Westinghouse UK
AP1000® GENERIC DESIGN ASSESSMENT
Resolution Plan for GI-AP1000-FS-07
Safety Case for Shutdown Faults

MAIN ASSESSMENT AREA	RELATED ASSESSMENT AREA(S)	RESOLUTION PLAN REVISION	GDA ISSUE REVISION
Fault Studies	-	1	0

GDA ISSUE:	Westinghouse is required to provide a fully integrated design basis safety case for shutdown faults in the PCSR. The safety case for shutdown faults needs to be reflected in and supported by the Fault Schedule, also to be reported in the PCSR.
ACTION: GI-AP1000-FS-07.A1	Westinghouse is required to provide a fully integrated design basis safety case for shutdown faults in the PCSR. The safety case for shutdown faults needs to be reflected in and supported by the Fault Schedule, also to be reported in the PCSR. An acceptable design basis safety case for shutdown faults requires Westinghouse to provide more than is currently presented in the EDCD and the response to RO-**AP1000**-54 (UKP-GW-GL-077 Rev 0). Shutdown faults need to fully integrated into the PCSR. If the available at-power design basis analyses (i.e. the thermal hydraulic analysis, radiological consequences and claims on SSCs) are assumed to bound or apply to shutdown faults then this needs to be clearly stated in the PCSR, justified as necessary, and initiating fault frequencies updated accordingly. Fault sequences which are significantly different in terms of consequences or claims on SSCs from their at-power equivalents need to be considered separately, but with the full rigour expected for design basis analysis (i.e. SAPs FA.4 to FA.9). This includes consideration of limiting single failures, demonstration of diversity for frequent faults and discussion of the consequences. It is expected that the worst normally permitted (under Tech Specs) configuration of equipment should be clearly stated for faults in each applicable shutdown mode in accordance with SAP FA.6. Faults during refuelling modes of operation need to be covered in the PCSR. The safety case for RNS pipe breaks outside of containment needs to be completed with arguments, transient analysis, design change proposals etc. presented in and referenced from the PCSR as necessary.

	The safety case for shutdown faults needs to be reflected in and supported by the Fault Schedule, also to be reported in the PCSR. With agreement from the Regulator this action may be completed by alternative means.
RELEVANT REFERENCE DOCUMENTATION RELATED TO GDA ISSUE	
Technical Queries	
Regulatory Observation	RO-**AP1000**-54
Other Documentation	

Scope of work:

Westinghouse will review with the ONR the fault schedule provided in Revision 0 of the **AP1000**® PCSR to confirm that the information provided for shutdown faults does address the remaining ONR questions and update as necessary the fault schedule and Section 9.12 of the PCSR to resolve any residual concerns.

Additionally, Westinghouse will enhance the level of detail provided in the PCSR to include information that is necessary to ensure that there is a complete understanding of the evidence supporting the safety case for shutdown faults. Furthermore, Westinghouse will complete the evaluation of the shutdown faults in regards to radiological consequences to determine whether they are bounded by the consequences calculated for equivalent at-power faults. If it is determined that the equivalent at-power fault is not bounding, Westinghouse will provide an assessment to determine the extent of the radiological consequences of the fault.

Once is the above work is complete and incorporated into the PCSR, Westinghouse will have addressed the ONR's request for a fully integrated safety case for shutdown faults.

Description of work:

At the end of March 2011, Westinghouse provided the ONR with Rev 0 of the PCSR. As noted by the ONR, this incorporated and completed the response to RO-**AP1000**-54 as well as an updated Fault Schedule. Westinghouse believes that most of the regulator's concerns outlined in FS8 are addressed in Rev 0 of the PCSR and will be closed out once the regulator has fully assessed the updates.

Specifically, the regulator expressed that there was insufficient information explaining which SSCs are claimed for individual shutdown faults (which can be different from at-power faults). The updated fault schedule provided in Rev 0 of the PCSR clearly addresses this concern by listing all of the SSCs claimed for the mitigation of each individual fault in all possible modes affected. If the mitigation of the fault is different for different modes, then the fault is split and the appropriate SSCs that are claimed for mitigation are listed accordingly.

Furthermore, the updated Fault Schedule addresses the regulator's request to assess initiating event frequencies for all of the identified faults. The initiating event frequencies

are listed in the Fault Schedule and for any fault that has a frequency greater than 10^{-3} per year, the diverse means of fault protection is provided in bold letters below the safety case listed in red, consistent with the approach used for at-power event. Therefore, the presented fault schedule does indeed consistently address both at-power and shutdown modes.

It was also stated by the regulator that the safety case for RNS pipe breaks outside of containment needed to be completed with arguments and analyses properly presented and referenced in the PCSR. This task has been completed and has been incorporated into Section 9.12.5.3 of Rev 0 of the PCSR, which summarises the evaluation of postulated pipe breaks in the RNS lines outside of containment. For each postulated case, the resulting containment water level was calculated to ensure that the minimum level required for long term cooling is maintained. This evidence supports the safety case for RNS pipe breaks outside of containment and addresses the regulator's concerns. The other remaining task for Westinghouse is to revise UKP-GW-GL-077 Rev. 0 to include the break analysis and close out the open item regarding the RNS breaks outside of containment.

Although Rev 0 of the PCSR addresses many of the regulator's concerns expressed in FS8, Westinghouse recognises that a more detailed description of the overall shutdown safety case needs to be provided in Chapter 9.12 to present a fully integrated design basis safety case. In shutdown modes, the SSCs available for protection and mitigation against shutdown faults differ from the at-power case. While the fault schedule summarises the SSCs and claims identified in Chapter 9.12 of the PCSR, a full description of the availability constraints, single failure tolerance, and operator actions is required to demonstrate a fully integrated safety case. This is true even for shutdown faults bounded by at-power faults because while the technical analysis of the consequences may be similar, the narrative of the fault sequence may be different. Therefore, for shutdown faults that are different from their equivalent at-power faults, a level of detail and a structure consistent with the at-power fault will be provided in Section 9.12 of the PCSR and for faults that are bounded by their equivalent at-power faults, a level of detail sufficient to provide a complete understanding of the safety case and supporting evidence will be provided.

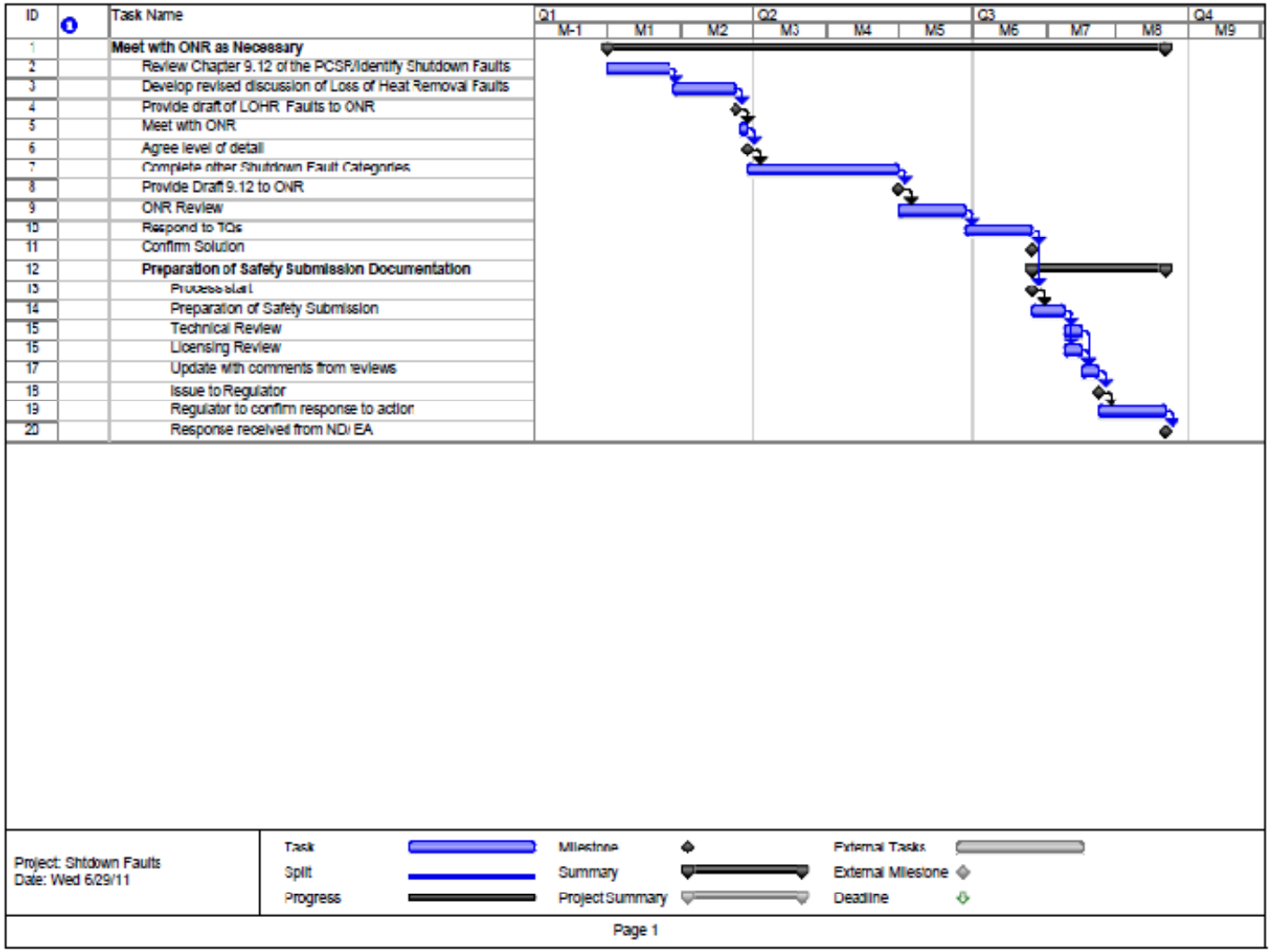
Included in the detail that will be added to the PCSR, the radiological consequences will be fully assessed and incorporated into Chapter 9.12. Westinghouse will conduct an evaluation of each shutdown fault and clearly identify faults that are bounded by the equivalent at-power fault, as well as explain why it is bounded. For other faults that are not bounded, Westinghouse will provide an assessment of each fault to ensure the potential consequences are adequately examined and explained in the appropriate fault subsection in the PCSR.

In order to ensure Westinghouse and ONR are in agreement with the approach to updating the PCSR to complete the fully integrated design basis safety case for shutdown faults, a pilot subsection (for loss of heat removal faults) of Chapter 9.12 will be revised and then discussed between Westinghouse and ONR. Once the content, level of detail, and structure of the revised pilot chapter is agreed upon, Westinghouse will fully revise chapter 9.12 of the PCSR. Chapter 9, in its entirety, will be reviewed and revised as required to capture any updates to the safety case.

In conclusion, Westinghouse believes that after a complete assessment of Rev. 0 of the PCSR, ONR will find that the updated Fault Schedule will satisfy the majority of the issues outlined in FS8. Westinghouse will remain in communication with ONR as it works to finalise the safety case for shutdown faults by updating the PCSR with a sufficient level of detail, as agreed upon with the ONR.

Schedule/ programme milestones:

Because all Resolution Plan start dates are subject to future contract placements, dates are presently undefined; therefore schedule dates have been anonymised for consistency. Actual dates will be inserted when contracts are placed.



Methodology:
Add sufficient detail to appropriate subsections of PCSR Chapter 9.12 to fully address availability constraints, single failure tolerance, preventative maintenance assumptions, operator actions, radiological consequences, and any other considerations necessary to capture the complete safety case for shutdown faults.

Justification of adequacy:
This resolution satisfies the remaining action items necessary to have a fully integrated design basis safety case for shutdown faults in the PCSR.

Impact assessment:
• PCSR, Chapter 9 • UKP-GW-GL-077, Section 3.5.3