



Assessing new nuclear power station designs

Generic design assessment of Westinghouse Electric Company LLC's AP1000[®] nuclear power station design

Supplement to the decision document

30th March 2017

We are the Environment Agency. We protect and improve the environment. Acting to reduce the impacts of a changing climate on people and wildlife is at the heart of everything we do.

We reduce the risks to people, properties and businesses from flooding and coastal erosion.

We protect and improve the quality of water, making sure there is enough for people, businesses, agriculture and the environment. Our work helps to ensure people can enjoy the water environment through angling and navigation.

We look after land quality, promote sustainable land management and help protect and enhance wildlife habitats. And we work closely with businesses to help them comply with environmental regulations.

We can't do this alone. We work with government, local councils, businesses, civil society groups and communities to make our environment a better place for people and wildlife.

Natural Resources Wales is the largest Welsh government sponsored body, employing 1,900 staff across Wales. We were formed in April 2013, largely taking over the work of the Countryside Council for Wales, Forestry Commission Wales and the Environment Agency in Wales, as well as certain Welsh government functions. The work we do makes sure that the environment and natural resources of Wales are sustainably maintained, enhanced and used, both now and in the future.

Published by:

Environment Agency
Horizon House, Deanery Road,
Bristol BS1 5AH
Email: enquiries@environment-agency.gov.uk
www.gov.uk/environment-agency

Further copies of this report are available from our publications catalogue:

www.gov.uk/government/publications

or our National Customer Contact Centre:
T: 03708 506506

Email: enquiries@environment-agency.gov.uk.

© Environment Agency 2017

All rights reserved. This document may be reproduced with prior permission of the Environment Agency.

Foreword

We, the Environment Agency and Natural Resources Wales, are the independent regulators for England and Wales. We both work to create better places for people and wildlife, and to support sustainable development. This includes our regulation of nuclear power stations to minimise the impact on the environment.

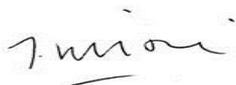
This document is a supplement to our earlier decision document on the generic design assessment (GDA) of the AP1000® nuclear power station design.

Our GDA work began in 2007. Over the past decade, we have worked with designers and developers early on in the development of new nuclear power station designs. This has enabled us to influence the designs, so that we can be confident that they will meet the highest standards of environmental protection and waste management.

In December 2011, we completed our assessment of Westinghouse's AP1000® nuclear power station design, published our conclusions in a decision document and issued an interim statement of design acceptability. This showed that we were largely satisfied with the environmental aspects of the design, but that there were a number of technical issues (GDA Issues) that Westinghouse needed to resolve.

This supplement to our 2011 decision document summarises our assessment of Westinghouse's response to these GDA Issues, and details the changes to its submission. This document also summarises our assessment of the work Westinghouse has carried out to address other nuclear safety related GDA Issues the Office for Nuclear Regulation (ONR) raised, where this has informed our final decision.

We are now satisfied that Westinghouse has resolved these issues and that the proposed design should meet the high standards of environmental protection and waste management we expect. We are, therefore, pleased to issue a statement of design acceptability for the AP1000® nuclear power station design.



Toby Willison, Executive Director of Operations, Environment Agency, March 2017

Executive summary

Our role

As the environmental regulators for the nuclear industry in England (Environment Agency) and Wales (Natural Resources Wales), our role is to regulate discharges and waste disposals from nuclear power stations and to make sure that their impact on air, water and land is acceptable and minimised.

Generic design assessment

In response to growing interest in nuclear power and potential applications to build new nuclear power stations in England and Wales, in 2007 we developed a new approach, generic design assessment (GDA), for assessing the environmental acceptability of new reactor designs.

Westinghouse Electric Company LLC (Westinghouse) submitted its AP1000[®] nuclear power plant design to us for assessment in August 2007. In 2011, we issued an interim Statement of Design Acceptability (iSoDA) for the AP1000[®] and published our decision document, which provides full details of the GDA process. We have now issued a full Statement of Design Acceptability (SoDA) and this supplement to the 2011 decision document that explains developments since 2011 and why we are now issuing a SoDA.

GDA means that we assess the acceptability of the generic environmental aspects of the nuclear reactor design before individual site applications are made. This approach enables us to get involved at the earliest stage where we can have most influence and where lessons can be learned for site-specific applications.

Through the GDA approach, we work closely with the Office for Nuclear Regulation (ONR), the UK regulator for nuclear safety and security to make sure any new nuclear power stations built in the UK meet the highest standards of safety, security, environmental protection and waste management, and provide greater protection for both people and the environment.

Our 2011 decision

By issuing an iSoDA for the AP1000[®] design, we confirmed that we were content that the environmental aspects of the design would meet the high standards we expect but that particularly significant, but still resolvable, issues remained that would need to be resolved before we would consider issuing a SoDA. The two GDA Issues we raised, jointly with the ONR, were:

- [GI-UKAP1000-CC-02](#): "PCSR to Support GDA" - to provide a consolidated final GDA submission, including agreed design changes for the AP1000[®] reactor.
- [GI-UKAP1000-CC-03](#): "Consider and action plans to address the lessons learnt from the Fukushima Event" - to demonstrate how Westinghouse has taken account of the lessons learnt from the unprecedented events at Fukushima.

Our decision document set out our detailed assessment of environmental aspects of the UK AP1000[®] nuclear power plant design. We used the comments and issues raised in our 2010 consultation to help inform our decisions.

Update to our decision

For both GDA Issues, we asked Westinghouse to show how it would address them, and since December 2011, we have been assessing the further information Westinghouse provided. We are satisfied that Westinghouse has now fully resolved the two GDA Issues, and we are issuing a full SoDA.

This supplement to our 2011 decision document summarises our assessment of Westinghouse's response to the GDA Issues, and details the changes to its submission. This supplementary document also summarises our assessment of the work Westinghouse has carried out to address

other safety related GDA Issues the Office for Nuclear Regulation (ONR) raised, where it has informed our final decision.

Changes to the submission

Westinghouse published its submission on its website in 2011 (<http://www.westinghousenuclear.com/uknuclear/Documentation>) and invited people to comment.

Westinghouse has revised its submission to reflect developments and to resolve the GDA Issues. The submission includes an environment report with supporting documents. We provide a summary of the changes it has made to the submission since 2011 in Section 4 of this document. The changes made do not modify our previous assessment and conclusions. However, the changes have led us to make minor amendments and clarifications to a small number of paragraphs in our decision document and final assessment reports; these are set out in this document (Appendix 2). We consider that the changes are not so significant as to require re-issue of revised documents. The documents we published in 2011 should now be read with the changes listed in Appendix 2 of this document.

When reviewing the additional information provided by Westinghouse in response to the GDA Issues, we considered whether further consultation was necessary to help inform our assessments. We have concluded that the additional information received and its implications are not significant such that further consultation is required prior to issuing a full SoDA for the AP1000® design.

GDA Issues raised by the Office for Nuclear Regulation

The Office for Nuclear Regulation (ONR) also raised 49 safety related GDA Issues as well as the 2 we issued together with them. We reviewed the information Westinghouse provided in response to these GDA Issues and ONR's assessment reports to see if there was any potentially significant impact on environmental matters or on our earlier decision. We conclude that the additional information provided does not change the conclusions or assessment findings in our earlier decision document.

ONR has also concluded that it is satisfied with the design and safety cases Westinghouse presented for the AP1000® reactor, and has issued a Design Acceptance Confirmation (DAC). Further information on the ONR assessment is available at: <http://www.onr.org.uk/new-reactors/index.htm>

Further assessment findings

GDA cannot provide a complete assessment of the final reactor design. There will be other issues relating to the specific operator or site that will be considered during the environmental permitting and site licensing stages. We raised 12 assessment findings in the 2011 decision document.

We would expect a future operator/ licensee to address these findings during the detailed design, procurement, construction, commissioning or early operational phases of a new build project. As a result of our assessment of Westinghouse's response to the GDA Issues, including those raised by ONR, we have raised 6 further assessment findings. Appendix 3 of this document shows the full list of findings.

Our decision

We have completed a detailed assessment of Westinghouse's GDA submission for the AP1000® nuclear power plant design, including the response to the GDA Issues that we identified in our December 2011 decision document. We conclude that the environmental aspects of the design would meet the high standards we expect, and have decided to issue a Statement of Design Acceptability (SoDA) for the design.

Next steps

The detailed design of the AP1000[®] reactor and the safety and environment cases that support it will evolve if operators take forward proposals for specific sites. We expect that the reactor design submitted for GDA and the statement of design acceptability would be used to support the permissions to build reactors of the AP1000[®] design that are more or less identical, apart from specific requirements for certain sites and operator choices.

Our Statement of Design Acceptability and ONR's Design Acceptance Confirmation alone do not allow the construction of a nuclear power station to go ahead. That needs a Development Consent Order from the Department of Business, Enterprise and Industrial Strategy's Secretary of State, and a nuclear site licence from the Office for Nuclear Regulation.

The SoDA is valid for 10 years from the date of issue, after which time the AP1000[®] design needs to be reviewed and reassessed

Contents

Foreword	3
Executive summary	4
1. Introduction	9
1.1. Introduction to GDA	9
1.2. About this supplement to our decision document.....	11
1.3. Additional information received since issue of the decision document	12
1.4. Closure of GDA Issues	13
1.5. After GDA.....	13
2. GDA Issue GI-AP1000-CC-02	14
2.1. Summary of joint GDA Issue GI-AP1000-CC-02.....	14
2.2. Additional information provided.....	14
2.3. Assessment.....	15
2.4. Conclusion.....	16
3. GDA Issue GI-AP1000-CC-03	17
3.1. Summary of joint GDA Issue GI-AP1000-CC-03.....	17
3.2. Additional information provided.....	17
3.3. Assessment.....	18
3.4. Conclusion.....	18
4. Changes to Westinghouse's submission	19
4.1. Introduction.....	19
4.2. Changes to the environment report	19
5. ONR assessments	24
5.1. Internal hazards.....	24
5.2. Civil engineering	25
5.3. Probabilistic safety analysis (PSA)	25
5.4. Fault studies	26
5.5. Control and instrumentation.....	27
5.6. Essential electrical systems.....	28
5.7. Fuel design.....	28
5.8. Reactor chemistry.....	29
5.9. Radiological protection	29
5.10. Mechanical engineering.....	30
5.11. Structural integrity.....	31
5.12. Human factors	31
5.13. Cross-cutting topics	32
5.14. ONR's conclusion	32
6. Our final decision	33

References	34
7. List of abbreviations	37
8. Glossary	39
Appendix 1 - Statement of design acceptability	41
Appendix 2 - Changes to our documents.....	44
Appendix 3 - Compilation of assessment findings.....	49
Appendix 4 - Consultation, public comments and engagement about the AP1000 reactor design	52

1. Introduction

Government policy on nuclear new build - the origins of generic design assessment (GDA)

The government has outlined its commitment to a significant expansion of new nuclear power stations in the UK, stating that nuclear power, alongside renewable energy, will ensure the UK has enough low carbon electricity in the future. It has taken a number of actions to encourage the development of new sources of nuclear energy, including asking us and the Office for Nuclear Regulation to consider 'pre-authorisation assessments' of new nuclear power stations. In response to this, the regulators have developed the GDA approach, which enables us to assess the safety, security and environmental impacts of new reactor designs at a generic level, before receiving an application to build a particular nuclear power station design at a specific location.

1.1. Introduction to GDA

1. As the environmental regulators for the nuclear industry in England (Environment Agency) and Wales (Natural Resources Wales), our role is to regulate discharges and waste disposals from nuclear power stations and to ensure that their impact on air, water and land is acceptable and minimised.

Role of Natural Resources Wales

Since April 2013, Natural Resources Wales has been the environmental regulator for nuclear sites in Wales. As new nuclear power stations may be built in Wales, Natural Resources Wales has participated in our GDA work and we have reached the preliminary conclusions set out in this document together. We anticipate that we will also reach the final conclusions together, so that the results of GDA will apply in both England and Wales. References to 'we', 'our', or similar terms in the rest of this document should be taken to refer to both the Environment Agency and Natural Resources Wales.

2. In response to growing interest in nuclear power and potential applications to build new nuclear power stations in England and Wales, we developed our generic design assessment (GDA) approach, for assessing the environmental impacts of new reactor designs. GDA means that we begin assessing the acceptability of the generic environmental aspects of the nuclear reactor design before individual site applications are made. This approach enables us to get involved at the earliest stage where we can have most influence and where lessons can be learned for site-specific applications.
3. The GDA approach has given us the opportunity to work closely with the Office for Nuclear Regulation (ONR), effectively providing a 'one-stop-shop' for new nuclear regulation. The process has enabled a rigorous and structured examination of detailed environmental, safety and security aspects of the reactor designs in 2 phases over approximately 7 years (see timeline below). We believe that GDA has improved efficiency both for the regulators and the nuclear industry, and is providing greater protection for both people and the environment.
4. GDA cannot provide a complete assessment of the final reactor design. There will be other issues relating to a particular operator or site that will be considered as proposals for specific sites are made.

Timeline of GDA for the AP1000® reactor design

April to September 2007 - Step 1 (preparatory step)

September 2007 to June 2008 - Step 2 (initial assessment)

June 2008 to December 2009 - Step 3 (detailed assessment)

January 2010 to December 2011 - Step 4 (detailed design, safety case and security evidence assessment)

June 2010 to October 2010 - consultation on our preliminary conclusions following our detailed assessment of the AP1000® reactor design

December 2011 - Issue of interim Statement of Design Acceptability (iSoDA) and interim Design Acceptance Confirmation (iDAC)

December 2011 - Westinghouse paused GDA activities with 51 outstanding GDA Issues remaining

August 2014 - Westinghouse recommenced GDA of the AP1000® reactor

March 2017 - Issue of SoDA and DAC

5. Westinghouse Electric Company LLC (Westinghouse) submitted its AP1000® nuclear power plant design to us for assessment in August 2007. In 2011 we issued an interim Statement of Design Acceptability (iSoDA) for the AP1000® reactor and published our decision document, which provides full details of the GDA process. We have now issued a full Statement of Design Acceptability (SoDA) and this supplement to the 2011 decision document that explains developments since 2011 and why we are issuing a SoDA.
6. We carried out GDA in 2 stages: preliminary assessment and detailed assessment. We completed the preliminary assessment and published our findings in March 2008 (Environment Agency, 2008). On 28 June 2010, our consultation began on the views we had formed following our detailed assessment of the AP1000® reactor design (Environment Agency, 2010). This consultation closed on 18 October 2010. We carefully considered all of the comments received and used them to help inform our decision.
7. We conducted our GDA work in an open and transparent way and engaged with industry, academics, trade unions, non-governmental organisations, communities living near nuclear sites and other interested groups and individuals during the process.
8. Nuclear reactors generate radioactive waste as part of the process of producing nuclear energy. We need to make sure the amount of radioactive waste is minimised, and so our GDA approach has focused on radioactive waste related design. We have also looked at aspects of the design relating to other areas such as water abstraction and discharges to surface water, pollution control issues and management of non-radioactive waste.
9. In December 2011, we published our detailed assessment of environmental aspects of the AP1000® nuclear power plant design in our decision document (Environment Agency, 2011a). We were content that the environmental aspects of the design would meet the high standards we expect subject to the GDA Issues.

10. Together with ONR, we identified 2 GDA Issues, so we could only issue an interim Statement of Design Acceptability (iSoDA). The GDA Issues were:
 - [GI-UKAP1000-CC-02](#): "Pre-construction Safety Report (PCSR) to Support GDA" - Westinghouse was required to provide a consolidated final GDA submission, including agreed design changes for the AP1000® reactor
 - [GI-UKAP1000-CC-03](#): "Consider and action plans to address the lessons learnt from the Fukushima Event" - to demonstrate how Westinghouse has taken account of the lessons learnt from the unprecedented events at Fukushima

1.2. About this supplement to our decision document

11. We are now satisfied that the 2 GDA Issues have been resolved, and so we are issuing a full statement of design acceptability (SoDA) for Westinghouse's nuclear power plant design, the AP1000®. This supplement to our decision document sets out how we assessed Westinghouse's response to the GDA Issues and how we concluded that these were resolved.
12. In December 2011, we provided a decision document that gave:
 - an introduction to our role in nuclear regulation and the basis for GDA
 - an outline of the AP1000® reactor design
 - a guide to our detailed assessment
 - a summary of our detailed assessment and conclusions
 - our decision based on our assessment up to that time
 - annexes supporting the decision document
13. We also published 14 final assessment reports (FARs) that provided the full details of our detailed assessment (Environment Agency, 2011b - n).
14. In this document, we have not repeated information provided in the 2011 decision document or FARs, but we have explained why the extra information Westinghouse provided was enough for us to close the 2 GDA Issues from an environmental perspective and now issue the SoDA.
15. The iSoDA we issued references the environmental report (ER) Westinghouse issued in March 2011 and its supporting and reference documents. Westinghouse had to provide further information to address the 2 joint GDA Issues and the 49 other ONR GDA Issues. Westinghouse consolidated the additional environmental information in a 2017 version of the ER (as referenced in the SoDA in Appendix 1 of this document), along with some other minor revisions and corrections. We have summarised the changes from the 2011 submission and our assessment of them in Section 4 of this document.
16. We assessed the responses Westinghouse provided in response to the 49 GDA Issues raised by ONR to see if there was any impact on environmental matters or consequences for the decision we published in 2011. We have summarised our consideration of the relevant ONR GDA Issues in Section 5 of this document, where they helped inform our final decision.

Following our assessments, we made revisions to a small number of our 2011 documents and added additional assessment findings. The decision document and its supporting FARs should be read with the revisions listed in Appendix 2 of this document. Appendix 3 provides a consolidated list of all our assessment findings.
17. After GDA, the assessment findings will be subject to the appropriate regulation, and it will be the responsibility of the future operator to make sure they are addressed at the appropriate stage of site-specific design, construction, commissioning or operation of a new build project.

1.3. Additional information received since issue of the decision document

18. We have received further information from Westinghouse, mainly to address the 2 GDA Issues we raised. We highlight in this document the additional information that has helped inform our decision on the acceptability of the AP1000® design.

A **GDA Issue** is an unresolved issue considered by regulators (ourselves, NRW or ONR) to be significant, but resolvable, and which requires resolution before nuclear island safety-related construction of the reactor could be considered.

An **Assessment Finding** is an unresolved issue of lesser significance, not considered critical to the decision to start nuclear island safety-related construction. In some cases, it will not be resolvable until a later stage such as procurement or commissioning. It will need to be addressed, as normal regulatory business, either by the designer or by a future operator, as appropriate, during the design, procurement, construction or commissioning phase of the new build project. Issue of a final SoDA is, thus, not dependent on clearance of assessment findings. We may address assessment findings in site-specific permits, by means of pre-operational conditions or improvement and information requirements

19. Our involvement in consultation, public comments and engagement about the AP1000® reactor design commenced in 2007 and continued during the period following our consultation in 2010 (Appendix 4). When we reviewed the additional information provided by Westinghouse in response to the GDA Issues, we considered whether further consultation was necessary to help inform our assessments. We also considered whether there were any other significant information or changes, for example information provided by third parties or changes to government policy. We have concluded that any new information or changes are not significant such that further consultation is required prior to issuing a full SoDA for the AP1000® design.

Considering the need for further consultation on the AP1000® design in GDA

We consulted on the AP1000® design in GDA in 2010 (28 June to 18 October). We considered the consultation responses in producing our decision document and issuing an iSODA in 2011.

In our [Process and Information Document](#) we stated that ...“Where appropriate, we may carry out a further consultation, prior to issuing a full SoDA”

Changes to the AP1000® design since our 2010 consultation that are relevant to our assessment are limited. We have concluded that the additional information received and its implications are not significant such that further consultation is required prior to issuing a full SoDA for the AP1000® design.

The environment agencies will consult on any future permit applications for new nuclear reactor plant to be operated at specific sites.

1.4. Closure of GDA Issues

21. With ONR, we have completed our assessment of the responses to the 2 joint GDA Issues. We are producing the associated assessment reports together and we will publish these shortly.
22. By closing a GDA Issue the regulators are indicating that the issues is now resolved. With ONR, we have implemented an effective and efficient process for closing GDA Issues. This process has a level of internal challenge to moderate and decide on GDA Issue closure.
23. To close a GDA Issue we need confirmation that:
 - all the information within Westinghouse's plan to resolve the issue has been provided
 - this information has been reviewed
 - all responses to Regulatory Queries have been received
 - all related modifications have been identified (if appropriate)
 - the information provided adequately dealt with the GDA Issue
24. We set up the joint regulators' Regulatory Review Meeting (RRM) to provide peer review, to challenge and moderate the conclusions, and to make the final decision on closing GDA Issues. We have used this process to close all of the 51 GDA Issues.
25. All of the assessment reports for the GDA Issues, including those for GI-AP1000-CC-02 and GI-AP1000-CC-03, are published on the regulators' new reactors' website: <http://www.onr.org.uk/new-reactors/ap1000/reports.htm>

1.5. After GDA

26. Now that we have issued a Statement of Design Acceptability (SoDA), future work will be related to site-specific permitting. The detailed design of the AP1000[®] and the safety and environment cases that support it will evolve if operators take forward site-specific proposals. We expect that the generic reactor design submitted for GDA and the SoDA will be used to support the permissions to construct reactors of the AP1000[®] type that are more or less identical, except for site-specific and operator-specific requirements.
27. As an example, the generic AP1000[®] design supports the basis of the pending application by NuGen Limited for environmental permits¹ to operate a proposed new nuclear power station it intends to build at Moorside in Cumbria. You can find further information on our role in permitting the proposed power station and associated developments on our website at: <https://www.gov.uk/government/collections/nuclear-power-moorside>
28. Issuing a SoDA and a DAC alone does not allow any further activity in terms of building nuclear power stations. This needs approval of both a Development Consent Order by the Department of Business, Enterprise and Industrial Strategy's Secretary of State, and a specific regulatory permission given by ONR under a nuclear site licence.
29. The SoDA will remain valid for the AP1000[®] generic design for 10 years after it is issued. This would be subject to no significant new information arising during that period that might call into question our original assessment of the design. This period of validity is based on the existing ONR requirement for licensees to carry out safety reviews of their existing nuclear facilities every 10 years.
30. If Westinghouse wishes to renew the SoDA and DAC towards the end of this 10-year period, we will require them to review the submission in the manner of a periodic safety review. It is envisaged that renewing a SoDA or DAC would involve much less work than the original assessment, but some design improvements might be needed to renew, if these were found to be reasonably practicable at that time. For example due to changes in international best practices.

¹ The Environmental Permitting (England and Wales) Regulations 2016

2. GDA Issue GI-AP1000-CC-02

2.1. Summary of joint GDA Issue GI-AP1000-CC-02

31. GDA Issue GI-AP1000-CC-02, issued jointly by us and ONR, required Westinghouse to produce a consolidated final GDA submission, which included agreed design changes for the AP1000[®] reactor. This required Westinghouse to submit a safety case to support the GDA design reference and then to control, maintain and develop the GDA submission documentation, including the safety, security and environment reports (SSER), the master submission list (MSL) and design reference document, and provide final consolidated versions of these. It comprises 3 specific actions, in summary Westinghouse was required to:
- Submit to the joint regulators a consolidated pre-construction safety report (PCSR) and associated references, which provides the necessary claims, arguments and evidence to substantiate the adequacy of the AP1000[®] design described by the Design Reference Point (DRP) UKPGW-GL-060, and make available via the Westinghouse website a public version of the consolidated PCSR, the DRP and the MSL.
 - Make and implement arrangements to control, maintain and develop the GDA safety submission documentation. This must include the SSER, MSL and DRP. As part of this action, Westinghouse must provide final consolidated versions of these documents as the main references to any DAC or SoDA that ONR or the Environment Agency (the joint regulators) may issue at the end of GDA.
 - Implement the outstanding GDA agreed design changes, by incorporating the change details into all impacted documents, the MSL documentation, the PCSR and ER (as appropriate).
32. Ultimately, the aim of this GDA Issue was to make sure a final consolidated GDA documentation was submitted, which was appropriately controlled, maintained and updated to reflect changes to the reference design arising during GDA. Westinghouse was required to continue to control, maintain and develop the GDA submission documentation, including the ER (as referenced in the SoDA at Appendix 1), MSL and reference design configuration, taking account of any design changes agreed for inclusion in GDA, and provide final versions of these documents to the regulators. The final submission, therefore, encompasses the results of detailed assessment in Step 4, and work to close the GDA Issues raised when the interim Statement of Design Acceptability (iSoDA) and interim Design Acceptance Confirmation (iDAC) was issued. An important aspect was to make sure that any changes that took place while the GDA Issue was being resolved were included appropriately and consistently in Westinghouse's GDA documentation, which are the basis of the SoDA and DAC.
33. You can find more detailed information in our joint close-out report for this GDA Issue.

2.2. Additional information provided

34. Westinghouse's resolution plan published in response to this GDA Issue identifies the information to be provided, which included the:
- DRP providing the reference design configuration, this includes design changes to be included in GDA, including those design changes that the regulators needed to agree to include
 - final, consolidated SSER that includes how all GDA Issues were resolved. This includes the ER and supporting documents, which were controlled to make sure claims, arguments and evidence submitted in GDA were consistent
 - control of design changes to include in GDA. This included considering the design change management procedure used to raise and track design changes
 - MSL, listing all of the documentation included in the GDA submission
35. Some design changes agreed to be included in GDA (at Step 4) were fully incorporated into GDA documentation. There are also design changes agreed in GDA that require work by future

operators to implement (such as where a functional specification has been defined and captured but is yet to be implemented at a detailed design level).

2.3. Assessment

36. Our assessment has focused on the information Westinghouse provided in response to this GDA Issue, the design change process that Westinghouse follows and Westinghouse's GDA project arrangements for controlling GDA submission documents.
37. At an early stage after GDA was restarted, we issued a regulatory query (RQ) asking Westinghouse which GDA Issues it felt were likely to impact on the 'environment case' (RQ-AP1000-1307, 'Early view on environmental implications of GDA Issue close out', December 2014).
38. In response to RQ-AP1000-1307, Westinghouse provided an overview of the impact evaluation process and considered each GDA issue in turn. Other than issue CC-02 and CC-03, Westinghouse identified potential impacts associated with only 3 issues; these were GDA Issues: RP-01, FS-01 and RC-02 (see Section 5). For all other 46 GDA Issues Westinghouse suggested that, *'There are no significant impacts to the existing environment assessment bases, including additional generation of radioactive or other wastes, spent fuel management, changes to plant design or site layout, changes to decommissioning planning, or changes to anticipated operational actions as the result of planned responses to the GDA Issue.'*
39. Westinghouse updated the consideration against each GDA Issue when the DRP was issued (Revision 8). Westinghouse confirmed that further analysis during the GDA Issue close out programme (at that time) had not altered this early view, although it was further noted that addressing CC-03 had also resulted in no significant impact (see Section 3). Overall, impacts on the environment case are very limited (as outlined in Sections 4 and 5) and we agree with this result based on our assessment.
40. A significant number of design change proposals (DCPs) have been incorporated in the DRP (Revision 10) since we assessed the DRP (Revision 5) before issuing the iSoDA. We reviewed and inspected Westinghouse's process for design change control and its management of configuration control, including a joint inspection of such aspects with ONR in July 2015. We also considered updates to the ER and DRP to ensure comprehensive coverage of environmental aspects and consolidation across the GDA submission. Westinghouse was able to demonstrate appropriate configuration records and linkages to supporting documentation (online) when we sampled particular DCPs, noting that the relevant databases may link numerous (even hundreds) of documents, including technical drawings, via a single DCP.
41. For each DCP, Westinghouse uses a SmartPlant™ Foundation database and a related DCP database captures the affected documents and related impacts for all assessment areas. For GDA purposes, Westinghouse completes specific forms (F-UKP-GW-GAP-026-1), which capture the UK documents that are relevant to the GDA DRP. The completed forms identify the affected PCSR and SSER documents, often with details of the affected section. We sampled a number of DCPs and found the process to be consistent and traceable. This provided confidence that the approach is systematic and has been appropriately applied.
42. We also reviewed the process Westinghouse used to consider the environmental impact of proposed design changes, to inform our view on including these design changes in the GDA reference design and supporting documentation. We sampled a range of DCPs and reviewed the Westinghouse considerations as to any associated impact on the environment case. We concluded that Westinghouse appeared to be adequately assessing the impacts of design change on the environment case and suitably incorporating those changes into the supporting documentation for GDA.
43. Westinghouse evaluates design changes to include in the DRP in accordance with UKP-GW-GAP-026 (Design Reference Point change for GDA). This includes reviewing each new design change to determine potential impact of the PCSR and SSER (including the ER). The process involves completing F-UKP-GW-GAP-026-1 forms to make sure any impacts are systematically appraised.

We wrote to Westinghouse recommending that it included specific environmental considerations in its associated guidance to authors and reviewers of the F-UKP-GW-GAP-026-1 forms. In response, Westinghouse confirmed that guidance supporting the design change process was supplemented by additional advice covering such aspects. Subsequently, Westinghouse has incorporated this advice directly into the F-UKP-GW-GAP-026-1 form (Revision 2).

44. We found Westinghouse's project arrangements to be effective and we are satisfied that the final information provided as part of GDA, including the ER, MSL and reference design, are consistent based on our sampling.
45. Westinghouse has not fully incorporated all design changes identified during GDA. A number of design changes will need any future operator to carry out further work. Some of the design changes have not been fully implemented into the supporting design documentation that support the SSER. Such unincorporated DCPs are clearly identified in the DRP and they will need to be incorporated when considering future detailed design as part of nuclear site licensing and environmental permitting activities. We capture the need to address these as an assessment finding, as follows:
 - **AP1000-AF13:** An operator shall demonstrate that changes from the GDA design to the site-specific design are BAT and comply with the requirements of any permit that has been issued.
46. This assessment finding (AP1000-AF13) is aimed at confirming that the design changes agreed in GDA and the development of the site-specific design, including incorporating design changes agreed in GDA, are implemented during the site-specific phase under appropriate management arrangements and will ensure application of BAT. Our view is that the design changes identified in GDA and yet to be fully incorporated are not significant in relation to the environmental performance of the design. Any future operators will need to fully assess and incorporate these design changes when developing the site-specific design, and we will seek assurances through our future regulatory activities.

2.4. Conclusion

47. We are satisfied that Westinghouse's arrangements for controlling updates to the final GDA submission documentation, including the ER, MSL and DRP for the AP1000[®] reactor design are adequate. We are satisfied that the GDA Issue has been addressed appropriately and that these documents can be used as the main references to the SoDA. Therefore, we have closed this GDA Issue from an environmental perspective.
48. The regulators closed GDA Issue GI-AP1000-CC-02 at the RRM and the GDA Issue close-out assessment reports are published on the regulators' new reactors' website:
<http://www.onr.org.uk/new-reactors/ap1000/reports.htm>.

3. GDA Issue GI-AP1000-CC-03

3.1. Summary of joint GDA Issue GI-AP1000-CC-03

49. On 11 March 2011, the Fukushima Dai-ichi site was inundated by a large tsunami resulting from the worst earthquake ever to be recorded in Japan. External and standby power supplies and cooling was lost and reactor units 1, 2 and 3 overheated, resulting in major releases of radioactivity and further damage to plant.
50. This joint GDA Issue was identified to make sure that the lessons learned from the Fukushima accident were considered within GDA for the AP1000® design. GDA Issue GI-AP1000-CC-03 required Westinghouse to demonstrate how it will take account of the lessons learned from Fukushima. This included those arising from Westinghouse's own internal reviews and lessons, and recommendations identified in Her Majesty's Chief Inspector of Nuclear Installations' interim and final reports (ONR, 2011a, 2011b). More detailed information will be found in our joint close-out report for this GDA Issue.
51. As part of resolving this GDA Issue, Westinghouse completed an assessment verifying the resilience of the AP1000® design to a Fukushima-like event. It focused the information it provided on accident scenarios rather than normal operations, which are the focus of our interests in relation to radioactive substances regulation. However, changes to the design or the generic site to ensure resilience of the AP1000® design could be suggested, which have an effect on the ER and associated references (for example, where additional plant is introduced that adds to waste arisings).

3.2. Additional information provided

52. Westinghouse's plan published in response to this GDA Issue included the following information:
 - summary report of the results of Westinghouse's internal AP1000® design robustness analysis
 - review of the robustness of the AP1000® design against beyond design basis seismic events
 - review of the robustness of the AP1000® design against beyond design basis flooding events
 - review of the robustness of the AP1000® design power sources and long-term cooling of the reactor and fuel pool
 - review of the design measures in place in the event of an assumed severe accident scenario
 - response to recommendations from Her Majesty's Chief Inspector of Nuclear Installations' reports on the Fukushima events
 - updated ER submission as appropriate
53. As a result of this work, Westinghouse also identified a number of design enhancements to improve the robustness of the AP1000® design.

3.3. Assessment

54. Our assessment focused on the information we received from Westinghouse in response to this GDA Issue. We considered the environmental implications of the robustness reviews and any resulting design changes.
55. Westinghouse provided sufficient design reviews and supporting analyses to demonstrate the robustness of the generic design at normal operating and shutdown states against severe seismic and flooding events. Westinghouse provided appropriate evidence to demonstrate the generic AP1000® design could retain its radioactive inventory following events that result in loss of electrical power and/or cooling. Westinghouse has provided enough responses to the Chief Inspector's recommendations from the Fukushima lessons learned reports. We are satisfied that the ER submission has been updated appropriately to reflect relevant changes, see Section 4 and Appendix 2 of this report for a summary of the changes and our assessment of them.
56. ONR also represents the UK in the Multinational Design Evaluation Programme (MDEP), which is a multinational initiative taken by national safety authorities. This programme seeks to develop innovative approaches to share the resources and knowledge of the national regulatory authorities tasked with reviewing new reactor power plant designs. During the process of closing GDA Issues, ONR has participated in the MDEP meetings, exchanging information with overseas regulators on the impact of Fukushima-type scenarios on the AP1000® design.
57. Westinghouse's assessment identified design changes in response to GI-AP1000-CC-03 and it has assessed each of these through its design change process, and incorporated them in the relevant documentation supporting GDA, as described in Section 2. None of these GI-AP1000-CC-03 related changes impacted significantly on the environment case. Westinghouse ultimately concluded that resolving this issue had no significant impacts to the existing environment assessment bases. This included generating additional radioactive or other wastes, spent fuel management, changes to plant design or site layout, changes to decommissioning planning, or changes to anticipated operational actions. This seems a reasonable conclusion based on our assessment.
58. We note that other design changes Westinghouse proposed in response to other safety related GDA Issues will also have improved robustness of the design in response to extreme events (as per resolving the GDA Issues outlined in Section 5).
59. You can find more detailed information in our joint close-out report for this GDA Issue.

3.4. Conclusion

60. From our assessment of the information provided associated with this GDA Issue, we are satisfied that the lessons learned from Fukushima have been addressed within the scope of the GDA AP1000® design. Therefore, we have closed this GDA Issue from an environmental perspective.
61. The regulators closed GDA Issue GI-AP1000-CC-03 at the RRM and the GDA Issue close-out assessment reports are published on the regulators' new reactors' website:
<http://www.onr.org.uk/new-reactors/ap1000/reports.htm>.

4. Changes to Westinghouse's submission

4.1. Introduction

62. We issued the iSoDA following Westinghouse's submission in 2011. Our main interest was in the ER and its supporting and reference documents.
63. Westinghouse had to provide further information to address the 2 joint GDA Issues and the 49 other ONR GDA Issues. This information was in the form of reference documents (as detailed in the MSL, as referenced in the SoDA, Appendix 1 of this supplement).
64. Westinghouse reviewed and revised the ER and 2 supporting documents to bring in summaries of the supplementary information and include additional references. The revision also included some minor changes such as:
- changes to organisational designations and responsibilities
 - update of the table of contents
 - minor formatting changes
 - minor changes to terminology
 - all the references listed under each numbered section or sub-section heading have been reviewed, updated, and re-numbered as needed to remove potential ambiguity.
 - revision history amended with the changes
65. Westinghouse published a revised submission on its website: (<http://www.westinghousenuclear.com/uknuclear/Documentation>) in March 2017.
66. We summarise the specific changes below and provide our view of the implications for our assessment. We felt it unnecessary to update any of our final assessment reports (FAR) that we published in December 2011 (Environment Agency, 2011b-o). We summarise the specific, minor changes to our original assessment findings and we also list 6 new A-Assessment Findings resulting from our assessment of GDA Issue close out (Appendix 3).

4.2. Changes to the environment report

67. We had assessed Revision 4 of the ER and supporting documents when we issued the iSoDA (2011). Subsequently, closing the 51 GDA Issues has had a limited impact on the ER, which is now issued as Revision 7.
68. Westinghouse has made only limited revisions to the ER (UKP-GW-GL-790) and the supporting references relative to Revision 4. In summary:
- 19 DCPs have impacted the ER. These impacts have been incorporated into Revision 7 of the document (changes to the ER are outlined below). We conclude that the impacts are minor and there are no fundamental or significant changes to the environmental performance of the reactor, the associated waste arisings and environmental impacts as per our regulatory assessment in GDA to 2011. In particular, there have been no changes to proposed discharge profiles and, therefore, no revised assessments of the associated environmental impacts have been necessary. Changes to the amounts of radioactive waste arisings are small and are due to further HEPA filtration media being added and small plant items that may become active (as outlined further below). Overall, there have been design improvements that are likely to improve environmental performance overall, and these are outlined below.
 - The ER has been updated to reflect current organisational designations since Revision 4 of the document was produced and as referenced in the iSoDA (in 2011). In particular, previous references to the Nuclear Installation Inspectorate (now ONR) and Radioactive Waste

Management Directorate (RWMD) (now Radioactive Waste Management Ltd. RWM) have been revised. The role of Natural Resources Wales is recognised in Revision 7.

- Only 2 underpinning references to the ER have been updated due to specific changes in the combustion plant design and to reflect assessment against revised thresholds in COMAH legislation (see below for details).

69. Specific changes to the ER (Revision 7) (chapter by chapter) are described below, and all changes are relative to the ER (Revision 4). We also outline the implications of these changes for our assessment.

4.2.1. Chapter 1 Introduction

70. This UK AP1000 ER (Revision 7) consolidates and summarises the environmental information in the PCSR. Revision 7 incorporates DRP (Revision 10), 'AP1000 Design Reference Point for UK GDA' UKP-GW-GL-060, rather than DRP (Revision 5) as was referenced in the iSoDA.

71. Westinghouse no longer stipulates EPS-GW-GL-700, 'AP1000 European Design Control Document' (EDCD) as the main source of technical information for the NPP design. The relevant reference is now the 'AP1000 pre-construction safety report' (PCSR). Reference to the EDCD is removed (throughout).

4.2.2. Chapter 2 Generic plant description

72. Section 2.2.1 (and Section 2.6.2 'Reactor coolant pump selection'), a design change from canned motor to wet winding pumps is described. This does not change the design enhancement compared to prior generation PWRs where elimination of shaft seals significantly reduce leakage potential (and hence potential waste arisings).

73. Section 2.6.6 'Zinc addition' has been revised to clarify the benefits of zinc injection into the reactor coolant in terms of reducing the mobility of corrosion products and avoiding crud-induced power shift effects. Crud Induced Power Shift (CIPS)² is an unexpected deviation in axial power distribution from design or predicted values during power operation. We have not changed our conclusions as we considered such aspects in our earlier assessment.

74. Section 2.7.3 'Demineralised water treatment system (DTS)' has been revised to indicate that the DTS design has been improved by adding a 'clean in place unit' and a 'sample panel unit'. A chlorine reducing agent is also now injected into the demineralised water treatment process from the turbine island chemical feed system (CFS). This reagent has not been identified in GDA and will be selected by a future operator. We have added an assessment finding to reflect this:

- **AP1000-AF14:** An operator shall identify the chlorine reducing agent to be injected into the demineralised water treatment process from the turbine island chemical feed system (CFS), assess the environmental impacts and ensure compliance with all relevant legislation.

75. Section 2.8.2 'Spent fuel' now reflects revised fuel storage arrangements, and specifically a changed fuel storage capacity of 617 fuel assemblies (compared to 889 assemblies previously). This means capacity for 6 refuelling offloads, representing approximately 10 years of operations (compared with 18 years previously which included the first cycle with no fuel in the spent fuel pool and approximately 16 years of cooling time), plus a full core offload. Ultimately this means a reduced pond cooling period for spent fuel (approximately 10 years, compared to approximately 16

² Crud-Induced Power Shift (CIPS) is an unexpected deviation in axial power distribution from design or predicted values during power operation. CIPS occurs when sufficient crud deposits build up on fuel surfaces undergoing sub-cooled nucleate boiling to cause concentration and deposition of boron compounds within the crud. These crud deposits consist primarily of nickel and iron oxides that are initially released into the reactor coolant by corrosion of the alloy 600 or 690 and stainless steel surfaces of the reactor coolant system (RCS). Nickel is the primary constituent of thick crud and is considered to be the most important contributor to CIPS. The presence of the boron neutron absorber retained in the crud in the upper portions of the core causes the neutron flux to shift toward the lower portions of the core. Continued operation with CIPS then skews the core axial burnup distribution toward the bottom of the core compared to design predictions.

years previously) before transfer to dry storage casks. As further discussed below (Paragraph 87), there are no implications for our conclusions.

76. Section 2.9.1.3 'Reactor coolant' has been updated to describe how hydrazine solution is introduced into the coolant system at a stoichiometric amount based on the measured oxygen concentration and typically at a concentration of 1.5 times that of oxygen (rather than at 10 ppm as per Revision 4). There are no implications in terms of the hydrazine inventory and the associated environmental risks relative to our earlier assessments.
77. Westinghouse has assessed the relevant inventories against updated COMAH regulations (Statutory Instrument 2015 No. 483, 'The Control of Major Accident Hazards Regulations 2015'). Section 2.9.2.1 'Control of Major Accident Hazards' (COMAH), has been revised to indicate that fuel oil is a consideration in relation to COMAH. The quantity held does not exceed the COMAH threshold quantities.
78. Section 2.9.2.1 has been revised to state that the stored inventory of hydrazine is 3.1 tonnes of 35% (w/v) hydrazine solution, rather than 1.1 tonnes of pure hydrazine, as was stated in Revision 4 of the ER. This means that an AP1000[®] reactor site (as defined in GDA) will be an upper tier COMAH establishment. This is a change from the lower tier classification that was assumed in 2011. The change reflects a correction to the proposed hydrazine inventory. Previously the inventory had been quoted in terms of the mass of pure hydrazine rather than the mass of hydrazine as a 35% w/v aqueous solution. The total inventory of pure hydrazine is unchanged from Revision 4 of the ER, but a larger volume of hydrazine as an aqueous solution is now proposed for storage on site. We only carry out a basic assessment on information presented in GDA to see if COMAH might be applicable. The change in COMAH assignment to upper tier means that appropriate regulatory controls will be needed. This will be ensured at the site-specific design stage and during our routine site regulation.
79. Section 2.9.2.2 'Substances under the Groundwater Directive' now reflects the existing Groundwater Directive 2006/118/EC, rather than a previous directive (80/68/EEC).
80. Section 2.9.3.2 'Standby diesel fuel oil' has been revised to indicate that the 2 diesel generator day tanks located in the diesel generator building each have an increased volume of 7.6m³ (increased from 4.9m³). Other than an increased fuel inventory there are no implications for our conclusions.
81. Section 2.9.3.3 'Central chilled water system (VWS)' has been revised and there is no longer reference to using ethylene glycol as antifreeze (ethylene glycol is no longer required following the introduction of trace heating in the relevant system).
82. Table 2.9-1 'Chemical inventory on AP1000 NPP turbine island' has been revised to indicate larger holdings of fuel oil (as per revisions to Section 2.9.3.2, above) and removal of ethylene glycol from the inventory (as per revisions to Section 2.9.3.3). The columns headed 'Mass (of) chemical (tonnes)' in Tables 2.9-1 - 2.9-3 now give the mass of the solution containing the chemical rather than the mass of the pure chemical.

4.2.3. Chapter 3 Radioactive waste management systems

83. Section 3.3.1.1 was revised to indicate that *average* calculated holdup times are 38.6 days for xenon and 2.2 days for krypton, based upon a continuous input flow rate to the WGS of 0.85m³/h¹ (0.5 scfm). Revision 4 wrongly stated that the given values were *minimum* holdup times.
84. Table 3.4-2 has been revised to remove the level indications description and to reflect revised tank alarm arrangements.
85. Table 3.4-3 text relating to sump arrangements has been revised to clarify that water is collected in the auxiliary building sump and tank 'low level alarms' are added to reflect tank leak detection arrangements.
86. Section 3.4.3.6 'Monitor tanks', has been revised to reflect new, reduced storage capacities for treated effluent monitor tanks (total storage capacity reduced from 342m³ to 270m³). This reflects changed range and control set points to accommodate level instrumentation in the 6 monitor tanks, plus changes to overflow piping arrangements. Overall, this has resulted in a decrease in the

working or usable volume from 57m³ to 45m³ for each of the 6 tanks, although the overall dimensions of the tanks remain the same and only 3 (of 6) monitor tanks are in use at one time. We agree with Westinghouse's argument that there is still appropriate capacity for the expected operational liquid radwaste volumes and to enable appropriate monitoring and sentencing of the associated waste arisings.

87. Section 3.5.8.3 'High level waste storage', has been revised to indicate that each multi-purpose container (MPC) will now contain 24 (rather than 32) spent fuel assemblies, and that the overall number of MPCs over the 60-year plant life will be 130 (rather than 97). There is no change to the overall number of spent fuel assemblies over the 60-year plant life. This change has no material impact on the spent fuel disposal case, as there is a GDA assumption that assemblies from each MPC would be repackaged into disposal containers and, therefore, no implications for the disposability assessment by RWM.

4.2.4. Chapter 4 Non-radioactive waste management systems

88. Section 4.1.1.2 'Standby generators' has been revised to indicate that the generators operate at 50 Hz (not 60 Hz as per Revision 4) and the maximum thermal rated input of each standby generator is now 12.8 MW (reduced from 12.9 MW, as per Revision 4). This reflects improved generator efficiency.
89. Section 4.2.1.1 'Waste water system (WWS)' now indicates that waste water from the oil separator is pumped to a waste water retention basin (WWRB), rather than flowing under gravity as was the case in Revision 4.
90. Section 4.2.2.1 'Demineralised water treatment system (DTS)' has now been revised to include a 'clean in place unit' and a 'sample panel unit' (as per Paragraph 88 above).
91. Section 4.2.4.2 'Central chilled water system' no longer makes reference to adding antifreeze solution (see Paragraph 81, above).
92. Section 4.2.6 'Treatment and disposal of non-radioactive effluent' has been revised to describe how waste water from the transformers area is also collected in the 2 turbine building sumps. The text has been updated to indicate that the diesel fuel oil area sump pump and the transformers sump pump also discharge waste water to the oil separator. The oil separator removes oily waste from the waste water stream, which flows by gravity to the waste oil storage tank. It contains an oil hold-up tank, sampling provisions are included on the oil hold-up tank to confirm that the oil does not require handling and disposal as a hazardous waste. A sampling connection is also provided at the discharge of the oil separator. The waste water from the oil separator is pumped to the WWRB (rather than flowing by gravity as per Revision 4).
93. Table 4.3-1, 'Summary of main solid non-radioactive waste produced by the AP1000 NPP' has been revised to indicate a slightly increased inventory of waste lead acid batteries (Normal volume per unit frequency now 360m³, revised from 324m³ as per Revision 4).

4.2.5. Chapter 5 Environmental impact

94. There are no changes to Chapter 5, other than minor editorial changes.
95. Notably, there has been no change to the projected radioactive discharges and, therefore, no reappraisal of the associated impacts (relative to Revision 4).

4.2.6. Chapter 6 Environmental monitoring

96. There are no changes to Chapter 6, other than minor editorial changes.

4.2.7. Chapter 7 Selected considerations for specific sites

97. There are no changes to Chapter 7, other than minor editorial changes.

4.2.8. Appendix A: Waste arisings

98. There have been minor editorial changes to a small number of table entries, largely to revise item identifiers or descriptors and part numbers.
99. Specific changes to entries in the table comprising Appendix A2, 'Identification of waste arisings from primary system components' have been made, as follows:
- addition of:
 - batteries (EDSS-DB-1A (60 cells)), equating to a further 70 tonnes of potential battery waste in the plant lifetime, with a proposed disposal method of recycle or free issue
 - passive SPS Exhaust HVAC filters to the VAS. Creating an additional volume of up to 23m³ of LLW, with a proposed disposal route to the LLWR
 - passive fuel handling area exhaust HVAC filters to the VAS. Creating an additional volume of up to 23m³ of LLW, with a proposed disposal route to the LLWR
100. One specific addition to the table comprising Appendix A4, 'Estimated radwaste arisings from small volume components at decommissioning', as follows: addition of a tungsten shield plate, destined to arise potentially as LLW and which may require disposal or may be amenable to decontamination and free release. The estimated volume of this plate is 0.1m³.
101. Small increases to the volumes of solid LLW arisings do not alter our conclusions. Future operators will be expected to minimise these wastes arisings, where practicable, and to ensure appropriate disposal as per our regulatory requirements under any future permits.

4.2.9. Changes to references documents supporting the ER

102. Two supporting references to the ER have been updated. The changes reflect further consideration of the diesel generator design and assessments versus revised COMAH legislation. The relevant changes are as summarised below:
- **Applicability of the Environmental Permitting (England and Wales) Regulations 2010 to the AP1000® UKP-GW-GL-036 (Revision 3).** This document was updated to reflect revised standby diesel generator information based on vendor technical data. Westinghouse now proposes using a different engine that is more efficient and has a slightly reduced maximum thermal rated input power of 12.8 MW (compared to 12.9 MW as per the previous version). There is no change to our conclusions as a result of this minor change in thermal rated input power.
 - **Applicability of COMAH Regulations UKP-GW-GL-037 (Revision 3).** This document was revised following consideration of the new COMAH thresholds as per recent changes to COMAH legislation (Statutory Instrument 2015 No. 483, 'The Control of Major Accident Hazards Regulations 2015'). The review confirmed that none of the relevant COMAH thresholds for reagents used in the AP1000® design have been updated. However, as discussed above (Paragraph 78), an AP1000® reactor as defined in GDA would be an upper tier COMAH establishment because of the proposed hydrazine inventory.

5. ONR assessments

103. ONR had 49 other GDA Issues as well as the 2 shared with us.
104. We considered all of the GDA Issues and worked closely with ONR on reviewing the responses Westinghouse provided and the relevant ONR assessment reports to see if there was any potential impact on environmental matters or on the decision we published in 2011 (Environment Agency, 2011a).
105. The following sub-sections summarise our consideration of those ONR nuclear safety related GDA Issues and the closure of these issues has informed our assessment and contributed to our final decision. As a result of this, we have added new assessment findings which are set out in Appendix 3 as revised paragraphs to the decision document. The decision document and its supporting ARs should now be read with the revisions listed in Appendix 2 of this document. A full list of our assessment findings is given in Appendix 3 of this document.
106. Full information on all the ONR nuclear safety related GDA Issues is available in the ONR close-out GDA Issue summary report and the ONR assessment reports (see ONR's website: <http://www.onr.org.uk/new-reactors/ap1000/reports.htm>). ONR has concluded that Westinghouse has responded appropriately to each GDA Issue and, therefore, that the GDA Issues can be closed.
107. In our summary which follows we reflect only on aspects relevant to our overall assessment and we do not reproduce the detail of the ONR assessment reports.
108. Note that when we permit the disposal and discharge of radioactive wastes, we only require events that are reasonably foreseeable during the lifetime of the reactor to be considered. Severe accident scenarios are well outside the scope of our environmental permitting.

5.1. Internal hazards

109. ONR raised 6 GDA Issues relating to internal hazards, as outlined below:
- [GI-AP1000-IH-01](#) - Internal fire safety case substantiation - Westinghouse to provide evidence to substantiate the nuclear significant hazard barriers claimed to provide the level of fire resistance stated within the PCSR for integrity, insulation and load bearing capacity (where applicable).
 - [GI-AP1000-IH-02](#) - Internal flooding safety case - Westinghouse to provide an updated internal flooding safety case as there are inconsistencies associated with claims made on barriers, drains and sumps, and flood calculations.
 - [GI-AP1000-IH-03](#) - Pressure part failure - Westinghouse to provide evidence to support claims and arguments made within the area of pressure part failure.
 - [GI-AP1000-IH-04](#) - Internal explosion safety case substantiation - Westinghouse to provide evidence to support claims and arguments made within the area of internal explosion.
 - [GI-AP1000-IH-05](#) - Internal missile safety case - Westinghouse to identify and substantiate the claims, arguments and evidence that constitute the internal missile aspects of the internal hazards safety case.
 - [GI-AP1000-IH-06](#) - Substantiation and analysis of the consequences of dropped loads and impact from lifting equipment Included within the AP1000[®] design - Westinghouse to provide substantiation and analysis of the consequences of dropped loads and impact from lifting equipment included within the AP1000[®] reactor design.
110. ONR's assessment of internal hazard GDA Issues concluded that Westinghouse's response was sufficient and the issues are closed.
111. This topic is directly safety related and, therefore, there was limited impact on the environment case. We reviewed the ONR assessment reports and the associated assessment findings. There

has been no impact on the ER or any of its supporting documents as a result of closing these GDA Issues. We conclude that there are no aspects that affect our conclusions.

5.2. Civil engineering

112. ONR raised 4 GDA Issues relating to civil engineering, as outlined below:
- [GI-AP1000-CE-01](#) - Justification of novel form of structure for the steel/concrete composite walls and floors known as CA (Civil A) modules - Westinghouse was asked to define and justify the novel design used for the steel/concrete composite system proposed for the CA modules within the nuclear island. These are the prefabricated structural modules used for the in containment structures and within the auxiliary building.
 - [GI-AP1000-CE-02](#) - Further justification of novel form of structure for steel/concrete composite wall to the enhanced shield building - Westinghouse was asked to further justify the novel design used for the steel/concrete composite wall proposed for the Enhanced Shield Building within the nuclear island.
 - [GI-AP1000-CE-03](#) - AP1000[®] material standards and material specifications - Westinghouse to provide evidence to justify that materials adopted on the AP1000[®] design are compatible for European construction and to make sure European materials are appropriately substituted for the US materials specified in the AP1000[®] design.
 - [GI-AP1000-CE-04](#) - Fuel handling area secondary containment leak detection and collection system - Westinghouse to provide evidence to justify that the civil structures that retain pool water in the fuel handling area of the auxiliary building have secondary containment, each having its own dedicated system to detect potential leakage and allow that leakage to be collected.
113. ONR's assessment of civil engineering GDA Issues concluded that the Westinghouse response was sufficient and the issues are closed.
114. Westinghouse's consideration of materials of construction and materials performance in response to these GDA Issues lead to no significant changes in projected waste arisings. Overall, resolving these GDA Issues has had no impact on the ER or any of its supporting documents as a result of closing these GDA Issues. We conclude that there are no aspects that affect our conclusions.
115. Work to address GI-AP1000-CE-04 has helped to ensure that the fuel handling area secondary containment design is optimised to contain and detect any leakage and, therefore, future waste arisings. ONR raised an assessment finding (CP-AF-AP1000-CE-05) that expects a future licensee to establish a site-specific groundwater monitoring programme for the full life cycle of the facility. We support this assessment finding and note that such a monitoring programme is likely to be needed in support of a future operator's site wide environmental safety case.

5.3. Probabilistic safety analysis (PSA)

116. ONR raised 2 GDA Issues relating to probabilistic safety analysis (PSA), as outlined below:
- [GI-AP1000-PSA-01](#) - Success criteria for the PSA - Westinghouse was asked to provide a fully traceable design specific analysis including success criteria that meet ONR expectations.
 - [GI-AP1000-PSA-02](#) - Fire PSA - Westinghouse was asked to develop and provide a modern standards fire PSA to close a potential gap between the current estimated AP1000[®] plant risk associated with internal fires, and the AP1000[®] plant fire risk based on an up-to-date, realistic and complete evaluation.
117. These GDA Issues are directly related to safety analysis. Overall, resolving these GDA Issues has had no impact on the ER or any of its supporting documents. We conclude that there are no aspects that affect our conclusions.

5.4. Fault studies

118. ONR raised 8 GDA Issues relating to fault studies, as outlined below:
- [GI-AP1000-FS-01](#) - Spent fuel pool safety case - ONR concluded that the design basis case developed in GDA Step 4 for the spent fuel pool for the fault studies topic area needed to be cascaded into other technical areas and any new claims clearly identified in the PCSR. The design change process needed to be followed to incorporate the various physical modifications identified and all the affected documents needed to be updated. Fault studies concerns on the availability of the normal residual heat removal system (RNS) and protecting fuel above the spent fuel racks were to be addressed.
 - [GI-AP1000-FS-02](#) - Design reference point and adequacy of design basis analysis - Westinghouse was asked to demonstrate for all design basis faults that the submitted design basis analysis is appropriate for the agreed GDA design reference point and that all safety claims are supported by the analysis. If this could not be done with pre-existing analysis, new analysis was required. The final PCSR produced for GDA was to summarise this analysis for all design basis faults. A complete and consistent set of core design limits reflecting the design basis fault analysis was required.
 - [GI-AP1000-FS-03](#) - Diversity for frequent faults - Westinghouse was asked to provide a demonstration of functional diversity for frequent faults.
 - [GI-AP1000-FS-04](#) - Use of In-core detectors to protect against adverse power distributions - Westinghouse was asked to examine the feasibility of enhancing the flux protection on the AP1000® design to provide automatic and diverse protection against frequent adverse power distribution faults, possibly using the current design of in-core instrumentation.
 - [GI-AP1000-FS-05](#) - Potential enhancements to the diverse safety injection system - Westinghouse was asked to examine whether it is reasonably practicable to enhance the design of the RNS system in its role as the diverse safety injection system on the AP1000® reactor.
 - [GI-AP1000-FS-06](#) - Validation of the In-containment refuelling water storage tank (IRWST) cooling function for the passive residual heat removal (PRHR) - Westinghouse was asked to provide validation evidence that the IRWST is functionally capable of cooling the PRHR system during intact circuit faults for 72 hours.
 - [GI-AP1000-FS-07](#) - Safety case for shutdown faults - Westinghouse was asked to provide a fully integrated design basis safety case for shutdown faults in the PCSR.
 - [GI-AP1000-FS-08](#) - Fault schedule for AP1000® reactor - Westinghouse to present a fault schedule to ONR and support ONR's subsequent assessment of it, as necessary. The fault schedule was to be updated, as appropriate, following assessment by ONR and to incorporate any changes/additions to the AP1000® safety case resulting from GDA Issues.
119. ONR's assessment of the fault studies GDA Issues concluded that the Westinghouse response was sufficient and the issues are closed.
120. Work to address GI-AP1000-FS-01 led to introducing additional HEPA filtration on ventilation blowout panels on the spent fuel pool. This design change will result in a small increase in solid low level radioactive waste arisings (see Paragraph 101 above), as reflected in the updated ER. We agree that this additional filtration capacity is justified as it provides a barrier to the environment should there be a need to utilise the ventilation blowout panels in adverse operational situations (beyond normal operations).
121. There are no aspects that affect our conclusions.

5.5. Control and instrumentation

122. ONR raised 10 GDA Issues relating to control and instrumentation, as outlined below:

- [GI-AP1000-CI-01](#) - Adequacy of safety case for diverse actuation system (DAS) - Westinghouse had proposed design changes to the DAS secondary protection system and, as a result, the DAS design is not complete. This led to a lack of safety case argumentation and evidence to substantiate the DAS design. Westinghouse was asked to provide a response to ONR's observations on the basis of safety case (BSC), progress the detailed design, complete the safety case, provide the evidence identified in the safety case and introduce the design change proposal.
- [GI-AP1000-CI-02](#) - DAS Adequacy of architecture - Westinghouse to demonstrate that both the automatic and manual DAS can achieve its declared reliability targets. ONR asked Westinghouse to clarify the adequacy of the DAS (the secondary protection system) operating philosophy. In response, Westinghouse proposed significant changes to the architecture of the DAS. The expectation was that modified architecture will allow the DAS to remain in service during power operation, but this needed to be substantiated as the detailed design and reliability analyses are completed.
- [GI-AP1000-CI-03](#) - Diversity between the protection and safety monitoring system (PMS) component interface module (CIM) and DAS - ONR had identified an apparent lack of diversity of the primary protection system PMS (the CIM) and the diverse secondary protection system DAS. Diversity between the PMS (CIM) and DAS was a significant issue as it was proposed to use the same Field Programmable Gate Array (FPGA) component suppliers and application developers. The change of choice of DAS platform to a conventional discrete electronic one provided a significant step forwards. Nevertheless, a detailed diversity analysis was required for the DAS against the Plant control system (PLS)/Data display and processing system (DDS) and the PMS. ONR's expectation was that these diversity analyses will be set out in an appropriate BSC.
- [GI-AP1000-CI-04](#) - PMS spurious operation - Westinghouse to provide a design basis safety case covering such spurious actuations of engineered safety features. The PMS has the capability to actuate any of the engineered safety features (ESF) on the AP1000[®] reactor. This includes the potential to spuriously actuate the automatic depressurisation system (ADS) valves or the containment recirculation valves. The spurious operation of these functions has the potential to initiate safety significant variations such as a large loss of coolant accident (LOCA) or drainage of the IRWST.
- [GI-AP1000-CI-05](#) - smart device justification for use - ONR raised the issue that Westinghouse's approach to using smart devices (that is ones containing programmable elements) was not developed. ONR sought evidence of the approach actually being implemented through, for example, its application to sample devices at different classes.
- [GI-AP1000-CI-06](#) - Ovation platform - Adequacy of safety case - ONR sought an adequate safety case for the ovation platform that supports the Class 2 closed loop controls and the Class 3 manual controls and displays of the AP1000[®] design. A basis of safety case for the ovation platform and access to its supporting evidence was required.
- [GI-AP1000-CI-07](#) - Distributed control and information system (DCIS) - Adequacy of safety case - Westinghouse was asked to provide evidence to justify the claims for the automatic controls, manual controls and displays in the DCIS (PLS/DDS).
- [GI-AP1000-CI-08](#) - PMS - Adequacy of safety case - Westinghouse was asked to address shortfalls that were identified in providing a claims - argument - evidence structure for the PMS safety demonstration, which ONR has found difficult to understand without a logically structured safety case. The PMS safety case needed to incorporate the responses to the PMS related assessment findings and to reflect PMS development progress as the design is further developed.
- [GI-AP1000-CI-09](#) - CIM - Adequacy of safety case - Westinghouse to provide address shortfalls that ONR identified in providing a claims - argument - evidence structure in the CIM

safety case. The CIM safety case needed to incorporate responses to a CIM related ONR control and instrumentation assessment report and to reflect CIM development progress as the design is further developed.

- [GI-AP1000-CI-010](#) - Class 1 Displays and controls - Westinghouse was required to review the reasonable practicability of providing Class 1 displays and controls in the remote shutdown room (RSR).
123. These issues are directly related to safely operating the reactor plant. Overall, resolving these GDA Issues has had no impact on the ER or any of its supporting documents and there are no aspects that affect our conclusions.
124. However, we would expect any future operators to apply the methodology developed in response to GI-AP1000-CI-05 to smart devices that provide an environmental protection function, and, therefore, we have added the following assessment finding:
- **AP1000-AF16:** - An operator shall provide evidence during the detailed design phase that the methodology used to qualify smart devices for nuclear safety functions, has been applied to relevant smart devices that provide an environmental protection function.

5.6. Essential electrical systems

125. ONR raised 1 GDA Issue relating to essential electrical systems, as outlined below:
- [GI-AP1000-EE-01](#) - PCSR Presentation of claims, arguments and evidence - Westinghouse was required to provide, within the PCSR, the claims, arguments and evidence to substantiate the design of the complete plant electrical distribution system. The claims made for the electrical system needed to be related to the overall safety claims for the plant.
126. This GDA Issue relates directly to safely operating the reactor plant. Overall, resolving this issue has had no impact on the ER or any of its supporting documents and there are no aspects that affect our conclusions.

5.7. Fuel design

127. ONR raised 3 GDA Issues relating to fuel design, as outlined below:
- [GI-AP1000-FD-01](#) - Fuel pin modelling safety justification - Westinghouse to comprehensively demonstrate that performance analysis and design (PAD) predictions of temperatures for fresh fuel will in all cases exceed the expected temperatures of irradiated fuel, including allowances for uncertainty.
 - [GI-AP1000-FD-02](#) - Tolerability of depressurisation forces in a large break loss of coolant accident (LBLOCA) - Westinghouse to demonstrate that pressure forces associated with the depressurisation of the primary circuit are limited enough to maintain a coolable geometry in the core.
 - [GI-AP1000-FD-03](#) - Use of the BEACON™ code for online compliance - Westinghouse was asked to provide a safety case to demonstrate compliance with the fuel and fault study limits in the event of an unrevealed failure of the BEACON™ code.
128. These GDA Issues are directly related to safely operating the reactor plant. Overall, resolving these GDA Issues has had no impact on the ER or any of its supporting documents and there are no aspects that affect our conclusions.

5.8. Reactor chemistry

129. ONR raised 3 GDA Issues relating to reactor chemistry, as outlined below:
- [GI-AP1000-RC-01](#) - Accident source terms - Westinghouse was asked to demonstrate that the source term released into the containment during accidents is appropriate for the reactor design.
 - [GI-AP1000-RC-02](#) - Primary sampling system (PSS) - Westinghouse was asked to demonstrate that the sampling arrangements for the primary circuit and connected auxiliary systems of reactor design are adequate to support safe operation of the plant.
 - [GI-AP1000-RC-03](#) - Hydrogen dosing system - Westinghouse was asked to demonstrate that the hydrogen dosing system in reactor design has the capacity and capability to provide suitable control over the primary coolant hydrogen concentration during all operating modes and potential faults.
130. Overall, resolving these GDA Issues has had no significant impact on the ER or any of its supporting documents and there are no aspects that affect our conclusions.
131. We note that in response to GI-AP1000-RC-02 Westinghouse has progressed design modifications in a number of discrete areas, namely the sample header configuration, online boron metering and corrosion product sampling. The changes enable increased sampling of reactor chemistry parameters. A design change proposal (APP-GW-GEE-5402) is approved and included in DRP Revision 10 but remains to be fully incorporated and is to be progressed at the detailed design stage.
132. While additional sampling may increase liquid waste volumes we also note that improved controls on reactor chemistry may also help reduce some waste arisings (for example, by better plant control leading to reduced corrosion rates). Westinghouse has suggested that increased liquid waste volumes from any additional sampling are unlikely to increase the total radioactivity discharged overall (that is, volumes of liquid waste may increase but the total radioactivity will not).
133. Options for the onward treatment of liquid sample arisings before discharge are to be considered at detailed design. ONR has raised an assessment finding (CP-AF-AP1000-RC-06) prompting any future licensee to provide justification for the omission of the capability to recycle the sampling effluent, in order to minimise the production of radioactive waste as low as reasonably practicable. We support this assessment finding and will seek to ensure that the final design is optimised to minimise the production and discharge of radioactive waste. We also note that our earlier assessment finding AP1000-AF12 relates to optimised sampling arrangements to be defined at the detailed design stage (see Appendix 3).

5.9. Radiological protection

134. ONR raised 1 GDA Issue relating to radiological protection, this was:
135. [GI-AP1000-RP-01](#) - Spent fuel pool – Criticality safety case - Westinghouse was asked to demonstrate why it is not reasonably practicable to design the spent fuel pool such that criticality control is achieved through geometrical control and fixed poisons alone.
136. A new spent fuel pool rack configuration has been incorporated for the UK AP1000® design. As a result of this design change, the spent fuel pool capacity has changed from 889 to approximately 617 fuel assemblies. This represents capacity for 6 refuelling offloads (compared to 10 previously). The fuel pond storage time has changed from 18 to 10 years before transfer to long term interim storage, and before eventual geological disposal. The multi-purpose canisters for fuel storage will now hold 24 instead of 32 assemblies, giving a total of 130 canisters instead of 97 for the 60-year plant life time.
137. While fuel is to be stored in the spent fuel pool for less time, the number of elements entering the spent fuel pool over the plant life is unchanged. Impurities in the fuel pool water that need to be cleaned out of the pond arise from the fuel elements in the early storage period. Therefore, the amounts of clean-up resin and demineraliser needed to clean-up the pool water are not expected

to change significantly overall. Therefore, there will be no significant change in the operational waste arisings as a result of this design change.

138. This design change has no impact on the amount of spent fuel arisings for eventual disposal. As we noted above (Paragraph 87) spent fuel will be repackaged for final disposal and, therefore, there will be no increase in the number of spent fuel disposal containers.
139. Overall, the resolution of this GDA Issue has had no significant impact on the ER or any of its supporting documents and there are no aspects that affect our conclusions.

5.10. Mechanical engineering

140. ONR raised 3 GDA Issues relating to mechanical engineering, as follows:
- [GI-AP1000-ME-01](#) - Squib valve concept and design substantiation - Westinghouse was asked to provide adequate arguments and evidence for the selection, system incorporation and qualification of the squib valve designs.
 - [GI-AP1000-ME-02](#) - Metrication of mechanical equipment and civil structural steelwork connections - Westinghouse was asked to provide GDA documentation that includes SI units (that is, international system of units) and to reflect a design that is essentially metric, using metric structures, systems and components.
 - [GI-AP1000-ME-03](#) - Mechanical system pipework design - Westinghouse was asked to provide further justification for the pipework design of the AP1000® for systems important to safety and to demonstrate incorporation of adequate isolation and drainage arrangements to enable all anticipated examination, inspection, maintenance and testing (EIMT) activities to be carried out in a safe and controlled manner.
141. As per the response to GI-AP1000-ME-01, squib valves will need periodically testing, which will create waste. The in-service testing for each squib valve will include both testing the remote position indication and a test-firing of the igniter and propellant. The squib valve charge assembly is removed and then test-fired outside of the valve in a test rig that can monitor explosive charge performance. An operator will decide the exact testing regime, but according to Westinghouse current test recommendations a total of 4-20% of squib valves charges and initiators per unit and outage will be tested. Those tests are performed before being used in the plant and, therefore, there is no scope for radioactive contamination. Should an operator choose to test squib valves charges and initiators that have been inside containment, additional requirements would need to apply.
142. Valves for all systems are listed in the ER Appendix A3 and it is assumed that these will arise as solid LLW. Westinghouse has confirmed that although squib valves are located in containment, the squib valve chargers and initiators are not likely to be exposed to contamination or airborne radioactivity. There is no reactor coolant contacting the chargers and the initiators, the reactor coolant will only contact internal surfaces up to the inside of the shear plate and, therefore, it should be possible to clean or decontaminate the valves when taken out of containment. Westinghouse observes that a reactor facility will include a hot machine shop that is designed for such activities and could be used, at the discretion of a future operator, for decontamination work, if required.
143. We will expect any future operators to develop optimised arrangements for managing and disposing of squib valve waste and any secondary waste from testing programmes. We have raised an assessment finding to capture this:
- **AP1000-AF15:** An operator shall ensure that radioactive waste arisings from squib valve testing are minimised and appropriately routed for disposal.
144. Westinghouse has updated the ER to include SI units and metric designations in response to GI-AP1000-ME-02.
145. In response to GI-AP1000-ME-03, Westinghouse has added draining provisions to steam generator blowdown system (BDS), chemical and volume control system (CVS) and reactor

coolant system (RCS) to enable safe EIMT activities. For a number of other systems, dedicated drainage was felt unnecessary and system flushing is considered appropriate. The contaminated volume of water, from the systems requiring flushing, is removed from the system using existing collection points (such as tanks and drain valves) and is routed via a flexible hose to a drain. It is then treated by the AP1000® waste processing systems (including abatement). It will not, therefore, contribute any additional waste arisings to those already assessed.

146. Overall, resolving these GDA Issues has had no significant impact on the ER or any of its supporting documents and there are no aspects that affect our conclusions.

5.11. Structural integrity

147. ONR raised 6 GDA Issues relating to structural integrity, as follows:

- [GI-AP1000-SI-01](#) - Avoidance of fracture - Westinghouse was required to demonstrate defect tolerance and the absence of planar defects in the components for which the likelihood of gross failure is claimed to be so low it can be discounted.
- [GI-AP1000-SI-02](#) - Fatigue analysis - Westinghouse was required to provide sufficient evidence to show that American Society of Mechanical Engineers (ASME) III Class 1 pipework has an adequate fatigue life for the 60-year design life of the reactor.
- [GI-AP1000-SI-03](#) - Reactor coolant pump - Westinghouse was required to provide a technical report addressing the structural integrity considerations related to a clad ferritic pump bowl casing and support the assessment of the pump bowl integrity case.
- [GI-AP1000-SI-04](#) - Containment vessel - Westinghouse was required to provide sufficient evidence to show that the containment vessel can adequately tolerate the thermal shock due to the flow of passive cooling system (PCS) water onto the top head.
- [GI-AP1000-SI-05](#) - Compliance of AP1000® main structural components with ASME III design rules - Westinghouse was required to provide evidence to show that the design of the main structural vessels is compliant with the ASME III code.
- [GI-AP1000-SI-06](#) - Categorisation and classification - Westinghouse was required to provide evidence to show that categorisation and classification has been applied in an appropriately to components with an important structural integrity claim.

148. Resolving these GDA Issues has had no significant impact on the ER or any of its supporting documents and there are no aspects that affect our conclusions.

5.12. Human factors

149. ONR raised 1 GDA Issue relating to human factors, as follows:

- [GI-AP1000-HF-01](#) - Completeness of the human factors (HF) safety case - Westinghouse was required to provide a complete human factors safety case, specifically addressing limitations in the areas of human error mechanisms, operator misdiagnosis potential and violation potential.

150. The only area where there is considered to be a potential impact on the environmental assessment is in relation to the analysis of potential human errors that could lead to safety related structures, systems and components (SSCs) failing. Some of these SSCs are also used in environmental systems. However, the work is aimed at eliminating and/or reducing the likelihood of errors. It should, therefore, lead to improvements rather than a fall in environmental performance.

151. Resolving this GDA Issue does not impact on the information presented in the ER and supporting documentation. However, we would expect any future operators when carrying out detailed design of SSCs that provide an environmental protection function, to provide evidence that demonstrates the allocation of actions between humans and technology has been substantiated and dependence on human action to maintain a benign state has been optimised. We have, therefore, added the following assessment finding:

- **AP1000-AF17:** An operator shall provide evidence demonstrating the allocation of actions between humans and technology has been substantiated and dependence on human action to maintain a benign state has been optimised when undertaking detailed design of structures, systems and components (SSCs) that provide an environmental protection function.

5.13. Cross-cutting topics

152. ONR raised 1 additional GDA Issue relating to cross-cutting topics, in addition to the 2 joint cross-cutting GDA Issues raised with the EA, as follows:
- [GI-AP1000-CC-01](#) - Limits and conditions - Westinghouse was required to identify and advise the future licensee of the conditions and limits necessary in the interests of safety via suitable arrangements. These arrangements need to ensure that there is an appropriate link between the analysis documented in its safety case and the associated operational limits and conditions derived from the safety case, such that the licensee can operate in accordance with the safety case.
153. Resolving this GDA Issue does not impact on the information presented in the ER and supporting documentation. However, we would expect any future operators to apply an appropriate methodology for categorising environmental protection functions and classifying SSCs that provide an environmental protection function, and, therefore, we have added the following assessment finding:
- **AP1000-AF18:** An operator shall provide evidence during the detailed design phase that an appropriate methodology has been applied for categorising environmental safety functions and classifying structures, systems and components (SSCs) that provide an environmental protection function.

5.14. ONR's conclusion

154. ONR has concluded that an appropriate assessment of the AP1000® generic reactor design has been completed as per the scope and expectations of GDA. In view of the safety case and design change improvements that Westinghouse has provided, ONR is now content, for this stage in the design process, that the current AP1000® generic reactor design and safety case has demonstrated that the risks to workers and the public are as low as reasonably practicable (ALARP).
155. In recognition of the fact that all the nuclear safety related GDA Issues are closed, and in accordance with its published guidance, ONR has, therefore, decided to issue a design acceptance confirmation (DAC) for the AP1000® reactor design. This has been issued alongside a summary report and means that ONR believes that the AP1000® reactor is suitable for construction on licensed sites in the UK, subject to site-specific assessment and licensing.
156. Design changes that have been agreed by the regulators are included in the final GDA reference design configuration, which is referenced in the DAC.
157. Summary and supporting technical reports published in relation to the AP1000® reactor design can be found on ONR's website: <http://www.onr.org.uk/new-reactors/ap1000/reports.htm>

6. Our final decision

158. We have now concluded that we are satisfied with the generic environmental case for the AP1000[®] generic reactor design and that it should meet the high standards we expect, and have issued a statement of design acceptability (SoDA). This is reproduced at [Appendix 1](#). It is valid only for a site consistent with the identified generic site characteristics (see Section 13.3 of our [decision document](#) (Environment Agency, 2011a)).
159. We made our decision to issue a SoDA after we had carefully considered all responses to our consultation which took place in 2010, and assessed that Westinghouse has resolved the 2 outstanding GDA Issues identified in the iSoDA we issued in December 2011.
160. As part of our assessment, we identified 18 assessment findings (12 previously, and 6 new). We expect future operators to address these assessment findings during the detailed design, procurement, construction, commissioning or early operational phases of any new build project.

References

Reference	Author / Publication / Website
Environment Agency, 2008	Environment Agency, 2008. Statement of findings following preliminary assessment of the submission by Westinghouse Electric Company LLC for its AP1000® design. Bristol: Environment Agency. http://www.onr.org.uk/new-reactors/reports/ap100summary.pdf
Environment Agency, 2010	Environment Agency, 2010. Generic design assessment. AP1000® nuclear power plant design by Westinghouse Electric Company LLC. Consultation document. Bristol: Environment Agency. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/296538/geho0510bruw-e-e.pdf
Environment Agency, 2011a	Environment Agency, 2011a. Generic design assessment. AP1000® nuclear power plant design by Westinghouse Electric Company LLC. Decision document. Bristol: Environment Agency. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/296662/geho1211btoi-e-e.pdf
Environment Agency, 2011b	Environment Agency, 2011a. Generic design assessment. AP1000® nuclear power plant design by Westinghouse Electric Company LLC. Final assessment report. Management systems. Bristol: Environment Agency. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/296664/geho1211btnt-e-e.pdf
Environment Agency, 2011c	Environment Agency, 2011a. Generic design assessment. AP1000® nuclear power plant design by Westinghouse Electric Company LLC. Final assessment report. Integrated waste strategy. Bristol: Environment Agency. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/296664/geho1211btnt-e-e.pdf
Environment Agency, 2011d	Environment Agency, 2011a. Generic design assessment. AP1000® nuclear power plant design by Westinghouse Electric Company LLC. Final assessment report. Best available techniques to prevent or minimise creation of radioactive wastes. Bristol: Environment Agency. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/296664/geho1211btnt-e-e.pdf
Environment Agency, 2011e	Environment Agency, 2011a. Generic design assessment. AP1000® nuclear power plant design by Westinghouse Electric Company LLC. Final assessment report. Gaseous radioactive waste disposal and limits. Bristol: Environment Agency. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/296664/geho1211btnt-e-e.pdf

Reference	Author / Publication / Website
Environment Agency, 2011f	Environment Agency, 2011a. Generic design assessment. AP1000 [®] nuclear power plant design by Westinghouse Electric Company LLC. Final assessment report. Aqueous radioactive waste disposal and limits. Bristol: Environment Agency. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/296664/geho1211btnx-e-e.pdf
Environment Agency, 2011g	Environment Agency, 2011a. Generic design assessment. AP1000 [®] nuclear power plant design by Westinghouse Electric Company LLC. Final assessment report. Solid radioactive waste (LLW and ILW). Bristol: Environment Agency. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/296664/geho1211btny-e-e.pdf
Environment Agency, 2011h	Environment Agency, 2011a. Generic design assessment. AP1000 [®] nuclear power plant design by Westinghouse Electric Company LLC. Final assessment report. Spent fuel. Bristol: Environment Agency. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/296664/geho1211btnz-e-e.pdf
Environment Agency, 2011i	Environment Agency, 2011a. Generic design assessment. AP1000 [®] nuclear power plant design by Westinghouse Electric Company LLC. Final assessment report. Disposability of ILW and spent fuel. Bristol: Environment Agency. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/296664/geho1211btoa-e-e.pdf
Environment Agency, 2011j	Environment Agency, 2011a. Generic design assessment. AP1000 [®] nuclear power plant design by Westinghouse Electric Company LLC. Final assessment report. Monitoring of radioactive disposals. Bristol: Environment Agency. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/296664/geho1211btob-e-e.pdf
Environment Agency, 2011k	Environment Agency, 2011a. Generic design assessment. AP1000 [®] nuclear power plant design by Westinghouse Electric Company LLC. Final assessment report. Generic site. Bristol: Environment Agency. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/296664/geho1211btoc-e-e.pdf
Environment Agency, 2011l	Environment Agency, 2011a. Generic design assessment. AP1000 [®] nuclear power plant design by Westinghouse Electric Company LLC. Final assessment report. Radiological impact on members of the public. Bristol: Environment Agency. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/296664/geho1211btod-e-e.pdf
Environment Agency, 2011m	Environment Agency, 2011a. Generic design assessment. AP1000 [®] nuclear power plant design by Westinghouse Electric Company LLC. Final assessment report. Radiological impact on non-human species. Bristol: Environment Agency. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/296664/geho1211btod-e-e.pdf

Reference	Author / Publication / Website
Environment Agency, 2011n	Environment Agency, 2011a. Generic design assessment. AP1000® nuclear power plant design by Westinghouse Electric Company LLC. Final assessment report. Other environmental regulations. Bristol: Environment Agency. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/296664/geho1211btof-e-e.pdf
ONR, 2011a	Japanese Earthquake and Tsunami: Implications for the UK Nuclear Interim Report May 2011. http://www.onr.org.uk/fukushima/interim-report.pdf
ONR, 2011b	Japanese Earthquake and Tsunami: Implications for the UK Nuclear Industry – Final Report October 2011. http://www.onr.org.uk/fukushima/final-report.pdf

7. List of abbreviations

ADS	Automatic depressurisation system
ASME	American Society of Mechanical Engineers
BAT	Best available techniques
BDS	Steam generator blowdown system
BSC	Basis of safety case
C&I	Control and instrumentation
CIM	Component interface module
COMAH	Control of Major Accident Hazards (regulations)
CVS	Chemical and volume control system
DAC	Design acceptance confirmation
DAS	Diverse actuation system
DCIS	Distributed control and information system
DDS	Data display and processing system
DRP	Design reference point
EIMT	Examination, inspection, maintenance and testing
ESF	Engineered safety features
FAR	Final assessment report
FPGA	Field programmable gate array
GDA	Generic design assessment
HEPA	High efficiency particulate air
HLW	High level waste
HSE	Health and Safety Executive
HVAC	Heating, ventilation and air conditioning system
ILW	Intermediate level waste
IRWTS	In-containment refuelling water storage tank
iSoDA	Interim statement of design acceptability
LLW	Low level waste
LLWR	Low level waste repository
LBLOCA	Large break loss of coolant accident
LOCA	Loss of coolant accident
MPC	Multi-purpose container
MSL	Master submission list
NRW	Natural Resources Wales
ONR	Office for Nuclear Regulation
P&ID	Process and information document

PCS	Passive cooling system
PCSR	Pre-construction safety report
PLS	Plant control system
PMS	Protection and safety monitoring system
PRHR	Passive residual heat removal
PSS	Primary sampling system
REPs	Radioactive substances environmental principles
RRM	Regulatory review meeting
RSR	Remote shutdown room
RI	Regulatory issue
RNS	Normal residual heat removal system
RO	Regulatory observation
RQ	Regulatory query
RWM	Radioactive Waste Management Limited
SoDA	Statement of design acceptability
SSC	Structures, systems and components

8. Glossary

Assessment Finding: an unresolved issue of lesser significance than a GDA Issue and not considered critical to the decision to start nuclear island safety-related construction.

Best available techniques (BAT): the latest stage of development (state of the art) of processes, of facilities or of methods of operation, which indicate the practical suitability of a particular measure for limiting discharges, emissions and waste. In determining whether a set of processes, facilities and methods of operation constitute the best available techniques in general or individual cases, special consideration shall be given to:

- comparable processes, facilities or methods of operation which have recently been successfully tried out
- technological advances and changes in scientific knowledge and understanding
- the economic feasibility of such techniques
- time limits for installation in both new and existing plants
- the nature and volume of the discharges and emissions concerned

Discharge: the release of gaseous or aqueous waste to the environment.

Disposal: includes:

- placing solid waste in an authorised land disposal facility without plans to retrieve it at a later time
- releases to the environment (emissions and discharges) of gaseous waste (gases, mists and dusts) and aqueous waste
- transfer of waste, together with responsibility for that waste, to another person

Dose: a general term used as a measure of the radiation received by man and usually measured in sieverts.

Final SoDA: the statement of design acceptability provided when all GDA Issues have been addressed to the Environment Agency's satisfaction.

GDA Issue: an unresolved issue considered by regulators to be significant, but resolvable, and which requires resolution before nuclear island safety-related construction of the reactor could be considered.

GDA submission: the total number of documents presented to regulators in GDA, including the Design Reference, the GDA safety, security and environmental submissions and related supporting references.

GDA master submission list: a 'live' document that lists all the individual documents making up the GDA safety, security and environmental submissions and all the supporting documents referenced in them, and identifies their current revision status.

Generic site envelope: the generic siting characteristics, specified by the requesting party, against which the regulators assess the acceptability of the design safety case. These characteristics, such as seismic hazard, extreme weather events and environmental receptors should, as far as possible, envelop or bound the characteristics of any potential UK site so that the reactors could potentially be built at a number of suitable UK locations.

High level waste (HLW): waste in which the temperature may rise, as a result of its radioactivity, to an extent that it has to be accounted for in designing storage or disposal facilities.

Interim SoDA: an interim statement of design acceptability, issued when there are GDA Issues for which the requesting party has provided a credible resolution plan.

Intermediate level waste (ILW): waste with radioactivity levels exceeding the upper boundaries for low level waste but which does not require heat generation to be accounted for in the design of disposal or storage facilities.

Low level waste (LLW): waste containing levels of radioactivity greater than those acceptable for disposal with normal refuse but not exceeding 4 GBq/tonne alpha-emitting radionuclides or 12 GBq/tonne beta-emitting radionuclides.

Radioactive waste: waste that contains radioactivity above levels specified in the Environmental Permitting Regulations 2010.

Radioactivity: the property of some atomic nuclides to spontaneously disintegrate emitting radiation such as alpha particles, beta particles and gamma rays.

Radiological assessment: an assessment of the radiation dose to members of the public, including that from discharges, which will result from operation or decommissioning of a facility.

Radionuclide: a general term for an unstable atomic nuclide that emits ionising radiation.

Regulatory issue (RI): a serious regulatory shortfall that is potentially significant enough to prevent issuing a SoDA, and which requires action and new work for it to be addressed.

Regulatory observation (RO): a potential regulatory shortfall that requires further justification by the requesting party and further assessment by the regulators in the expectation that it can be resolved.

Regulatory query (RQ): a request for clarification or further information resulting from the assessment process. It may result in an RO or RI being raised if the query cannot be satisfactorily resolved.

Symbols and units

MW	Megawatt
te	Tonne

Appendix 1 - Statement of design acceptability



Generic assessment of candidate nuclear power plant designs

Statement of design acceptability for the AP1000® design submitted by Westinghouse Electric Company LLC (Westinghouse)

The Environment Agency and Natural Resources Wales have undertaken a Generic Design Assessment of Westinghouse AP1000® reactor design during the period July 2007 to March 2017, using the process set out in the document Process and Information Document for Generic Assessment of Candidate Nuclear Power Plant Designs^[1].

The findings of our assessment are summarised in the documents:

Decision Document. Generic Design Assessment of Westinghouse Electric Company LLC's AP1000® nuclear power plant design^[2]

Supplementary Decision Document. Generic Design Assessment of Westinghouse Electric Company LLC's AP1000® nuclear power plant design^[3]

The Environment Agency and Natural Resources Wales are satisfied that Westinghouse has demonstrated the acceptability for environmental permitting of the AP1000® reactor design on the generic site, as defined in Schedule 1.

This statement is provided as advice to Westinghouse, under section 37 of the Environment Act 1995. It does not guarantee that any site-specific applications for environmental permits for the AP1000® reactor design will be successful.

Name	Date
 Steve Hardy Manager, Nuclear Regulation Group (North)	28th March 2017

Authorised on behalf of the Environment Agency

Name	Date
 Isobel Moore Head of Regulation & Permitting	26th March 2017

Authorised on behalf of Natural Resources Wales

References

1. Process and Information Document for Generic Assessment of Candidate Nuclear Power Plant Designs, Version 3, Environment Agency, October 2016
2. Decision Document. Generic Design Assessment of Westinghouse Electric Company LLC's AP1000® nuclear power plant design, December 2011
3. Supplementary Decision Document. Generic Design Assessment of Westinghouse Electric Company LLC's AP1000® nuclear power plant design, March 2017

Schedule 1 – Scope of the GDA

This statement of design acceptability refers to the AP1000® design as described in the design reference documentation:

Document reference	Title	Version number
UKP-GW-GL-060	AP1000® Design Reference Point for UK GDA	Revision 10
UKP-GW-GL-790	UK AP1000® Environment Report	Revision 7
UKP-GW-GLX-001	The documents contained in the AP1000® Master Submission List for UK GDA.	Revision 2

Appendix 2 - Changes to our documents

We described changes to the ER and its supporting documents and provided our assessment of the implications of these changes in Section 4. We described the implications of closing GDA Issues and provided our assessment of the implications of this in Sections 2, 3 and 5.

This has led us to make some minor revisions to the text in our decision document and the supporting final assessment reports (FAR), which we issued in 2011. We decided that the revisions were not significant enough that we needed to re-issue the documents. Those documents should now be read with the revised paragraphs tabulated below. The most significant changes relate to adding a number of assessment findings, as outlined above and summarised in Appendix 3.

Document to be changed	Location of change	Change (highlighted)
Decision document	Paragraph 16, minor edits to 2 assessment findings (AF07 and AF11) and addition of new rows for AF13-AF-18.	<p>Details provided in Appendix 3, specifically:</p> <ul style="list-style-type: none"> minor edits to assessment findings AF07 and AF11 addition of new rows for 6 new assessment findings AF13 - AF-18
Decision document	Para 787	The spent fuel pool has the capacity to store 617 fuel assemblies (changed from 889). Each typical refuelling offload discharges 64 fuel assemblies. The spent fuel pool has the capacity for 6 refuelling offloads (changed from 10 refuelling offloads), which is approximately equal to 10 years of operation (changed from 18 years), plus one full core offload.
Decision document	Para 652	Treated radioactive effluent from the WLS is collected in 6 monitor tanks, each with a usable capacity of 45m ³ (reduced from 57m ³), located in the radwaste building. Westinghouse claims that the average daily radioactive liquid waste arisings are approximately 8m ³ . The monitor tanks will, therefore, provide up to 33 days (reduced from 42 days) typical storage capacity in normal operation. This storage period will be longer for most operations but reduced for short periods during higher discharges associated with refuelling.
Decision document	Para 1124	Westinghouse states that the maximum rated thermal input of each will be 12.8 MW (reduced from 12.9 MW). The aggregate of the 2 units is, therefore, 25.6 MW (reduced from 25.8 MW).
Decision document	Para 1147	The AP1000 will store hydrazine (a dangerous substance as defined in the COMAH regulations) in quantities exceeding the upper tier COMAH threshold and will, therefore, be a COMAH upper tier establishment; (changed from lower tier designation)
Decision document	Para 1149 Table entry	Stored quantity (te): hydrazine (35% w/v solution) 3.05 (changed from 1.1te hydrazine (as hydrate))
Decision document	Para 1150	Westinghouse, therefore, states that the site of an AP1000 will become a COMAH upper tier establishment because of the expected storage quantity of more than 2 tonnes of hydrazine 35% w/v solution. (ERs2.9.2.1) (changed from lower tier designation)

Document to be changed	Location of change	Change (highlighted)
Decision document	Para 1159	Westinghouse claims the above measures make it unlikely that the whole stored quantity of hydrazine 35% w/v solution (3.05 te) will reach the sea. (changed to reflect the revised hydrazine inventory)
All FAR	Westinghouse documentation	All references to the 'EPS-GW-GL-700: European Design Control Document' are removed. EPS-GW-GL-700 remains as an archived document but the relevant reference for onward development is to the UKP-GW-GL-793 Pre-construction safety report where equivalent details are provided.
Gaseous radioactive waste disposal and limits FAR	Paragraph 77(e), Paragraph 98, Paragraph 147 (d (I))	The average (changed from 'minimum') calculated holdup times are 38.6 days for xenon and 2.2 days for krypton which are based upon a continuous input flowrate to the gaseous radioactive waste system of 0.85m ³ h ⁻¹ .
Best available techniques to prevent or minimise creation of radioactive wastes FAR	Paragraph 107, Paragraph 121	Text referring to 'canned motor reactor coolant pumps', should now refer to 'wet winding reactor coolant pumps pumps' .
Other environmental regulations FAR	Para 50	a) the demineralised water treatment system treats raw water using filters, reverse osmosis and electrodeionisation. Chemicals are added in trace quantities to adjust pH, act as an anti-scalant and to chemically reduce chlorine. This system includes design features to enable direct sampling and has a 'clean in place' unit to enable maintenance.
Other environmental regulations FAR	Para 113	Westinghouse states that the maximum rated thermal input of each will be 12.8 MW (reduced from 12.9 MW). The aggregate of the two units is, therefore, 25.6 MW (reduced from 25.8 MW).
Other environmental regulations FAR	Para 114	The capacity of the 2 diesel generator days tanks has been increased, therefore, a revision to the volume quoted: b) 2 day tanks each of 7.6m³ (changed from 4.9m ³).
Other environmental regulations FAR	Para 136	The estimated quantity of hydrazine (35% w/v solution) potentially to be stored on the site is 3.05 tonnes (revised from 1.1 tonnes of pure hydrazine). The estimated quantity of petroleum spirits (diesel for back-up generators) potentially to be stored on the site has increased to 472 tonnes (changed from 467 tonnes).
Other environmental	Para 137	Westinghouse, therefore, states that the site of an AP1000 will become a COMAH upper tier

Document to be changed	Location of change	Change (highlighted)
regulations FAR		<p>establishment because of the expected storage quantity of more than 2 tonnes of hydrazine 35% w/v solution. (ERs2.9.2.1).</p> <p>(changed from lower tier designation)</p>
Other environmental regulations FAR	Para 145	<p>Westinghouse claims the above measures make it unlikely that the whole stored quantity of hydrazine 35% w/v solution (3.05 te) will reach the sea.</p> <p>(changed to reflect the revised hydrazine inventory)</p>
Other environmental regulations FAR	Para 146	<p>a) the AP1000 will store hydrazine (a dangerous substance as defined in the COMAH regulations) in quantities exceeding the upper tier COMAH threshold and will, therefore, be a COMAH upper tier establishment.</p>
Spent fuel FAR	Para 56	<p>Spent fuel assemblies are discharged from the reactor at every refuelling outage and are placed into the spent fuel pool. The spent fuel pool has the capacity to store 617 fuel assemblies. Each typical refuelling offload discharges 64 fuel assemblies. The spent fuel pool has the capacity for 6 refuelling offloads, which is approximately equal to 10 years of operation, plus 1 full core offload.</p>
Spent fuel FAR	Para 85	<p>Spent fuel is stored in high density racks, which include integral neutron absorbing material to maintain the required degree of sub-criticality. The racks are designed to store fuel of the maximum design basis enrichment. An assembly cannot be inserted into a location that is full and the design of the racks is such that a fuel assembly cannot be inserted into a location other than a location designed to receive an assembly. The pool contains rack modules and 5 individual defective fuel assembly storage cells.</p>
Spent fuel FAR	Para 86	<p>The spent fuel assemblies are usually stored in the pool for up to 10 years, which reduces fission product activity and decay heat generation.</p>
Aqueous FAR	Para 198, 182, pages 35-37.	<p>Changes to the monitor tank capacities:</p> <p>Each monitor tank now has a volume capacity of 45m³ (reduced from 57m³), with a total capacity of 270m³ (reduced from 342m³). Note that the tank dimensions have not changed but the accessible volume has reduced due to the addition of level alarm arrangements.</p> <p>The monitor tanks will, therefore, provide up to 33 days (reduced from 42 days) typical storage capacity in normal operation.</p> <p>Time taken to reach capacity normal daily flow rate (days): 2.61 days (reduced from 3.31 days).</p>

Document to be changed	Location of change	Change (highlighted)
		Time taken to reach capacity maximum daily flow rate (days): 0.81 days (reduced from 1.03 days).

Appendix 3 - Compilation of assessment findings

We listed 12 assessment findings in our 2011 decision document. We have added 6 additional assessment findings following our assessment of the GDA Issues outstanding when the 2011 decision document was published.

We have also made some revisions to the original assessment findings in a number of cases. These do not change the intent of the findings, but seek to clarify what is expected and to reflect current terminology at this time.

The full list of assessment findings is shown in the table below.

Reference	Assessment finding
The following (AP1000-AF01 - AP1000-AF12) are the assessment findings as listed in our 2011 decision document. Changes to AP1000-AF07 and AP1000-AF11 are described.	
AP1000-AF01	The future operator shall provide at the detailed design stage, an updated decommissioning strategy and decommissioning plan.
AP1000-AF02	Future Operators shall, at the detailed design phase, provide a Best Available Techniques (BAT) assessment to demonstrate whether boron recycling represents BAT for their location.
AP1000-AF03	Future operators shall, before the commissioning phase, provide their proposals for how they intend to implement zinc injection. The proposals shall be supported by an assessment of the impact of zinc injection on waste and crud composition.
AP1000-AF04	Future Operators shall, before the construction phase, provide a BAT assessment to demonstrate that the design and capacity of secondary containment proposed for the monitor tanks is adequate for their location
AP1000-AF05	Future operators shall, at the detailed design phase, provide an assessment to demonstrate that techniques to minimise the discharge of all aqueous radioactive wastes are BAT for their location. In particular, the omission of an evaporator will need to be justified.
AP1000-AF06	Future operators shall, during the detailed design stage, provide a predicted mass balance showing how their proposed aqueous radioactive waste management regime will affect the disposal of carbon-14 to the gaseous, solid or aqueous routes. For each route the form of carbon-14 expected shall be provided. For solid wastes the quantities of each type of waste shall be provided with expected carbon-14 content.
AP1000-AF07	The future Operator shall provide confidence that adequate radioactive waste management cases (RWMCs), supported by appropriate stage Letters of Compliance (LoCs), can be developed for all intermediate

Reference	Assessment finding
	<p>level waste (ILW) on the timescales identified in Westinghouse's plan for disposability of ILW.</p> <p>Final version of AP1000-AF07:</p> <p>An operator shall, before the commissioning phase, provide confidence that adequate radioactive waste management cases (RWMCs), or equivalent cases, supported by appropriate stage Letters of Compliance (LoCs), can be developed for all intermediate level waste (ILW) and on timescales that are consistent with the operator's plans for disposal of ILW. This shall include production and presentation of appropriate plans for demonstrating disposability of ILW.</p> <p>Basis of change:</p> <p>This finding relates to the operator's plan for disposal of ILW (not Westinghouse's).</p>
AP1000-AF08	The future Operator shall provide evidence during the detailed design phase that the proposed specific techniques for preventing and, where that is not possible, minimising the creation of LLW and ILW are BAT.
AP1000-AF09	The future Operator shall provide evidence during the detailed design phase that the proposed specific techniques for treating and conditioning of LLW and ILW before disposal are BAT.
AP1000-AF10	The future operator shall propose, before the commissioning phase, techniques for the interim storage of spent fuel following a period of initial cooling in the pool, if the Westinghouse reference dry spent fuel storage option is not chosen. The future operator shall provide an assessment to show that the techniques proposed are BAT.
AP1000-AF11	<p>The future operator shall provide confidence, before the commissioning phase, that adequate RWMCs, supported by appropriate stage LoCs and taking due account of necessary storage periods, can be developed for spent fuel on the timescales identified in Westinghouse's plan for disposability of spent fuel.</p> <p>Final version of AP1000-AF11:</p> <p>An operator shall provide confidence, before the commissioning phase, that adequate RWMCs, or equivalent cases, taking due account of necessary storage periods, can be developed for spent fuel on timescales that are consistent with the operator's plans for disposal of spent fuel. This shall include producing and presenting appropriate plans for demonstrating disposability of spent fuel.</p> <p>Basis of change:</p> <p>This finding relates to the operator's plan for disposal of spent fuel (not Westinghouse's). RWM can provide only conceptual endorsement for spent fuel disposal at this time.</p>
AP1000-AF12	<p>Future operators shall provide:</p> <p>i) during the detailed design phase, the location and arrangement of sampling and continuous monitoring facilities for gaseous and aqueous</p>

Reference	Assessment finding
	<p>wastes supported by an assessment that these will provide representative sampling and monitoring;</p> <p>ii) during the detailed design phase and before final equipment selection, the details of equipment and techniques to be used for analysis of gaseous, aqueous and solid wastes supported by an assessment that these represent BAT for monitoring.</p>
<p>The following are further assessment findings that we have identified during our assessment of the close out of the 51 GDA Issues.</p>	
AP1000-AF13	An operator shall demonstrate that changes from the GDA design to the site-specific design are BAT and comply with the requirements of any permit that has been issued.
AP1000-AF14	An operator shall identify the chlorine reducing agent to be injected into the demineralised water treatment process from the turbine island chemical feed system (CFS), assess the environmental impacts and ensure compliance with all relevant legislation.
AP1000-AF15	An operator shall ensure that radioactive waste arisings from squib valve testing are minimised and appropriately routed for disposal.
AP1000-AF16	An operator shall provide evidence during the detailed design phase that the methodology used to qualify smart devices for nuclear safety functions, has been applied to relevant smart devices that provide an environmental protection function.
AP1000-AF17	An operator shall provide evidence demonstrating the allocation of actions between humans and technology has been substantiated and dependence on human action to maintain a benign state has been optimised when undertaking detailed design of structures, systems and components (SSCs) that provide an environmental protection function.
AP1000-AF18	An operator shall provide evidence during the detailed design phase that an appropriate methodology has been applied for categorising environmental safety functions and classifying structures, systems and components (SSCs) that provide an environmental protection function.

Appendix 4 - Consultation, public comments and engagement about the AP1000 reactor design

2007 to 2011

We began our assessment of the AP1000 reactor design in 2007 and [consulted on our draft decision](#) from 28 June 2010 until 18 October 2010. After we'd carefully considered all of the comments received and used them to help inform our decision, we published our [decision and interim statement of design acceptance](#) on 14 December 2011.

Throughout this period, the regulators and Westinghouse promoted the GDA process to interested groups and communities and worked with them to seek input and views on our assessments.

- Comments process – September 2007 to 2011
 - Information about how to comment on both the regulators' and Westinghouse websites
 - Leaflets, promotional materials and articles in industry and interested groups' publications
- Consultation 28 June 2010 to 18 October 2010
 - National interested groups' event in Birmingham, communications to communities and libraries living near sites named in the government's nuclear national policy statement, news stories, articles, presentations at site stakeholder groups and conferences
 - Speaking at conferences and presenting at meetings and exhibitions run by others
 - Joint nuclear regulators' e-bulletin
 - Regular updates in the joint quarterly report
 - Published assessment reports giving our views on the main issues raised and responses from Westinghouse
 - Information on the Environment Agency's website

Our consultation was reviewed by an independent evaluator and a [report was published](#) in May 2012. We also reviewed the comments process and updated our [published guidance](#) for design companies.

2014 to 2017

After NuGeneration Limited (NuGen) announced that it planned to build 3 AP1000 reactors at Moorside, Westinghouse re-entered the GDA process in September 2014. 51 issue resolution plans were published on the joint website in March 2015.

Following this re-start of our assessment, we reviewed our communications and engagement plan and set out activities to allow interested groups and communities to get involved with our work again.

During 2014 to 2016, we worked with Sciencewise to understand how the public want to be involved and consulted about our assessment of new nuclear power station designs. The findings from this work, along with other evaluation and research, informed our communications and engagement plan.

The comments process for the AP1000 closed on 30 November 2016. Throughout 2015 to 2016 the regulators and Westinghouse promoted our GDA work and the comments process to interested groups and communities.

We will evaluate the effectiveness of our communications and engagement after the end of the GDA process and use the findings to inform our work on future GDAs.

Comments process 2015 to 2016

- During this period, Westinghouse received only 1 comment in January 2016 and a further 7 in November 2016. The company responded to these and shared the questions and answers with us. The comments related largely to policy aspects, site-specific matters and major accident scenarios. We considered the comments but none have directly influenced our GDA assessment.
- Published updates about the work being done to resolve the 51 outstanding issues in quarterly reports on the joint website.
- Joint regulators' e-bulletin issued to subscribers.
- Environment Agency email updates to Moorside interested groups list.
- Updating MPs in West Cumbria through our Area Managers.
- Attending and updating non-governmental organisations (NGOs) at the government forum for NGO groups.
- Speaking to industry at conferences such as MarketForce nuclear new build (NNB) and the Nuclear Industry Association's (NIA's) events.
- Presenting and answering questions at the Springfields and west Cumbria site stakeholder groups.
- Attending and having a visible presence (event stands) at NuGen's DCO stage 2 consultation events in west Cumbria from May to July 2016.
- Liaised with Copeland Borough Council's Strategic Nuclear and Energy Board and spoke at NuGEN's Moorside Technical Group meetings.
- Digital campaign pushing people to the comments process (Twitter, Facebook, LinkedIn) from Sept to Nov 2016 with a focus on residents in the North West. The campaign focused on pushing people to the comments process website.
- Leaflets, promotional materials and articles in industry, interested groups and community publications.
- Blogs on Westinghouse website and GOV.UK.
- Re-launch of Westinghouse comments process webpages.

**Would you like to find out more about us
or about your environment?**

Then call us on

03708 506 506 (Monday to Friday, 8am to 6pm)

email

enquiries@environment-agency.gov.uk

or visit our website

incident hotline 0800 807060 (24 hours)

floodline 0345 988 1188 (24 hours)

Find out about call charges: www.gov.uk/call-charges



Environment first: Are you viewing this on screen? Please consider the environment and only print if absolutely necessary. If you are reading a paper copy, please don't forget to reuse and recycle if possible.