

Westinghouse UK
AP1000® GENERIC DESIGN ASSESSMENT
Resolution Plan for GI-AP1000-IH-01
Internal Fire Safety Case Substantiation

MAIN ASSESSMENT AREA	RELATED ASSESSMENT AREA(S)	RESOLUTION PLAN REVISION	GDA ISSUE REVISION
Internal Hazards	Civil Engineering Fault Studies PSA	8	1

GDA ISSUE:	Internal Fire Safety Case Substantiation
ACTION: GI-AP1000-IH-01.A1	<p>Provide substantiation of 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). This may include a multi-legged argument consisting of the following:</p> <ul style="list-style-type: none"> • Reference to physical fire testing or detailed supporting analysis (backed by appropriately verified and validated fire models) of the barriers and cable tray enclosures claimed. • The approach taken to minimise penetrations within the barriers. <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 my expectations. With agreement from the Regulator this action may be completed by alternative means.</p>
ACTION: GI-AP1000-IH-01.A2	<p>Provide the substantiation of the approach taken to the design and installation of fire dampers claimed within the AP1000® PCSR. This may include a multi-legged argument consisting of the following factors:</p> <ul style="list-style-type: none"> • Details of the design approach to the installation of fire dampers within the AP1000 design. • The consideration of the single failure criterion. • Reference to the appropriate codes and standards which demonstrate the fire dampers installed will meet the requirements for 3 hours fire resistance both in terms of integrity and insulation. <ul style="list-style-type: none"> • Provisions associated with the application of any passive fire protection to ensure that the dampers meet insulation requirements as detailed within point 3 above. The approach taken to the control of the fire dampers in terms of detection driven operation should ensure that full divisional segregation is met.

	<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-AP1000-913
Regulatory Observations	RO-AP1000-31
Other Documentation	<p>UKP-GW-GLR-001 Rev 3</p> <p>UKP-GW-GL-793 Rev 0</p>

Scope of work:

GI-AP1000-IH-01.A1:

Provide substantiation of 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.

This may include a multi-legged argument consisting of the following:

- Reference to physical fire testing or detailed supporting analysis (backed by appropriately verified and validated fire models) of the barriers and cable tray enclosures claimed.
- The approach taken to minimise penetrations within the barriers.

With agreement from the Regulator this action may be completed by alternative means.

GI-AP1000-IH-01.A2:

Provide the substantiation of the approach taken to the design and installation of fire dampers claimed within the **AP1000** PCSR.

This may include a multi-legged argument consisting of the following factors:

- Details of the design approach to the installation of fire dampers within the **AP1000** design
- Consideration of the single failure criterion
- Reference to the appropriate codes and standards which demonstrate the fire dampers installed will meet the requirements for 3 hours fire resistance both in terms of integrity and insulation. Provisions associated with the application of any passive fire protection to ensure that the dampers meet insulation requirements as detailed within point 3 above. The approach taken to the control of the fire dampers in terms of detection driven operation should ensure that full divisional segregation is met.

With agreement from the Regulator this action may be completed by alternative means.

Description of work:

GI-AP1000-IH-01.A1:

This work will provide additional substantiation of the **AP1000** fire barrier robustness and shall follow the same basic methodology as that previously used in justifying the sustainability of the CA module walls and floors.

Resolution Plan GI-AP1000-CE-01.A7 provides the following relevant additional information: Westinghouse has previously provided a demonstration that CA module floors can serve as three hour fire barriers. This was documented in DCP_JNE_000496 in response to Action Item 21.2 from the November 30-December 2 2010 civil engineering technical meeting.

Westinghouse believes the need to conduct CA module fire testing is unjustified relative to the robustness of the design margins and in order to demonstrate the adequacy of these barriers, Westinghouse intends to provide:

- A new finite element analysis to demonstrate that wall modules credited as fire barriers are capable of withstanding the worst case credible fire loading. This analysis supersedes and incorporates the intent of the CA Module Wall Hand Calculation of earlier Resolution Plan revisions.
- Additionally, Westinghouse shall provide three (3) case studies modeling realistic fire scenarios as illustrating the design robustness of the CA module walls. These case studies, and their assessment methodologies, shall be identified as:
 1. RNS Pump A room; To be assessed using the methodologies of NUREG 1805, "Algebraic Model (Fire Dynamics Tools (FDTs) Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection Inspection Program".
 2. I&C divisional area; To be assessed using the methodologies of the Consolidated Model of Fire and Smoke Transport (CFAST) from the National Institute of Standards and Technologies, US Department of Commerce.
 3. Squib Valve area in containment; To be assessed using Fire Dynamics Simulator (FDS) from the National Institute of Standards and Technologies, US Department of Commerce.
- Further, Westinghouse will assess typical fire barriers not part of the CA module design and not specifically identified as meeting acceptable UK (or equivalent) fire resistance rating design standards by providing similarity arguments as to their sustainability in meeting their design rated fire through comparisons with codes, standards, industry good practices, and the like.

The approach taken to minimisation of penetrations (HVAC, electrical, piping, doors) within nuclear significant hazard barriers is considered within the **AP1000** design and the details of which will be reviewed and captured within the deliverable of this task. Within this deliverable, the logic and results of barrier penetration minimisation efforts will be included.

The content of this work will be summarised in a calculation note(s) or report(s) documented within the Westinghouse EDMS as suitable for referencing within the safety case.

GI-AP1000-IH-01.A2:

An appropriate fire and fire/smoke damper summary report will be documented within the Westinghouse EDMS as suitable for referencing within the safety case. The report will contain the following information:

- A review of all fire and fire/smoke dampers to identify any fusible link fire dampers that do not meet UK fire and/or life safety codes.
- Fire and fire smoke damper installation details.
- A review of fire and fire/smoke dampers to show that a single failure will not prevent a safe plant shutdown.
- Provide details of any fire and fire/smoke damper installation that requires insulation around the fire damper.
- Provide a description of the control logic used to close fire/smoke dampers after fire or smoke is detected.

For both GI-**AP1000**-IH-01.A1 and A2, additional information will be compiled addressing:

- The impact of the changes made to the PCSR relating to the outcome of this substantiation on other safety case submissions such as civil engineering and mechanical engineering.
- Any further defence in depth and ALARP measures that could be implemented into the design.

Schedule / programme milestones:

In addition to the below listed actions, Westinghouse shall provide:

- A summary roadmap of the Internal Fire Safety Case.
- A topical report of the Internal Fire Safety Case.

GI-AP1000-IH-01.A1:

Please refer to the response to the resolution plan of GI-AP1000-CE-01.A7. Additional items of scope will be delivered in the same time frame. The specific deliverables associated with this Action are:

- Substantiation of Fire Barriers for the **AP1000** design. This will be in the form of either a Calculation Note or Report suitable to be referenced within the PCSR.

Westinghouse has provided a demonstration that the CA module floors can serve as a three hour fire barrier. This was documented in DCP_JNE_000496 in response to Action Item 21.2 from the November 30-December 2 2010 civil engineering technical meeting. In response to this action, Westinghouse intends to provide a new finite element analysis to demonstrate that the wall modules credited as fire barriers are capable of withstanding the worst case credible fire loading. The analysis will demonstrate how the structural capacity of the module walls is affected by a potential fire. This response will not involve fire testing. Westinghouse believes this thorough analysis will demonstrate the robustness of the structures to serve as a fire barrier. In addition, the resolution of this action will be consistent with the resolution of related items in action 8 of CE-02.

Additionally, Westinghouse shall provide three (3) case studies modeling realistic fire scenarios in illustrating the robustness of the CA module walls. In this work, Westinghouse shall use conventional fire modeling tools to illustrate the response of a CA module wall to realistic fire scenarios. Documentation of this work shall be summarized in a calculation note(s) or report(s) documented within the Westinghouse EDMS as suitable for referencing within the safety case.

Further, Westinghouse will assess typical fire barriers not part of the CA module design and not specifically identified as meeting acceptable UK (or equivalent) fire resistance rating design standards by providing similarity arguments as to their sustainability in meeting their design rated fire through comparisons with codes, standards, industry good practices, and the like.

The content of this work will be summarized in a calculation note(s) or report(s) documented within the Westinghouse EDMS as suitable for referencing within the safety case.

The approach taken to minimization of penetrations (HVAC, electrical, piping, doors) within nuclear significant hazard barriers is considered within the AP1000 design and the details of which will be reviewed and captured within the deliverable of this task. Within this deliverable, the logic and results of barrier penetration minimization efforts will be included. The content of this work will be summarized in a calculation note(s) or

report(s) documented within the Westinghouse EDMS as suitable for referencing within the safety case.

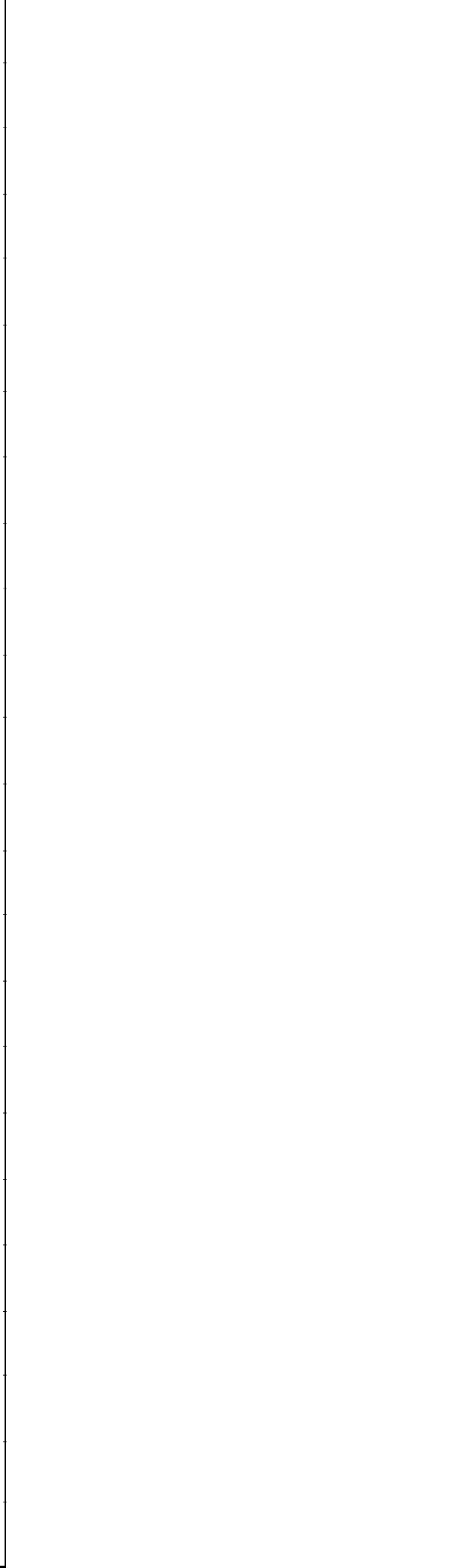
GI-AP1000-IH-01.A2:

The specific deliverables associated with this Action are:

- Fire and Fire/Smoke Damper Summary Report as suitable to be referenced within the PCSR. This report will contain the following information:
 - A review of all fire and fire/smoke dampers to identify any fusible link fire dampers that do not meet UK fire and/or life safety codes.
 - Fire and fire smoke damper installation details.
 - A review of fire and fire/smoke dampers to show that a single failure will not prevent a safe plant shutdown.
 - Provide details of any fire and fire/smoke damper installation that requires insulation around the fire damper.
 - Provide a description of the control logic used to close fire/smoke dampers after fire or smoke is detected.
 - The impact of the changes made to the PCSR relating to the outcome of this substantiation on other safety case submissions such as C&I, civil engineering and mechanical engineering will be compiled as well as any further defence in depth and ALARP measures that could be implemented into the design.

This effort shall be included in the Integrated Schedule development as presented 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.01 Internal Fire Safety Case Substantiation-Resolution Plan																								
IH.01 Internal Fire Roadmap																								
Internal Fire Roadmap- Submit to ONR																								
Internal Fire Roadmap- ONR Review of Submittal																								
IH.01 Fire Damper Report																								
Fire Damper Report- Submit to ONR																								
Fire Damper Report- ONR Review of Submittal																								
IH.01 Fire Damper Report Rev. 0																								
Fire Damper Report, Rev 0- Submit to ONR																								
Fire Damper Report, Rev 0 - ONR Review of Submittal																								
IH.01 FEA Calculation																								
FEA Calculation Report- Submit to ONR																								
FEA Calculation- ONR Review of Submittal																								
IH.01 Fire Barrier Similarity Report																								
Fire Barrier Similarity Report- Submit to ONR																								
Fire Barrier Similarity Report- ONR Review of Submittal																								
IH.01 Fire Barrier Similarity Report, Rev 0																								
Fire Barrier Similarity Report, Rev 0- Submit to ONR																								
Fire Barrier Similarity Report, Rev 0- ONR Review of Submittal																								
IH.01 Internal Fire Topic Report																								
Internal Fire Topic Report- Submit to ONR																								
Internal Fire Topic Report- ONR Review on Submittal																								
IH.01 Internal Fire Topic Report, Rev 0																								
Internal Fire Topic Report, Rev 0- Submit to ONR																								
Internal Fire Topic Report, Rev 0- ONR Review on Submittal																								
IH Combined Consequential Hazards																								
IH Combined Consequential Hazards- Submit to ONR																								
IH Combined Consequential Hazards- ONR Review on Submittal																								



Methodology:

GI-AP1000-IH-01.A1:

Please refer to the above Description of Work and resolution plan of GI-AP1000-CE-01.A7.

GI-AP1000-IH-01.A2:

Please refer to the above Description of Work.

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-01.A1:

The ONR GDA assessment identified areas of improvement within the safety arguments relative to the substantiation of **AP1000** fire barriers. These areas included:

- Reference to physical fire testing or detailed supporting analysis (backed by appropriately verified and validated fire models) of the barriers and cable tray enclosures claimed;
- Development of arguments associated with the approach taken to the horizontal segregation across individual trains within the Auxiliary Building;
- Substantiation of partial height barriers and barriers with penetrations that are not to be sealed;
- The approach taken to minimise penetrations within the barriers.

The deliverable stated within this Action will provide additional substantiation of the existing design fire barriers as required protecting the Category A safety functions and the supporting Category B safety functions. The methodologies employed, as discussed in the Description of Work are based on engineering principles and conservatively appropriate.

GI-AP1000-IH-01.A2:

The ONR GDA assessment identified that the standard quoted for fire dampers is an accepted standard for the design and installation of fire dampers for industrial practices. However, substantiation of the fire damper design relative to European Standards was lacking, specifically to that associated with the application of the single failure criterion to dampers which pass through nuclear significant hazard barriers.

The deliverable stated within this Action will provide the substantiation of the approach taken to the specification and design of the fire and fire/smoke dampers by taking into consideration applicable standards and guidance. Additionally, this work will consider relevant good practices as adopted by other existing nuclear facilities. The methodologies employed, as discussed in the Description of Work are based on engineering principles and conservatively appropriate.

Impact assessment:

GI-AP1000-IH-01.A1 and GI-AP1000-IH-01.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.