Westinghouse UK
AP1000® GENERIC DESIGN ASSESSMENT
Resolution Plan for GI-AP1000-FD-01
Fuel Pin Modelling Safety Justification

MAIN ASSESSMENT AREA	RELATED ASSESSMENT AREA(S)	RESOLUTION PLAN REVISION	GDA ISSUE REVISION
Fuel and Reactor Core	Fault Studies	1	0

GDA ISSUE:	There is a need to provide comprehensive documentation demonstrating that PAD predictions of temperatures for fresh fuel will in all cases exceed the expected temperatures of irradiated fuel, including allowances for uncertainty. Further, that fission gas release predictions are pessimistic after suitable allowances. In order to ensure this, a suitable constraint on fuel ratings as a function of irradiation needs to be qualified and adopted.
ACTION: GI-AP1000-FD-01.A1	Demonstrate in a documented safety case, to a high level of confidence that for fresh fuel temperatures predicted by PAD are bounding of all irradiated fuel within the burnup range considered. Define a formal limiting condition applied to the core design process to ensure that the assumptions utilised in this Action are realised. The current version of the PAD fuel performance code is deficient as the reduction in thermal conductivity of fuel material with irradiation is not represented. Westinghouse bases its safety case for fuel temperatures on the argument that fresh fuel is limiting due to the reduction of fuel reactivity with irradiation. However, this argument is based on assumptions about the power of the fuel and needs to be made This constraint needs to be considered a limiting condition of operation and controlled as such. The derivation of the constraint will need to make due allowance for uncertainty. With agreement from the Regulator this action may be completed by alternative means.
ACTION: GI-AP1000-FD-01.A2	Present a formal safety justification of the uncertainty of the current models of fission gas release and their limits of applicability. The current version of the PAD fuel performance code is deficient as the empirical fission gas release model does not include a gas release threshold model. Consequentially the prediction of the rate of gas release tends to be too high initially, and then too low later.

	Westinghouse bases its safety case for fuel pin pressures on the argument that empirical data can be used as a basis for prediction of fission gas release, but the **AP1000**® design envisages operating at fuel pin ratings and irradiations in excess of the current bulk of the data. This brings into question the basis for the assessment of uncertainty in the current safety case and requires a thorough justification of its statistical basis at the limiting conditions of relevance. With agreement from the Regulator this action may be completed by alternative means.
RELEVANT REFERENCE DOCUMENTATION RELATED TO GDA ISSUE	
Technical Queries	
Regulatory Observations	
Other Documentation	WEC70126R, "Response to RO-**AP1000**-092 and Actions RO-**AP1000**-092.A1.1 and RO-092.A1.2– Documentation for the Current Frozen Version of the Fuel Performance Code" Letter from H. A. Sepp (Westinghouse) to C. M. Craig (NRC), "Transmittal of Information Pertaining to Westinghouse Fuel Rod Internal Pressure Issue," NSD-NRC-97-5404, dated October 28, 1997. Westinghouse Owners Group presentation to the NRC Staff, dated November 6, 1997. NRC Internal Memorandum C. M. Craig (NRC) to T. H. Essig (NRC), "Summary of Meeting with the Westinghouse Owners Group (WOG) to Discuss Issues Related to 10 CFR 50.46," dated January 15, 1998. NRC Safety Evaluation Report, Section 4.3 for WCAP-15063-P-A, Revision 1, with Errata, "Westinghouse Improved Performance Analysis and Design Model (PAD 4.0)," dated July 2000. (Included as Attachment 1.C to this RO)

Scope of work:
In order to address the GDA action items, Westinghouse will: 1) Develop a safety case for the uncertainties associated with the current fission gas release model in PAD, considering more recent empirical data. 2) Develop a safety case for the adequacy of the current PAD fuel temperature models, which ignore thermal conductivity degradation. 3) Describe the methodology to be used in confirming the continued applicability of (2)

to a given core design (reload analysis confirmation).

Description of work:

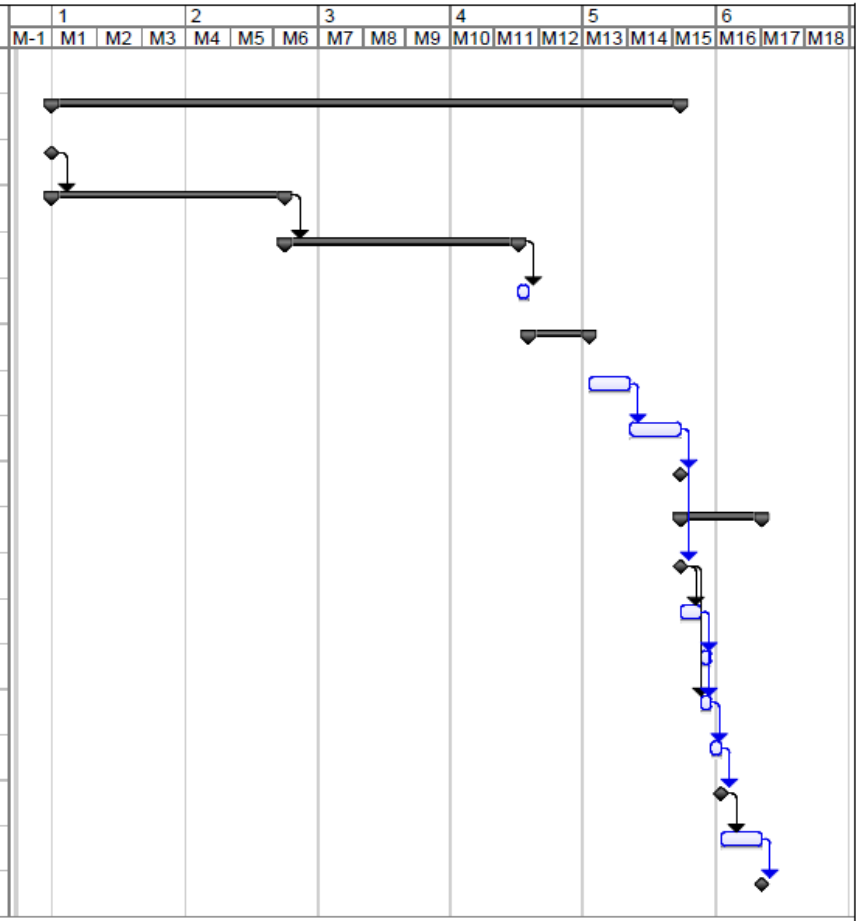
With respect to the above scope of work:

1) Westinghouse will review the uncertainties applied to PAD predicted fission gas release in light of more recent empirical data. Westinghouse will then develop a documented justification for the appropriate uncertainty to be applied to PAD predictions for **AP1000** PWRs.
2) Westinghouse will develop a documented safety case that demonstrates that the current PAD fuel temperature models are adequate in light of the fact that BOC conditions remain the limiting condition for accident analyses such as for LOCA events. This safety case will rely largely on work performed to develop a safety case for operating PWRs in the US, but will clearly justify applicability of these conclusions to the **AP1000** PWR design.
3) Westinghouse will document the reload design methodology that will be used to confirm the peaking factor burn-down utilised in the Step 2 safety case (above) remains applicable for a given core design. This methodology will become part of the reload design process such that it effectively becomes a core design constraint assuming the usage of the current PAD code for fuel rod design. Westinghouse will also document confirmation that the assuming peaking factor burn-down applies to the current **AP1000** Cycle 1 core design documented in the PCSR.

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.

ID	Task Name
1	Meet with ONR as required
2	**Issue**
3	Solution to Action
4	**Review Existing Documentation/Model**
7	**Develop Safety Case**
10	Convergence Meeting/Discussion
11	**Submit Safety Case**
13	ONR Review of Safety Case
14	Respond to TQs
15	ONR Close Issue
16	**Preparation of Safety Submission Documentation**
17	Process start
18	Preparation of Safety Submission
19	Technical Review
20	Licensing Review
21	Update with comments from reviews
22	Issue draft to Regulator
23	Regulator to confirm response to action
24	Response received from ND/ EA



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Methodology:
No new methodologies will be utilised to resolve this GDA issue.

Justification of adequacy:
The development of the safety case documented as required by the ONR will demonstrate the adequacy of the current version of the PAD code for use in **AP1000** core design. In the future, it is expected that a revised PAD version will be developed that overcomes the current shortcomings in the modelling methodology (i.e., fuel temperature models) and thus further strengthens the safety case for the core and fuel design processes that will be utilised for the **AP1000** PWR design.

Impact assessment:
No previously submitted documents are expected to be impacted by this work.