

**Westinghouse UK**  
**AP1000® GENERIC DESIGN ASSESSMENT**  
**Resolution Plan for GI-AP1000-RP-01**  
**Criticality control in SFP**

MAIN ASSESSMENT AREA	RELATED ASSESSMENT AREA(S)	RESOLUTION PLAN REVISION	GDA ISSUE REVISION
Radiation Protection	Fault Studies Radwaste and Decommissioning	4	0

<b>GDA ISSUE:</b>	Westinghouse has not adequately demonstrated why it is not reasonably practicable to design the <b>AP1000®</b> spent fuel pool such that criticality control is achieved through geometrical control and fixed poisons alone.
<b>ACTION: GI-AP1000-RP-01.A1</b>	<p>Provide a safety case, with supporting evidence, which demonstrates that criticality control of the spent fuel pool is assured for all foreseeable operating conditions through geometrical control and fixed poisons alone. ONR's expectation is that Westinghouse should adequately apply the hierarchy of safety measures, as described in the HSE's Safety Assessment Principles (SAPs) and international guidance, for criticality control of the <b>AP1000</b> spent fuel pool. In the context of the design of spent fuel pools at new nuclear power stations, it should be reasonably practicable for Westinghouse to submit an approach that relies on passive safety measures that do not rely on control systems, active safety systems or human intervention. ONR believes that options to improve the arrangements for spent fuel storage are available to Westinghouse. These options may include, but are not limited to:</p> <ul style="list-style-type: none"> <li>• Increasing the size of the spent fuel pool.</li> <li>• Redesigning the racking system so that the geometrical separation of fuel assemblies is increased and/or the effectiveness of fixed poisons contained within the racks is improved.</li> <li>• Designing rack inserts containing fixed poisons which can be positioned around fuel assemblies during storage.</li> <li>• Designing fuel assembly inserts to provide fixed poisons.</li> <li>• Utilising additional fuel storage facilities outside the nuclear island to increase storage capacity.</li> </ul> <p>With agreement from the Regulator this action may be completed by alternative means.</p>

<b>RELEVANT REFERENCE DOCUMENTATION RELATED TO GDA ISSUE</b>	
<b>Technical Queries</b>	TQ-AP1000-594
<b>Regulatory Observations</b>	RO-AP1000-073.A1
<b>Other Documentation</b>	<p>ONR letter WEC70261R - Spent Fuel Pool - Criticality Safety Case</p> <p>Table 3 of the Step 4 Radiological Protection Assessment Plan (AR09053) identified that criticality control in fuel ponds was an area for further assessment during Step 4</p> <p>Paragraph 209 of the Step 3 Fault Studies Assessment Report (AR09018) noted that strong arguments would be needed to justify why it was not reasonably practicable to enlarge the spent fuel pool to eliminate by design the risk of a criticality fault rather than rely upon administrative controls, etc</p> <p>ND Safety Assessment Principles: Paragraphs 136, 146, 471, 474</p> <p>ND Technical Assessment Guide: T/AST/041</p> <p>IAEA Draft Specific Safety Guide DS371, "Storage of Spent Fuel", January 2010</p> <p>IAEA Draft Specific Safety Guide SSD DS407 "Criticality Safety for Facilities and Activities Handling Fissionable Material", Version 4, November 2010</p> <p>Contact Report CR11055 - Westinghouse Level 3 Meeting - Manchester Airport - 23 February 2011</p>

**Scope of work:**

Westinghouse to re-evaluate the spent fuel pool configuration options and to provide ONR with an ALARP assessment of these and a safety case for a solution that achieves criticality control through geometrical control and fixed poisons alone.

**Description of work:**

Westinghouse will finalise the ALARP assessment of the following spent fuel pool configurations and options;

- Current configuration
- Extended pool within nuclear island
- Extended pool outside nuclear island
- Different construction material for fuel racks

- Fixed poisons in fuel assemblies
- Re-racking to all Region 1
- Blocking 2 out of 4 cells in Region 2
- Blocking 1 out of 4 cells in Region 2

The criteria the different options will be assessed against are;

- Criticality Control
  - a. Keff of 0.95 or lower for normal operation
  - b. Keff of 0.98 or lower for abnormal operation
    - i. Assuming all fresh fuel in analysis
    - ii. Analysing dropped loads
- Meeting double contingency principle
- Spent fuel cooling time prior to dry casking
  - a. Minimum 10 years of fuel cooling time in SFP
- Maintain safety benefits in standardisation
  - a. A wider pool of experience will inevitably provide better feedback for future improvement in safety
- Hierarchy of safety measures
- Relevant good practise

After agreement with ONR regarding the outcome of the ALARP assessment a full safety case will be produced for the chosen configuration, supported by the following;

- A criticality analysis.
- A proposed design of spent fuel pool blocking devices if applicable.
- A proposed design for fixed poison inserts if applicable.
- Fault analysis
- Human factors analysis

After agreement has been reached with ONR that the safety case is adequate, a DCP documenting the design change to adapt to UK licensing will be executed for the chosen option.

Deliverables will be;

- Overall UK ALARP assessment, including assessment of all considered options and ALARP demonstration for the selected solution.
  - o Fault analysis, Human factors analysis, and dose information.
- Summary Document describing criticality analyses for the options presented in the Resolution Plan, as well as the criticality analyses themselves and supporting documentation.
- A proposed design concept for the spent fuel pool, documented in a DCP.
- Mark-ups of impacted licensing documents;
  - o PCSR chapters 6, 9, 24, 26
  - o ER

#### **Schedule/ programme milestones:**

Please see the following page for the schedule.

#	Activity Name	2015												2016												2017		
		Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	
1	<b>UK Generic Design Assessment (GDA) Resolution Plans (51)</b>																											
2	<b>RADIOLOGICAL PROTECTION</b>																											
3	<b>RP01 Spent Fuel Pool Criticality Safety Case-Resolution Plan</b>																											
4	<b>RP01 Summary of SFP Criticality Analysis Documents</b>																											
5	Summary of SFP Criticality Analysis Documents-Submit to ONR																											
6	Summary of SFP Criticality Analysis Documents-ONR Review of Submittal																											
7	<b>RP01 Spent Fuel Pool-ALARP Argument Rev.0</b>																											
8	Spent Fuel Pool-ALARP Argument-Submit to ONR																											
9	Spent Fuel Pool-ALARP Argument-ONR Review of Submittal																											
10	<b>RP01 Spent Fuel Pool-ALARP UK DCP</b>																											
11	DCP-Discussion and Convergence on DCP with ONR																											

**Methodology:****ALARP analysis**

Following guidance provided at ONR/Westinghouse level 3 meeting 23<sup>rd</sup> February 2011.

**Criticality analysis**

Existed methodology will be used, already reviewed and determined acceptable by ONR.

**Justification of adequacy:**

1. Process will follow ONR ALARP guidance and design criteria discussed at the Westinghouse/ONR Level 3 meeting 23<sup>rd</sup> February 2011.
2. Criticality analysis methodology endorsed by ONR.
3. ONR has already indicated options potentially acceptable to ONR.

**Impact assessment:**

- Chapters 6, 9, 24, and 26 in the PCSR will be updated to reflect the revised design
- The Environment Report will be updated to reflect the revised design (storage period)
- The Master submission list will be updated
- The RO Matrix will be updated if applicable
- The DRP will be updated if applicable