

Westinghouse UK
AP1000® GENERIC DESIGN ASSESSMENT
Resolution Plan for GI-AP1000-SI-05
Compliance of AP1000 Main Structural Components with ASME III Design
Rules

MAIN ASSESSMENT AREA	RELATED ASSESSMENT AREA(S)	RESOLUTION PLAN REVISION	GDA ISSUE REVISION
Structural Integrity	MSQA	4	0

GDA ISSUE:	Provide evidence to show that the design of the Main Structural Vessels is compliant with the ASME III code.
ACTION: GI-AP1000-SI-05.A1	<p>Support the assessment of Westinghouse's response to ONR's findings on the AP1000® Stress Analysis. The review of the reactor pressure vessel report identified a number of areas where it was unclear why specific assumptions and approximations had been made. In their response to this review Westinghouse justified these. The review of the pressuriser report identified errors in the calculations for the safety relief nozzle however a revision of this report was in preparation during ONR's review; this corrected all the main errors.</p> <p>The response to the comments on the reactor pressure vessel report and the revision of the pressuriser report were both supplied too late for ONR to undertake a full assessment of these documents within GDA step 4.</p> <p>Activities by Westinghouse should comprise:</p> <ul style="list-style-type: none"> • Provide adequate responses to questions arising from ONR assessment of documents submitted during GDA Step 4 or in response to this Action. <p>With agreement from the Regulator this action may be completed by alternative means.</p>
ACTION: GI-AP1000-SI-05.A2	<p>Provide evidence that there will not be similar errors elsewhere in the design support documentation.</p> <p>ONR have identified errors on a sample review of the design calculations. The calculations were verified and issued, and referred to within the GDA submissions, but not approved as the formal issue (Rev 0) of the report. In this circumstance the formal issue of the report corrected the errors in the calculational route of 'design by rule', and in this case, even if error had not been detected, the design was still secure because the design route 'design by analysis' had also been followed. Nevertheless, since a sample review identified significant errors in a verified document, evidence is required to demonstrate that the process in raising design reports to Rev 0 is sufficiently robust to ensure that errors missed by the author and</p>

	<p>verifier of the earlier revisions will be reliably detected. Activities by Westinghouse should comprise:</p> <ul style="list-style-type: none"> • Provide evidence that the process for raising verified documents to Revision 0 is sufficiently robust. • Provide adequate responses to any questions arising from assessment by ONR of the response <p>With agreement from the Regulator this action may be completed by alternative means.</p>
--	--

RELEVANT REFERENCE DOCUMENTATION RELATED TO GDA ISSUE

Technical Queries	TQ-AP1000-1290
Regulatory Observations	None
Other Documentation	UKP-GW-GL-793 APP-MV20-Z0C-107 APP-MV20-Z0R-008 APP-MV20-Z0R-016 APP-MV20-Z0R-020 APP-MV20-Z0R-009 APP-MV20-Z0R-007 APP-MV01-Z0C-004 APP-MV01-Z0C-050 APP-MV01-Z0C-060

Scope of work:

The key activities which will need to be completed to close this GDA Issue are:

- Support ONR's review of the response to TQ-AP1000-1290.
- Provide evidence to demonstrate that similar errors do not exist in other primary pressure vessel design calculations.

Description of work:

Action 1

TQ-AP1000-1290 was generated in March 2011 and raised question about the supporting ASME design calculations for the AP1000 pressuriser and reactor vessel. The TQ was based on a report generated by a Technical Support Contractor (TSC) that was supporting ONR's review. The TSC's review of the pressuriser calculations was based on calculations issued in as far back as 2005 that were subsequently revised in late 2010. Westinghouse provided a partial response to the TQ on 7 April 2011 and a full response to the TQ on 19 May 2011. The partial response to the TQ provided a response to a number of the queries on the pressuriser calculations, and it provided updated pressuriser calculations. One of the key documents updated that was supplied is the Revision 0 of the Pressurizer Sizing Calculation. The full response to the TQ that was provided in May 2011 addressed each item raised in the report regarding the reactor vessel. To address this action, Westinghouse will support ONR's review of this response and the supporting calculations.

Westinghouse will also provide for information and upon request by ONR the latest revisions of the referenced calculations described below:

APP-MV20-Z0C-107 Rev. 1

APP-MV20-Z0R-008 Rev. 1

APP-MV20-Z0R-016 Rev. 1

APP-MV20-Z0R-020 Rev. 2

APP-MV20-Z0R-009 Rev. 1

APP-MV20-Z0R-007 Rev. 1

APP-MV01-Z0C-004 Rev. 7

APP-MV01-Z0C-050 Rev. 4

APP-MV01-Z0C-060 Rev. 4

Action 2

In the report generated by the TSC, the items of greatest concern were identified as a priority (1) items. All the items identified as a (1) were related to sizing calculation for the **AP1000** pressuriser. The calculations being reviewed were preliminary calculations. In advance of the ONR questions, Westinghouse recognised there was a need to revise and finalise these calculations. The updated supporting pressuriser calculations were completed in late 2010 prior to receiving the TQ from ONR.

The calculations that were reviewed by ONR's TSC were preliminary calculations that were completed in 2005. Being preliminary in nature, these calculations were not subject to the same level of rigorous review and verification as the revised calculations that were completed in 2010.

The revised calculations benefited from both the intermediate design review and the final design reviews for the pressuriser, which occurred during the timeframe between issuance of the initial and final calculations. As noted in Section 9.0 of the **AP1000** Pressurizer Final Design Review Report (APP-MV20-GGR-300), the revised sizing calculation was discussed in detail during the final design review. Westinghouse procedures require all **AP1000** primary pressure vessels to undergo various levels of formal design reviews. These independent design reviews serve as a tool to further ensure adequate design verification has been conducted for safety related components. Finally, a final ASME design report will be generated for the pressuriser that is required to be stamped by a certified Professional Engineer. The results of the ASME analysis are captured in the design report. Therefore, a further review of these and similar results occur at this time.

The same levels of reviews and verifications are inherent in the design process of the other primary pressure vessels. These levels of rigorous review and verification provide assurance that the vessels meet the code requirements.

To address this action, Westinghouse will provide a documented justification that adequate processes are in place to demonstrate that code requirements are met for the design of ASME components. The justification will reflect the process outlined above. A sample of additional evidence such as final design reports and ASME reports which

document the evidence of these reviews will be submitted along with the justification to provide additional evidence to support Westinghouse's position. Examples of such reports include the core makeup tank final design review report, APP-MT01-GGR-300, and the core makeup tank ASME Generic Design Report. Both documents include reviews of ASME design calculations such as the core makeup tank sizing calculation.

The deliverable for Action 2 is a document that contains the justification that adequate processes are in place to demonstrate that code requirements are met for the design of ASME components. This document will also include references to examples of the results of the design processes such as APP-MT01-GGR-300 Revision 2, APP-MT01-Z0R-001 Revision 4, and APP-MV20-GGR-300 Revision 2 which will be provided.

Schedule/ programme milestones:

Please see the following page for the schedule.

Activity Name	2015												2016												
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec				
UK Generic Design Assessment (GDA) Resolution Plans (51)																									
STRUCTURAL INTEGRITY																									
SI.05 Main Structural Components w/ ASME III Design Rules-Resolution Plan																									
SI.05 Stress Analysis Review (A1)																									
APP-MV20-Z0C-107, Rev. 1 "AP1000 Pressurizer Sizing Calculations"- Available to ONR for Information																									
APP-MV20-Z0R-008, Rev. 1 "AP1000 Pressurizer Safety Relief Nozzle Analysis"- Available to ONR for Information																									
APP-MV20-Z0R-016, Rev. 1 "AP1000 Pressurizer Upper Shell and Head Analysis"- Available to ONR for Information																									
APP-MV20-Z0R-020, Rev. 2 "AP1000 Pressurizer Spray Nozzle Analysis"- Available to ONR for Information																									
APP-MV20-Z0R-009, Rev. 1 "AP1000 Pressurizer Surge Nozzle Analysis"- Available to ONR for Information																									
APP-MV20-Z0R-007, Rev. 1 "AP1000 Pressurizer Lower Head, Support Pad and Shell Analysis"- Available to ONR for Information																									
APP-MV01-Z0C-004, Rev. 7 "AP1000 Reactor Vessel Sizing Calculation"- Available to ONR for Information																									
APP-MV01-Z0C-050, Rev. 4 "Detailed Analysis of the AP1000 Reactor Vessel Inlet Nozzle"- Available to ONR for Information																									
APP-MV01-Z0C-060, Rev 4 "Detailed Analysis of the AP1000 Reactor Vessel Outlet Nozzle"- Available to ONR for Information																									
Latest Revision of Pressurizer/Reactor Vessel Calcs Requested by ONR for Review - ONR Review																									
SI.05 Justification of Adequate Code Requirement Process (A2)																									
Justification of Adequate Code Requirement Process - Submit to ONR																									
APP-MT01-Z0R-001, Rev 4 - Submit to ONR																									
APP-MT01-GGR-300, Rev 2 - Submit to ONR																									
APP-MV20-GGR-300, Rev 2 - Submit to ONR																									
Justification of Adequate Code Requirement Process (and associated Docs) - ONR Review																									

Methodology:

Action 1

The primary **AP1000** pressure vessels are designed in accordance with the ASME Code Section III. The primary pressure vessels are designed according to the 1998 Edition of the code with the 1999 and 2000 Addenda. The ASME code evaluations are completed accordingly.

Action 2

A written justification will be provided that demonstrates adequate processes are in place to validate the ASME code requirements are met for the **AP1000** primary pressure vessels. The justification will be supported by evidence as described in the description of work.

Justification of adequacy:

Please refer to the description of work. The updated calculations and response to TQ-**AP1000-1290** address the actions in Issue 1. The primary tasks for this item will be for ONR to complete their review of this information and for Westinghouse support any questions they may have.

For Action 2, the justification provided in the description of work along with the additional evidence that will be provided is adequate to demonstrate that similar errors do not exist in other calculations. The evidence will demonstrate that multiple layers of review and verification that the final design of the primary pressure vessels undergo in order to demonstrate that they comply with the ASME code.

Impact assessment:

The primary safety submission document potentially affected by this Issue is the PCSR. Based on closure of the issue, it may be necessary to review and update as necessary the supporting Appendices in Chapter 20 of the PCSR.