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	2	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:

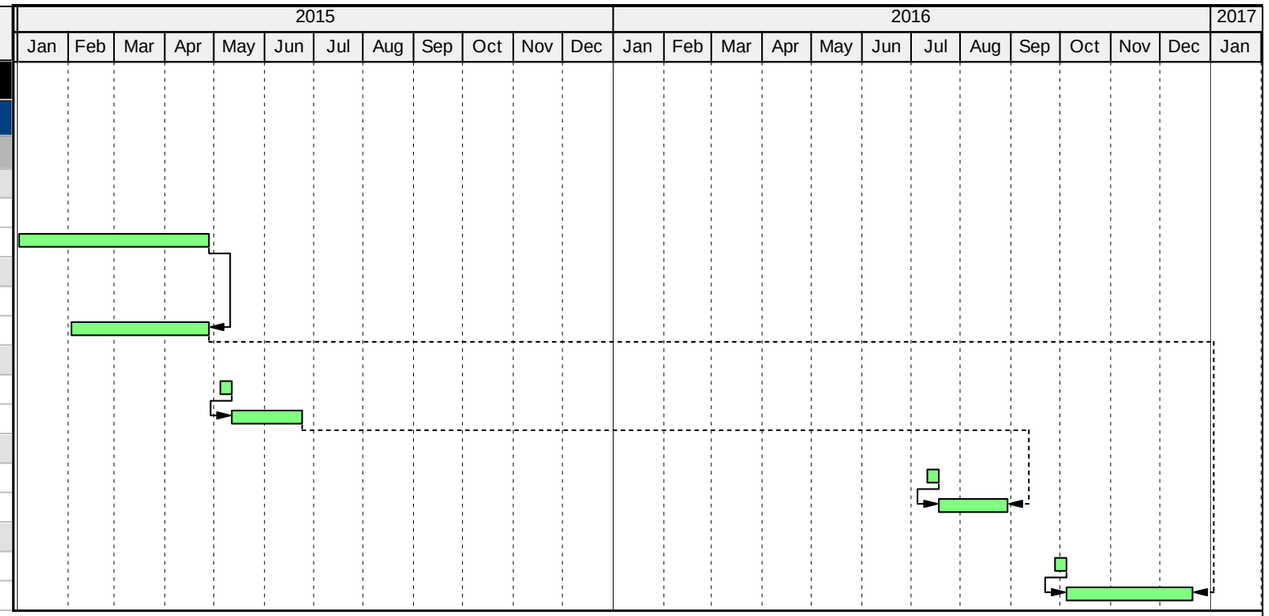
With respect to the above scope of work:

1) Westinghouse will provide: a new topical report on PAD5; a core reference report and an updated safety analysis report. The topical and the safety analysis reports are already available.
2) Westinghouse will address the GDA specific questions which were raised. Westinghouse will consider what they have done and how this is impacted by the revised fuel analysis. One particular area highlighted was the PCI safety case. This will either need to be revised or the existing analysis results justified.

Schedule/ programme milestones:

Please see the following page for the detailed schedule.

#	Activity Name
1	**UK Generic Design Assessment (GDA) Resolution Plans (51)**
2	**FUEL DESIGN**
3	**FD.01 Performance Analysis & Design - PAD**
4	**FD.01 Submittal of WCAP-17524**
5	WCAP-17524 -Submit to ONR
6	WCAP-17524-ONR Review of Submittal
7	**FD.01 Submittal of WCAP-17642**
8	WCAP-17642 -Submit to ONR
9	WCAP-17642-ONR Review of Submittal
10	**FD.01 Submittal of FINAL WCAP-17524**
11	WCAP-17524 -Submit to ONR
12	WCAP-17524-ONR Review of Submittal
13	**FD.01 Submittal of FINAL WCAP-17642**
14	WCAP-17642 -Submit to ONR
15	WCAP-17642-ONR Review of Submittal
16	**FD.01 Development of PCSR Mark-Ups**
17	PCSR Mark-Ups - Submit to ONR
18	PCSR Mark-Ups - ONR Review of Submittal



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.