

Westinghouse UK
AP1000® GENERIC DESIGN ASSESSMENT
Resolution Plan for GI-AP1000-IH-03
Pressure Part Failure

MAIN ASSESSMENT AREA	RELATED ASSESSMENT AREA(S)	RESOLUTION PLAN REVISION	GDA ISSUE REVISION
Internal Hazards	Civil Engineering Fault Studies Structural Integrity	10	1

GDA ISSUE:	Provide substantiation to support claims and arguments made within the area of pressure part failure.
ACTION: GI-AP1000-IH-03.A1	<p>Identify and substantiate all nuclear significant pipe whip restraints, barriers and shields claimed for the protection of redundant trains against the effects of pressure part failure.</p> <p>This substantiation should take consideration of the following:</p> <ul style="list-style-type: none"> • Quantitative assessment of the consequences of postulated pipe failures (including high energy pipework that is not claimed as HSS derived from the pipe rupture analysis. • Justification of the method applied to selection of the type of protection adopted e.g. pipe restraint, barrier or shield. <p>The list above should not be considered to be exhaustive and the items detailed above are provided as a means to inform Westinghouse of ONR expectations.</p> <p>With agreement from the Regulator this action may be completed by alternative means.</p>
ACTION: GI-AP1000-IH-03.A2	<p>Provide the updated safety case that details the identification and substantiation of all claims made in relation to Main Steam Isolation Compartments associated with pressure part failure. This substantiation should take consideration of the following:</p> <ul style="list-style-type: none"> • Structural integrity claims made on the main steam line and feedwater line pipework. • Engineered design provisions in place to either prevent or mitigate the potential consequences of pipe failure within the two MSIV Compartments e.g. pressure relief paths, valve actuation etc.

	<ul style="list-style-type: none"> • Whether there is a requirement for passive features such as pipewhip restraints, barriers or shields. <p>The list above should not be considered to be exhaustive and the items detailed above are provided as a means to inform Westinghouse of ONR expectations.</p> <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-AP1000-1288
Regulatory Observations	None
Other Documentation	UKP-GW-GLR-001, Rev 3 UKP-GW-GL-793, Rev 0

Scope of work:
<p>GI-AP1000-IH-03.A1:</p> <p>Identify and substantiate relevant nuclear significant pipe whip restraints, barriers and shields claimed for the protection of the capability to deliver the primary means of Category A and supporting post 72 hour Category B safety functions against the effects of pressure part failure. This substantiation should consider the following:</p> <ol style="list-style-type: none"> 1. Quantitative assessment of the consequences of postulated pipe failures (including high energy pipework not claimed as HSS) derived from the pipe rupture hazard analysis. 2. Justification of the method applied to selection of the type of protection adopted; e.g. pipe restraint, barrier or shield. <p>The basis for this work shall be founded on adoption of a gross piping failure assumption. Gross failure is acknowledged as the basis for the AP1000 plant safety case in the UK for failure of pressure-retaining systems where an Incredibility of Failure claim consistent with the Structural Integrity assessments per GI-AP1000-SI-01 are not applicable. Gross failure is evaluated for direct effects, the result of failure on the faulted fluid system and its effect on the associated safety function(s), and indirect effects, such as dynamic and environmental effects.</p> <p>GI-AP1000-IH-03.A2:</p> <p>Assess the safety case that details identification and substantiation of claims made in relation to Main Steam Isolation Compartments associated with pressure part failure and provide substantiation if necessary. This substantiation should take consideration of the following:</p> <ol style="list-style-type: none"> 1. Structural integrity claims made on the main steam line and feedwater line pipework are

- consistent with the **AP1000** Structural Integrity safety case reviewed under GDA.
2. Engineered design provisions in place to either prevent the potential or mitigate the consequences of pipe failures within the two MSIV Compartments
 3. Whether there is a requirement for passive features such as pipewhip restraints, barriers or shields.

With agreement from the Regulator these actions may be completed by alternative means.

Description of work:

GI-AP1000-IH-03.A1 & GI-AP1000-IH-03.A2:

Westinghouse's response to actions 1 and 2 will be undertaken as part of one single plan. This ongoing effort, which Westinghouse refers to as Pipe Rupture Hazards Analyses (PRHA), is designed to demonstrate that the plant can be safely shut down and maintained in a safe shutdown condition following each postulated pipe rupture. Inherent within this methodology are actions to be undertaken in assuring ALARP measures. The individual programme components of the PRHA are provided under Schedule / Programme Milestones.

A conservative pre-emptive evaluation was performed in 2010 to gain confidence that the **AP1000** design would successfully accommodate the effects of Pressure Part Failure. This evaluation resulted in the following conclusions and analyses:

- Ensured that potential pipe whip restraints could be spatially accommodated by the plant design,
- Performed bounding studies on affected structures, regarding their integrity to accommodate associated pipe whip effects, and
- Affected designs of structures to ensure sufficient venting areas for effects of subcompartment pressurisation for potentially problematic areas.

The content of this work will be summarised in a series of supporting PRHA reports documented within the Westinghouse EDMS as suitable for referencing within the safety case.

Further, additional information will be developed and compiled in a report (or reports as appropriate) documented within the Westinghouse EDMS as suitable for referencing within the safety case addressing the following activities:

- Systematically assessing the effect of pipe ruptures and identifying essential SSCs located within the vicinity of the rupture which may be affected if those structures were not already assumed or designed for associated High Energy Line Break

(HELB) loadings.

- Documenting the location of those targets according to official design documents.
- Subsequently tabulating or classifying those intervening walls / floors (between the break and the determined essential function) as a suitable passive barrier protecting Category A or supporting post 72-hour Category B safety functions.
- Where it is not possible to determine a suitable barrier, identifying the Category A or supporting post 72 hour Category B safety functions which may be at risk from a Pressure Part Failure and implementing appropriate design change corrections.

Additional information will be compiled addressing:

- Summary of break identification and location criteria
- The impact of potential changes to the PCSR relating to the outcome of this substantiation on other safety case submissions such as civil engineering and mechanical engineering.
- Assessment of further defense-in-depth and ALARP measures that could be implemented into the design.

Schedule/ programme milestones:

In accordance with the integrated schedule, Westinghouse shall provide:

- A summary roadmap of the Pressure Part Failure Safety Case.
- A topic report of the Pressure Part Failure Safety Case, including discussions of:
 - Break location criteria
 - Summary of the failure methodology and acceptance criteria
 - A limited number of examples (less than four) of pipe rupture assessments, including direct and indirect consequences, in demonstrating application of gross failure assumptions (such assessments include consideration of the consequences of pipe failure within an MSIV Compartment).
- Documented PRHA supporting reports and work (as necessary) described previously.
- Further reports (as necessary) documenting additional information identified in the Description of Work and documented within the Westinghouse EDMS as suitable for

referencing within the safety case addressing the following activities:

- Systematically assessing the effect of pipe ruptures using the AP1000 3D Model and identifying Category A or supporting Category B SSCs located within the vicinity of the rupture which may be affected if those structures were not already assumed or designed for associated High Energy Line Break (HELB) loadings.
 - Revisions to the technical report content supporting the MSIV Summary Report as reflecting adoption of a gross failure assumption will be presented in the topic report of the Pressure Part Failure Safety Case.
- Delivery of an updated Pressure Part Failure Safety Case.

The Westinghouse assessments shall be completed in accordance with the Integrated Schedule. Should the safety case require revision, this work will be scheduled accordingly or alternatively confirmation will be provided that the existing Pressure Part Failure safety case remains valid.

The schedule is provided on the following page.

Activity Name	2015												2016											
	Jan	Feb	Mar	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)																								
INTERNAL HAZARDS																								
IH.03 Pressure Part Failure-Resolution Plan																								
IH.03 Hazard Barrier Matrix																								
Hazard Barrier Matrix-Submit to ONR																								
Hazard Barrier Matrix-ONR Review of Submittal																								
IH.03 Hazard Barrier Matrix, Rev 1																								
Hazard Barrier Matrix, Rev 1 Submit to ONR																								
Hazard Barrier Matrix, Rev 1 ONR Review of Submittal																								
IH.03 MSIV Summary Report																								
MSIV Summary Report Note-Submit to ONR																								
MSIV Summary Report-ONR Review of Submittal																								
IH.03 Pressure Part Failure Roadmap																								
Pressure Part Failure Roadmap - Submit to ONR																								
Pressure Part Failure Roadmap - ONR Review of Submittal																								
IH03 - Break Location Criteria																								
IH03-Break Location Criteria - Submit to ONR																								
IH03-Break Location Criteria - ONR Review of Submittal																								
IH03 - PPF Topical Report																								
Summary of Methodology (Exec Summary)																								
IH03 PPF Topical Report - Summary of Methodology - Submit to ONR																								
IH03 PPF Topical Report - Summary of Methodology - ONR Review of Submittal																								
Draft PPF Topical Report (Body)																								
IH03 PPF Topical Report - Body - Submit to ONR																								
IH03 PPF Topical Report - Body - ONR Review of Submittal																								
GDA Examples/Cases (Appendix)																								
IH03 GDA Examples/Cases (Appendix) - Submit to ONR																								
IH03 GDA Examples/Cases (Appendix) - ONR Review of Submittal																								
Detailed DBL Methodology & AC (Appendix)																								
IH03 Detailed DBL Methodology & AC(Appendix) - Submit to ONR																								
IH03 Detailed DBL Methodology & AC(Appendix) - ONR Review of Submittal																								
PPF Topical Report - Finalize																								
Pressure Part Failure Topical Report-Submit to ONR																								
Pressure Part Failure Topical Report-ONR Review of Submittal																								

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Methodology:

GI-AP1000-IH-03.A1 & GI-AP1000-IH-03.A2:

See the above programme defining the Description of Work and Schedule. Potential PCSR changes will be identified and assessed by Westinghouse Licensing personnel; ALARP reviews will be conducted through use of an expert panel.

Justification of adequacy:

GI-AP1000-IH-03.A1 & GI-AP1000-IH-03.A2:

While the **AP1000** Pressure Part Failure safety case principles are present within PCSR, there was insufficient substantiation information available during the step 4 GDA period to fully assess some claims, arguments and evidence. The ONR Step 4 assessment found the **AP1000** Pressure Part Failure safety case required a greater substantiation basis for a claim-argument-evidence reliance on the adequacy of protection provided by civil structures, design basis, spatial segregation, protective barriers, and redundancy in safety related components and safety systems. Westinghouse recognised this late in Step 4 and provided a more comprehensive safety case in the later revision 0 of the PCSR. However, it was recognised that additional substantiation remained in order to support the Pressure Part Failure safety case.

This work is designed to verify and supplement substantiation of the PCSR, revision 0, Pressure Part Failure claims and arguments. Given that the potential for such failures is low and the compartmentalisation design of the **AP1000** plant leads to isolation of internal hazard influences, augmenting existing pressure part failure assessments is expected to complete substantiation of the **AP1000** Pressure Part Failure safety case.

Impact assessment:

GI-AP1000-IH-03.A1 & GI-AP1000-IH-03.A2:

Safety case impacts (PCSR / ALARP assessment / Master Submission List), if any, are to be assessed following completion of the defined workscope and changes identified if necessary and warranted. Any design changes will be captured and evaluated as part of the Westinghouse Design Change Process.