This is in development and will be the subject of discussions at the next progress meeting with Hitachi-GE.

Human Factors

- 56 Hitachi-GE has addressed ONR's concern about the lack of UK HF resource and we are now reasonably confident that Hitachi-GE can meet its HF commitments for GDA Step 4.
- 57 Hitachi-GE's presentation and clarity of its HF submissions is good. Our assessment recently has commented on a sampled check of a HRA calculation and clarity on the application of its HRA methodology. These matters have been rectified by Hitachi-GE responses to an RQ.

Reactor Chemistry

- 58 Overall the trend in reactor chemistry is a steadily improving picture, however the topic remains challenging. Hitachi-GE remains committed to producing an adequate generic safety case, however a number of Step 4 submissions already assessed by ONR require re-work and re-submission; placing increased pressure on an already tight Step 4 schedule.
- 59 Despite this there have been some good interactions during the quarter which have built some regulatory confidence in Hitachi-GE's proposed approach to further developing the reactor chemistry PCSR and supporting documentation; alleviating some of ONR's previous concerns in this area, specifically where documentation is cross-cutting. There has also been some positive progress with Hitachi-GE's development of a full scope Step 4 plan.
- 60 To resolve RI-0001, numerous submissions have been made and our assessment has commenced. In general, based on the submissions assessed, the normal operational source terms topic appears to be moving in the right direction. We still have a number of significant, un-resolved questions in this area, and Hitachi-GE is working towards responding to these.
- 61 Information submitted by Hitachi-GE on its approach to dealing with chemistry effects during accidents has led to ONR issuing a new RO (RO-0066) on the topic; meaning the extant resolution plan for RO-0043, which asks about suppression pool chemistry and pH control during accidents, will also be updated and re-submitted in parallel with the resolution plan for RO-0066.
- 62 We have also received new information from Hitachi-GE to respond to RO-0035; materials selection. The latest response indicates that Hitachi-GE is considering the need for material changes as part of its ALARP review for the UK ABWR, however, ONR has also raised additional queries in this topic which we would like to see resolved early in the next quarter. More clarity is required on Hitachi-GE's proposed approach to producing suitable and sufficient evidence in this area.

Radiation Protection

- 63 All radiation protection submissions have been received in line with the plan. A number of RQs have been generated and these submissions have also been received and are currently being assessed. Hitachi GE continues to make progress in response to three ROs. Communications with Hitachi-GE in this area continue to be positive and open with a good degree of challenge. Areas of enquiry currently being developed include exposures and life safety risks during reactor start up and shut down, and design of Heating Ventilation and Air Conditioning (HVAC) system. It is anticipated that a number of RQs will be raised in these areas along with a number of RQs in relation to general operational exposure. ONR is currently preparing a progress statement in support of the Environment Agency's consultation plans.

Management of Safety and Quality Assurance (MSQA) Arrangements

- 64 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 their GDA submissions.
- 65 The focus of MSQA activities has been to seek improvements in the UK specific legal, environmental and safety case training given to the Hitachi-GE safety case development team, and to ensure that Hitachi-GE has developed and implemented appropriate arrangements for agreeing the incorporation of GDA design changes with the regulators after the establishment of the Design Reference Point at the end of Step 3. There has also been regular engagement to help Hitachi-GE to develop its arrangements, required in Step 4, for moving the safety case into the operating regime.

Management of Radioactive Wastes

- 66 In the previous quarter, ONR and the Environment Agency jointly raised RQ-ABWR-668 in order to better understand the basis of Hitachi-GE's design choice for omission of an evaporator from the Liquid Waste Management System, in favour of a demineraliser and filtration. Having reconsidered its evaluation of options, Hitachi-GE has since decided to re-adopt evaporative technology, in line with the established practice in Japan. Hitachi-GE confirmed recent developments on Source Terms, associated with RI-ABWR-001 and RQ-ABWR-006, will not alter the disposability of the Higher Activity Wastes and Spent Fuels expected to arise over the lifetime of the UKABWR. We expect that this will be reflected in an addendum to Radioactive Waste Management Limited's assessment by the end of Step 4.

Decommissioning

67 During this quarter Hitachi-GE has worked closely with Horizon to implement new working arrangements via the JSCO to deliver its early Step 4 submissions on Decommissioning, and participated in Level 4 meetings with ONR and the Environment Agency. Hitachi-GE submitted its topic report on the management of decommissioning wastes on schedule, with a further six topic reports in an adequate stage of progress. ONR also reviewed Hitachi-GE's PCSR Rev B Chapter 31 on decommissioning as submitted in October 2015. Although ONR has confidence that decommissioning of the UKABWR is technically feasible, we will review the evidence provided to judge whether it gives an adequate demonstration that the risks and challenges associated with decommissioning have been optimised in line with the principles of ALARP and Best Available Technique (BAT). To meet this expectation, Hitachi-GE needs to provide a stronger, systematic and thorough challenge of the UKABWR design (taking account of relevant good practice), to identify options to reduce Decommissioning risks and then justify whether the identified options are reasonably practicable or not.

Management of Spent Fuel

68 During this quarter Hitachi-GE has participated in Level 4 meetings with ONR and the Environment Agency, covering design of the UKABWR facilities for both storage and export of Spent Fuel. In addition, ONR has reviewed PCSR Rev B Chapters 19 and 32. This review found that there was not sufficient documentation to discount some potential shortfalls against UK regulatory expectations for specific steps in the Spent Fuel Management process, relating to the demonstration of ALARP. ONR will consequently consider these aspects in closer detail as Step 4 progresses. ONR has also established links with US NRC and other overseas regulators for the purpose of benchmarking international practices on the dry storage of spent fuel, to inform the upcoming judgements on relevant good practices.

Environmental

69 Throughout this period the Environment Agency has continued regular communication with Hitachi-GE on a range of on-going topics. These include joint working with ONR on the final source term and also the development of the methodology to determine a realistic headroom factor for proposed discharges. Hitachi-GE made significant progress in these areas during this period.

70 We also received a submission relating to the resolution of RO-60, which resulted in some further work required before the RO could be closed. This RO had required Hitachi-GE to carry out work to demonstrate that the environmental impact of the emissions to air from the Emergency Diesel Generators (EDGs) and Back-up Building Diesel Generators (B/B DGs) are at an acceptable level.

- 71 Communications and interactions between the Environment Agency and Hitachi-GE have been positive, timely, clear and unambiguous.

Conventional Safety

- 72 Positive recent progress on the CDM Regulations Compliance Plan. Our current focus is on developing an understanding of, and reviewing the open top construction methodology, with its potential cross-cutting themes.

Fire Safety

- 73 Recent submissions have continued to build upon the good progress already made in the protective measures for life safety from fire. The approach to design features which depart from building design codes of practice has continued to demonstrate an adequate ALARP justification. There are no emerging issues.

2.10 Forward look

- 74 Over the coming months we will continue to progress our detailed assessment of Hitachi-GE's Step 4 submissions, prepare our consultation document and associated assessment reports for the GDA consultation, and undertake a series of cross cutting workshops in Japan in April.

3 GDA of the AP1000

3.1 Progress update

- 75 This has been a difficult period for the Westinghouse project. The ONR team continued to report delays and quality issues with submissions in a number of topic areas towards the end of last year. In addition, it also came to light that there was a lack of technical convergence / agreement in certain topics, which was hampering progress, leading to reduced regulatory confidence in the continued viability of the closure programme.
- 76 Regulatory confidence in GDA programmes is important as it affects the deployment of our specialist resource, our contracts with the supply chain and confidence in the subsequent site development programme.
- 77 To understand the root causes of the Westinghouse position further, ONR and Westinghouse (together with NuGeneration) undertook independent 'deep-dive' reviews of the status of the project. Our conclusions were similar in terms of the areas of focus needed.
- 78 Following this, in December 2015 ONR convened a convergence workshop with Westinghouse to try to resolve technical differences of opinion and to move the project forward. A great deal of progress was made and further progress has been made in the intervening period. As a result, very few areas of non-convergence remain. We further requested Westinghouse senior management to attend a meeting with us in January 2016 where we described our concerns and presented our view on the current position. Westinghouse set out what management action they had taken to recover their position. Our concerns were also documented in a letter to Westinghouse. Further work is necessary to restore regulatory confidence in the project and we have requested Westinghouse undertake a full review of its programme and submit it for assessment before the end of February 2016, ahead of a further senior level meeting in April.
- 79 The situation is varied across topic areas, indeed in some areas good work has been delivered and the programme is on or ahead of schedule. ONR inspectors have reported that the work related to CC-03 on Fukushima-related matters has been exemplary, and that the work in fault studies is generally of a good standard. We readily acknowledge this, but the fundamental question of whether the overall closure programme can be met remains.
- 80 ONR's view is that Westinghouse needs to fully commit the necessary resources to the UK AP1000 project to avoid further problems with delays to submissions and the quality of its reports. Westinghouse also needs to engage the appropriate level of UK expertise to help ensure that its submissions meet UK regulatory expectations and are fit for purpose. We were assured at the January meeting that the UK project has increased in prominence at the most senior levels within Westinghouse, and we noted enhancements to the UK project senior team.

81 Our concern is that the current programme has less than a year to completion but in some areas the majority of the work is yet to be delivered. This is very acute in some areas and we question whether the baseline programme remains credible.

82 Within the period the regulators have issued 73 RQs.

3.2 Meetings in period

83 Within the period there were 101 technical meetings and 11 non-technical project meetings.

3.3 International work

84 A very productive ONR-US NRC meeting addressing AP1000 human factors was held in November 2015. Topics discussed included: main control room heat-up, modelling of advanced human systems interfaces within safety cases, treatment of human factors outside of the main control room, etc. Both parties agreed to schedule future meetings to facilitate the sharing of regulatory intelligence on human factors for the AP1000 design.

85 We are also engaging with US NRC’s specialists to discuss matters related to the structural integrity for the AP1000.

3.4 Engagement

86 Within the period there was one comment posted on the Westinghouse public comments website, which Westinghouse has responded to. There are no repeat questions.

3.5 Technical Support Contracts

87 Between November 2015 and January 2016 ONR have let four technical support contracts relating to the AP1000 project:

| Topic Area | Contractor Organisation | Value |
|---|-------------------------|----------|
| Structural Integrity: GDA Assessment Review of the AP1000 ASME III Class 1 Piping Fatigue Analyses | Frazer-Nash | £ 29,296 |
| Civil engineering: Provision of Support on Civil Engineering Assessment for the Resolution of GDA Issues of the UK AP1000 Nuclear Power Plant | Arup | £374,996 |
| Structural Integrity: Review of ASME III Compliance for the Main Structural Components on the UK AP1000 | Frazer Nash | £50,735 |

| | | |
|--|-------------|---------|
| Structural Integrity: Review, Support and Comparative Fracture Assessments for HSS Welds | Frazer Nash | £57,243 |
|--|-------------|---------|

3.6 Summary of regulator charges

AP1000

Office for Nuclear Regulation:

- Charges for the quarter October 2015 – December 2015 £ 1,102,157
- Cumulative charges: £ 27,447,360

Environment Agency:

- Charges for the quarter October 2015 – December 2015 £ 57,702
- Cumulative charges: £ 2,559,593

3.7 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 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 | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 2 - Submissions | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 3 - interactions | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 4 - GDA Issue 1 | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 4 - GDA Issue 2 | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 4 - GDA Issue 3 | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 4 - GDA Issue 4 | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 4 - GDA Issue 5 | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 4 - GDA Issue 6 | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 4 - GDA Issue 7 | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 4 - GDA Issue 8 | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 4 - GDA Issue 9 | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 4 - GDA Issue 10 | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 5 - Emerging Issues | N | D | J | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | D | Y | Y | Y | N | N | D | Y | Y | Y | Y |
| | N | D | J | N | D | J | N | D | J | N | D | J | N | D | J | J | F | M | N | D | J | N | D | J |
| | PSA | | | Electrical Engineering | | | Radiological Protection | | | Human Factors | | | Cross Cutting 1 | | | Cross Cutting 2 | | | Cross Cutting 3 | | | | | |
| Category 1 - Programme | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 2 - Submissions | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 3 - interactions | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 4 - GDA Issue 1 | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 4 - GDA Issue 2 | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 4 - GDA Issue 3 | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 4 - GDA Issue 4 | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 4 - GDA Issue 5 | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 4 - GDA Issue 6 | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 4 - GDA Issue 7 | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 4 - GDA Issue 8 | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 4 - GDA Issue 9 | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 4 - GDA Issue 10 | | | | | | | | | | | | | | | | | | | | | | | | |
| Category 5 - Emerging Issues | N | N | N | N | N | N | Y | Y | Y | N | N | N | N | D | N | N | D | N | N | D | Y | | | |
| | N | D | J | N | D | J | N | D | J | N | D | J | N | D | J | N | D | J | N | D | J | | | |

3.8 Metrics Detail

Civil Engineering

- 88 A further submission was received from Westinghouse during this period, in accordance with the planned schedule. This submission is currently being reviewed by the ONR and a formal response will be given in the next quarter.
- 89 The submitted documents present only a summary of the safety case and ONR will make further requests for supporting information using RQs.
- 90 ONR awarded a Technical Support Consultant contract to Ove Arup & Partners Ltd during this period and the contract start-up meeting chaired by the ONR on 18 January 2016. We are optimistic at this stage that ONR assessment programme to completion can be recovered. There is no reason to believe that the Westinghouse delivery schedule will not be met.

Internal Hazards

- 91 ONR has had concerns about the progress of work in the Pressure Part Failure area since the September 2015 workshop. This is impacting on the delivery of Topic Reports for both Pressure Part Failure and Internal Flooding. Non-convergence was identified for GDA Issues IH-02 (Internal Flooding) and IH-03 (Pressure Part Failure).
- 92 A technical meeting between ONR and Westinghouse took place between in January, and convergence has been agreed. The safety case on Internal Flooding and Pressure Part Failure will be based on gross failure and must demonstrate consistency between internal hazards, structural integrity and fault studies submissions. Westinghouse is now required to put forward a programme of work including revised Resolution Plans for IH-02 and IH-03.
- 93 The overall adequacy of submissions to date, in other internal hazards areas, is not what we expect and there are issues of clarity and coherence.
- 94 Overall, there is a need 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.
- 95 Westinghouse is currently revising all Internal Hazards Resolution Plans (IH-01 to IH-06) to reflect ONR's concerns.
- 96 Westinghouse is proposing to transfer more of the work scope to its TSC who appear to be familiar with ONR's regulatory expectations.

Mechanical Engineering

- 97 ONR held meetings with Westinghouse in December 2015 and January 2016 in order to progress the development of a revised schedule and resolution plans, due to the on-going closure programme slippage. Although concern still remains that Westinghouse's recovery is reliant upon an ONR resource level that is not achievable, Westinghouse has developed a schedule that provides limited confidence in the delivery of the mechanical engineering issues, albeit to a tight timeframe and with little or no scope for slippage, particularly in ME-01. This remains a concern and is being monitored closely.
- 98 ONR has secured limited additional resource on the Mechanical Engineering issues to provide some mitigation against the additional assessment work expected in 2016, however the timely closure of mechanical engineering issues and the recovery of delays seen to date remain Westinghouse's risk. Although there have been some positive developments within this topic area, there is still concern with regard to the quality, scope and adequacy of ALARP assessments being submitted by Westinghouse
- 99 Westinghouse has not submitted a revised resolution plan for ME-01 which is delaying quarterly technical meetings. Westinghouse's ALARP deliverables were judged to require considerable revision and development in order to meet ONR expectations, which is also concerning with regard to the timely delivery of ME-01.
- 100 A draft submission for ME-02 was reviewed at a high level in November 2015 and Westinghouse is working to address comments, with the aim of submitting the revised document in February 2016 for formal assessment. Progress on this will be reported in the next quarterly update. A revised resolution plan is expected in early February 2016, showing this latest revision and a later close-out date for ME-02 (although this is not currently on the critical path for a January 2017 completion).
- 101 Westinghouse has reported that work is progressing well in ME-03. The project is planning meetings in February, and ONR awaits submission of the first of three deliverables in March 2016.

Structural Integrity

- 102 Westinghouse provided a draft re-baselined programme covering SI-01 to SI06 during the current period. This included proposals to manage the risks relating to achievement of reconciliation between the fracture assessments and inspection plans for SI-01 through on-going discussion. Several other SI and GDA issues depend on the progression of the SI-01 and SI-06 work. However, Westinghouse is currently unable to commit to dates to deliver the fracture assessments for SI-01. In addition, initial calculations suggest that there are some difficulties with providing a safety justification for welds in certain HSS components. The cause of these difficulties, which may be due to significant conservatism in the analyses, is under investigation.

- 103 The draft re-baselined programme also included a defined timetable of activities to close-out the RCP pump bowl missile interaction with the steam generator vertical support (SI-06). Westinghouse is now investigating several options and proposing work in parallel rather than sequentially. This work is technically challenging, and with the outcome of the analyses uncertain, there is now provision for investigating design changes/protection. The timing of these activities should avoid foreclosure of design modifications within the GDA.
- 104 Progress is being made in the assessment of SI-02 and SI-03. However, ONR's assessment work for SI-04 and SI-06 has slipped due to resource limitations and the delays in gaining Technical Support Consultant support to progress review work for SI01, SI02, and SI05. Some Technical Support Consultant support now available but ONR requires additional resource to recover and achieve the programme.
- 105 Overall, there remain significant technical and closure programme risks associated with completion of the work for SI01 and SI-06. The way forward and implications for achievement of the GDA timescales will be clearer pending review and agreement of a revised programme for SI01 to SI-06. Further programme discussions are scheduled for late February.

Electrical Engineering

- 106 ONR has not received an acceptable response on the compliance of the AP1000 design with the UK Grid Code. Demonstration that the AP1000 reactor can operate within defined UK Grid Code limits is required to be included in the safety case. The impact on the Westinghouse baseline programme and the closure date can only be determined once the issue has been resolved, and a safety case in line with ONR expectations has been submitted.

Control and Instrumentation

- 107 There have been further submission delays in this area since the previous reporting period. Cumulatively of the 45 formal submissions expected, 18 have now been delayed. Given this situation Westinghouse has decided to re-baseline their programme of C&I submissions. ONR will review the outcome of the re-baseline exercise in order to determine the credibility of the resulting schedule.
- 108 In addition to reviewing their delivery performance, Westinghouse has recently engaged the support of a number of personnel with experience of the UK regulatory regime in order to provide submissions that will improve the likelihood of meeting ONR expectations without the need for extensive revisions. ONR will continue to monitor the situation in this regard and provide feedback to Westinghouse accordingly.

Fault Studies

- 109 During this period, regular interactions have continued with Westinghouse on all eight fault studies GDA Issues, and the relevant chapters of the AP1000 Pre-construction safety report. Notably, a large meeting was held in December at Westinghouse's UK offices for it to provide updates on its on-going work, and for ONR to provide feedback on received submissions.
- 110 A sensible review of the delivery schedule was undertaken by Westinghouse during this period to provide clarity to all parties on the future programme. This re-evaluation of the fault studies schedule should not have an impact on the overall timescales for the closure phase.

Fuel and Core

- 111 ONR's assessment of Westinghouse's fuel performance code has been completed and therefore the GDA Issue (FD-01) is expected to be closed shortly.
- 112 Westinghouse's progress with the analysis of the effects of dynamic forces has been monitored by ONR and the information provided to date on the approach being adopted has been broadly satisfactory. A graded approach to the analysis has been accepted; with a less conservative method being appropriate to the large loss-of-coolant accident, than to more frequent faults. The outcome of the analysis will be available next quarter, but initial indications are that the core-barrel design will be substantiated.
- 113 The Westinghouse documentation to substantiate the code compliance of the BEACON system has been received, and arguments to support the safety categorisation are expected late in the next quarter. While this is later than originally planned, ONR has agreed to this approach as it will help to ensure that Westinghouse achieve the required quality.
- 114 A number of design modifications have been identified and Westinghouse has supplied some of the supporting information for ONR's assessment. The most notable are the changes to core loading pattern (and limiting form factors) and a change to the design of some of the control rods.

Human Factors

- 115 Progress in the closure of GDA Issue HF-01 (Human Factors) is now progressing as we would expect. There have been some significant challenges over the last quarter, particularly with regard to establishing an agreed scope of work in the areas of HF and PSA. It has proven difficult to agree on an appropriate scope of risk important human action analysis, which is essential to the closure of HF-01, and some PSA GDA issues. These challenges have now been overcome and a final scope should be agreed shortly. ONR is cognisant of the challenging programme of HF work that Westinghouse has set itself to close out GDA, and we are providing advice enabling Westinghouse to make better use of existing data to

reduce the programme of risk important human action analysis, whilst still achieving the same outcomes. Whilst this should help Westinghouse deliver against its programme targets for HF, the lack of clarity in the programme reported last quarter remains.

PSA

- 116 For PSA-01 (Success Criteria) ONR has completed its assessment of the comprehensiveness of the initiating events considered in the internal events at-power risk model. The risk modelling for accident sequences and the success criteria used for the plant is currently under assessment.
- 117 Together with the Human Factors Inspector, discussions with Westinghouse have taken place to agree a set of risk significant human error probabilities for review in accordance with UK relevant good practice. This incorporates information on the Main Control Room (MCR) simulator trials to demonstrate the adequacy of the human-machine interface. The way forward to address the risk significance of any human engineering deficiencies in the MCR has taken place with Westinghouse, noting that the design of the MCR continues to develop. WEC has provided a limited-scope low power and shutdown PSA to ONR for assessment.
- 118 PSA technical discussions continue with the C&I Inspectors to risk inform CI-10, which is addressing the safety classification of displays within the remote shutdown room.
- 119 For PSA-02 (Fire PSA) ONR has completed assessment of the following technical areas of the fire PSA: 1) the methodology used by Westinghouse, 2) the fire initiating event frequencies, 3) the plant partitioning into fire areas, and 4) the selection of plant equipment for modelling within the fire PSA. Westinghouse has provided a presentation to ONR on how the fire PSA is developing.

Reactor Chemistry

- 120 Westinghouse has started to engage further with ONR on their work to resolve RC01, which is encouraging. They have altered the programme of work for RC01, delaying the first submission to ONR by two months. The final submission date remains intact however through proposals of parallel working. We believe this presents a significant challenge to the Westinghouse and we will continue to monitor progress with this issue closely.
- 121 Most of the interactions over the period have been related to resolution of RC02 and the design of the sampling system for AP1000. During the period Westinghouse submitted a draft of their final submission on this topic, at our request. Detailed exchanges have taken place in meetings regarding this, and it is clear that gaps remain between regulatory expectations and Westinghouse proposals. These discussion have been useful in identifying where these gaps exist, what the underlying reasons for these may be and where there are

improvements needed to the Westinghouse case. What is clear is that there are some fundamental building blocks to the Westinghouse safety case, such as limitations on the number and use of containment penetrations along with requirements for boron meters, where further detailed discussion will be needed in order to satisfactorily resolve this issue. Westinghouse has delayed the submission of the final report on RC02 by around 2 months in order to undertake further work.

- 122 The final submission for RC03 has been the subject of RQs for which responses are awaited.
- 123 Reactor chemistry is one of the topic areas in which an updated draft of the PCSR has been shared. Feedback regarding this has been shared at meetings and will be formally captured in RQs.

Radiological Protection

- 124 All submissions relating to RP01 have been received in line with the plan. However, there are a number of areas requiring clarification or further explanation needed in the Westinghouse case to demonstrate that the management of risks are ALARP against RP01: the final justification for ALARP position is yet to be determined. In reaching its preferred option, Westinghouse has placed a high weighting on minimising design changes for cost and standardisation reasons, for which the justification is unclear. The case also highlights a need to adequately underpin the spent fuel cooling time prior to export of fuel, in order to maintain fuel integrity. Westinghouse's responses to outstanding RQs are expected soon and our assessment is on-going.

GI-AP1000-CC-01 Limits and conditions

- 125 A significant deliverable was provided by Westinghouse as scheduled during the quarter. There are currently no indications that this GDA Issue cannot be closed in an acceptable and timely manner.

GI-AP1000-CC-02 PCSR to support GDA

- 126 Individual chapters of the PCSR are being submitted to the regulators for assessment in accordance with Westinghouse's strategy. It is anticipated that all of the chapters will be delivered to the regulators by mid-2016 as scheduled. The Regulator's satisfaction with each chapter will determine whether a further revision will be necessary. Progress with chapters undergoing major revision will be monitored carefully in the coming months.

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

- 127 Westinghouse has delivered the UK AP1000 Plant Post-Fukushima Assessment and is due to deliver the equivalent report on international lessons learned in February 2016.
- 128 RQs have been raised against the post-Fukushima assessment in the topic areas of fault studies and human factors. Further RQs are expected in topic areas of civil, C&I engineering and electrical engineering. Westinghouse responding to the RQs, but they are not expected to delay the closure of CC-03.

3.9 Forward look

- 129 The next period will focus on assessing the Westinghouse revised closure programme, continuing the senior management level discussions and progressing assessment.