Westinghouse UK
AP1000® GENERIC DESIGN ASSESSMENT
Resolution Plan for GI-AP1000-FS-06
Validation of the IRWST Cooling Function for the PRHR

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

GDA ISSUE:	Westinghouse is to provide validation evidence that the IRWST is functionally capable cooling the passive residual heat removal (PRHR) during intact circuit faults for 72 hours.
ACTION: GI-AP1000-FS-06.A1	• Westinghouse is to provide validation evidence that the IRWST is functionally capable cooling the passive residual heat removal (PRHR) during intact circuit faults for 72 hours. Or • Propose a design change to rectify the situation. No design basis transient analysis is presented within the DCD to demonstrate that the IRWST and PCS has the functional capability to act as an adequate heat sink to the PRHR when the latter is performing its post-trip heat removal safety function following an intact circuit fault. For this reason, Westinghouse is to provide explicit transient analysis using design basis techniques to demonstrate the functional capability of these systems. If relevant, Westinghouse needs to identify any bounding single failure. The analysis needs to be performed on a conservative basis with justification given for any modelling assumptions. Where possible, the analytical models should be validated by comparison with appropriate experiments or tests. The validation should be of the model as a whole or, where this is not practicable, on a module basis, against experiments that represent as closely as possible the expected plant conditions. Interpretation of experiments should take account of uncertainties in replicating the range of anticipated plant conditions. The limits of applicability of any analytical model should be identified. In particular, Westinghouse is required to provide validation evidence supporting the claimed condensate return efficiency of 95% to the IRWST and to demonstrate that the effect of containment pressure on the effectiveness of the IRWST cooling function for the PRHR has been taken into account in the safety analysis for loss

	of feed faults. The resultant transient analysis studies will need to be incorporated within the PCSR. With agreement from the Regulator this action may be completed by alternative means.
RELEVANT REFERENCE DOCUMENTATION RELATED TO GDA ISSUE	
Technical Queries	TQ-**AP1000**-296 TQ-**AP1000**-481 TQ-**AP1000**-1023
Regulatory Observations	RO-**AP1000**-047
Other Documentation	Step 4 Assessment Report - Fault Studies - Design Basis Assessment of the Westinghouse **AP1000** - AR 04/020a NII SAPs FA.4, FA.6 to FA.8, FA.17 to FA.22 NII TAGs T/AST/034 and T/AST/042

Scope of work:

- Provide validation evidence, both analytical and testing, supporting the claimed condensate return rate of 95%.

- Perform sensitivity studies with lower condensate return rates to demonstrate that there is significant margin to design condensate return rate of 95%; these studies will show that the IRWST and PRHR are capable of cooling the RCS for at least 72 hours following an intact-circuit fault, even if significantly lower condensate return rates are assumed.

- Provide a complete assessment summary of different faults, and how the effect of containment pressurisation is considered, relevant to the effectiveness of the PRHRS to remove decay heat from the reactor core.

Description of work:

- To provide adequate justification for the design condensate return rate of 95%, the following actions will be taken:

  1. Perform Containment Condensate Return Rate PIRT assessment. The relative importance coupled with the current state of knowledge for the phenomena will provide a framework for the planning of the testing programme and analytical efforts.

  2. Review experimental data to determine the performance of the condensate return system for steam condensing on the inside surface of the containment shell. Perform scaling assessment, as appropriate, to support applications of the testing data.

     Perform a test of a sector of the containment to quantify what if any condensate

losses occur at the crane rail and stiffener.

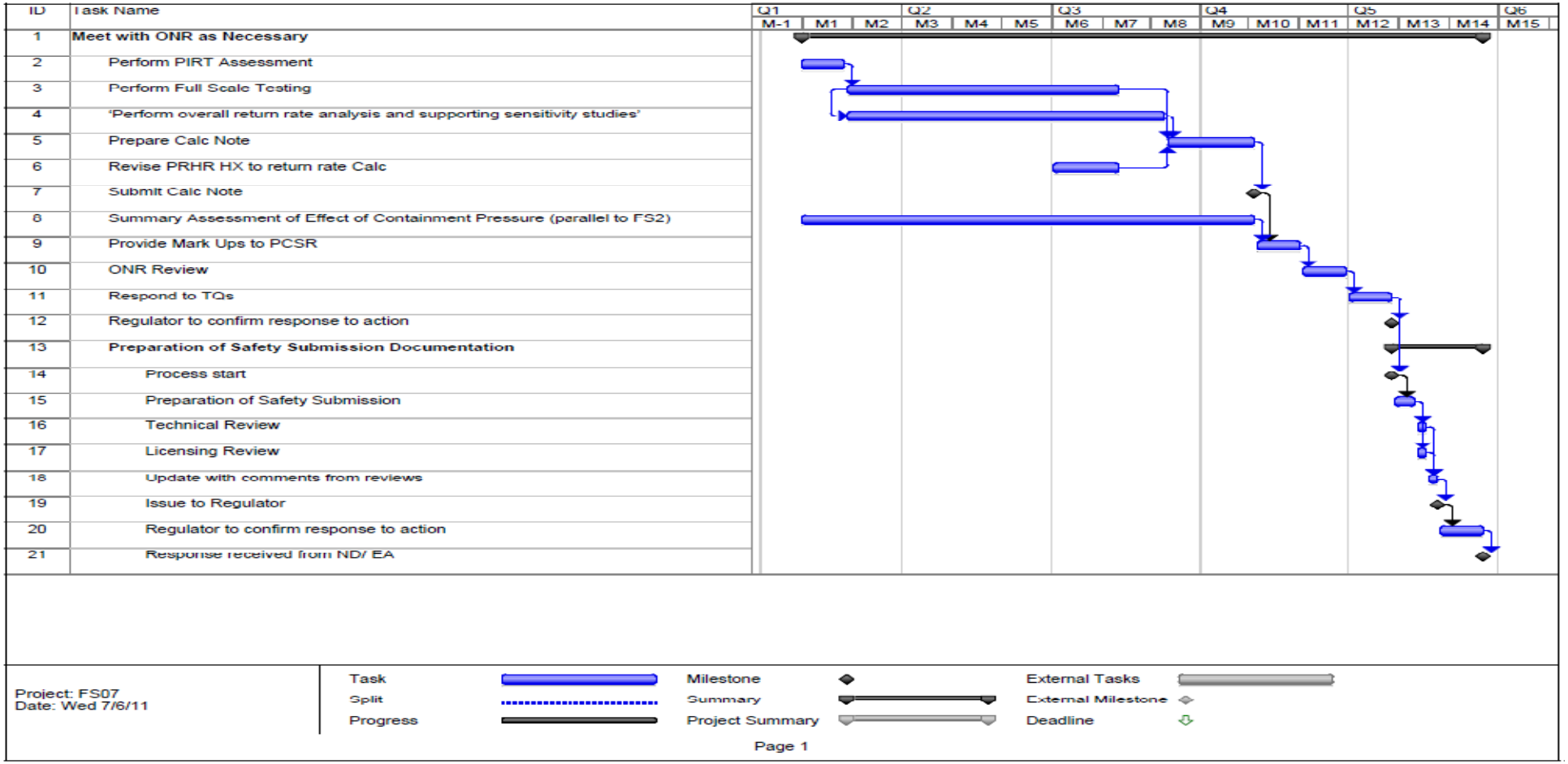
3. Perform a calculation that integrates the test data and analytical information to justify the overall design basis condensate return rate. This calc note will consider the test data as well as analytical models for steam generation rates and short-term steam losses to passive heat sinks other than the containment shell.

- PRHR / IRWST / PCS performance will also be evaluated for a range of condensate return rate varying from 95% to much lower values. The goal of these sensitivity cases is to determine how low the condensate return rate would have to be to challenge long-term PRHR HX operation and thus demonstrate that there is significant margin to “cliff edge” effects in the design.

- Finally, Westinghouse will provide a summary assessment of how the effect of containment pressure is considered in the analysis of different faults, in terms of impact on the performance of the PRHR for 72 hours. This assessment will be based on the consolidated safety analyses, and will be performed in parallel to the resolution of GDA Issue FS-02.

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:

- The internal PIRT assessment will define the full set of phenomena to include any physical behaviour and/or process that may be displayed by the **AP1000**® plant design in the steam condensation return rate process during intact non-LOCA faults. The objective of this internal PIRT is to identify the relative importance of the full set of identified phenomena. This relative importance coupled with the current relative state of knowledge for the phenomena, will provide the framework for the planning of the testing programme and analytical efforts.

- Testing programme, defined in the PIRT, will be conducted. Test data exists for condensation on a downward facing surface and the slope angle required to have the condensation drain down without detaching. Additional testing will be conducted to demonstrate if there is any loss at the crane rail and stiffener.

- A calculation note will be developed to determine the total average condensate return rate and confirm that it is greater than the current specification of 95%. Inputs for this calculation note will be taken from existing and new experimental data and appropriate analyses.

- Additionally, sensitivity studies for average condensate return rate lower than 95%, will be performed to demonstrate the robustness of the design and to assess the impact of lower return rates This study will be documented in a separate calc note.

Justification of adequacy:

The Containment Condensate Return Rate PIRT assessment followed by identified testing programme, scaling analyses and bounding analyses for the phenomena that the state of knowledge sufficient will provide validation for the condensate return rate.

The results of this work shall show that the average condensate return to the IRWST meets or exceeds the current 95% design basis of the gutter system or if not, is shown to be adequate to support long-term PRHR HX operation.

Additionally, supporting calculations will demonstrate the margin existing in the design, evaluating the minimum condensate return rate to support PRHR operation for at least 72 hours, thus demonstrating the margin between the validated return rate and a critical return rate that would challenge the safety case position.

Finally, to address the second element of the issue, Westinghouse will provide a summary assessment of how the effect of containment pressurisation is accounted for in different faults, with specific focus on loss of normal feed. This will be performed in parallel to the resolution of GDA Issue FS-02, to ensure and confirm that the final, consolidated set of safety analyses does appropriately account for this effect in applicable faults.

Impact assessment:
The relevant chapters within the PCSR will updated as appropriate.