

Office for Nuclear Regulation

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Redgrave Court Merton Road Bootle Merseyside L20 7HS

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WESTINGHOUSE AP1000® GENERIC DESIGN ASSESSMENT

GDA ISSUE

SQUIB VALVE CONCEPT AND DESIGN SUBSTANTIATION

GI-AP1000-ME-01 REVISION 1

Technical Area		MECHANICAL ENGINEERING	
Related Technical Areas		Probabilistic Safety Assessment Fault Studies Control & Instrumentation	
GDA Issue Reference	GI-AP1000-ME-01	GDA Issue Action Reference	GI-AP1000-ME-01.A1
GDA Issue	While undertaking the GDA the availability of adequate arguments and evidence for the selection, system incorporation and qualification of the squib valve designs has been limited. Westinghouse is required to issue appropriate approved documentation that provides adequate arguments and evidence for their selection, equipment design, and associated system design.		
GDA Issue Action	Generate and issue appropriate approved documentation that provides adequate arguments and evidence for the squib valve selection. ONR considers a GDA can not be completed without the design being finalised and the availability of auditable and approved design documentation that demonstrates the valve selection at the concept stage is ALARP. ONR's expectation is for Westinghouse to finalise their designs and provide the formal Summary Report, which is to include the appropriate arguments and evidence to demonstrate the squib valve selection is ALARP, with sufficient evidence of optioneering, and the design has followed a robust design process. With agreement from the Regulator this action may be completed by alternative means.		

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Related Technical Areas		Probabilistic Safety Assessment Fault Studies	
GDA Issue Reference	GI-AP1000-ME-01	GDA Issue Action Reference	GI-AP1000-ME-01.A2
GDA Issue Action	Generate and issue appropriate approved documentation to justify the squib valve detailed component designs are able to achieve the safety case requirements and assumptions. ONR considers a GDA can not be completed, without the designs being finalised and the availability of approved design documentation that demonstrates the valve detailed component designs meets the safety case requirements. ONR's expectation is for Westinghouse to finalise their designs and provide the formal approved design justification, which includes the appropriate arguments and evidence that the valves' detailed component designs meet the safety functional requirements. With agreement from the Regulator this action may be completed by alternative means.		

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Related Technical Areas		Probabilistic Safety Assessment Fault Studies	
GDA Issue Reference	GI-AP1000-ME-01	GDA Issue Action Reference	GI-AP1000-ME-01.A3
GDA Issue Action	Generate and issue appropriate approved documentation to justify that the squib valve interfacing system designs (e.g. supports, interfacing pipework etc.) are able to achieve the safety case requirements and assumptions. ONR considers a GDA can not be completed, without the designs being finalised and the availability of approved design documentation that demonstrates each valve is integrated into its associated system, and meets the safety case requirements. ONR's expectation is for Westinghouse to finalise their designs and provide the formal approved design justification, which includes the appropriate arguments and evidence that each valve is integrated into its associated system, and meets the safety functional requirements. With agreement from the Regulator this action may be completed by alternative means.		

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GDA Issue Reference	GI-AP1000-ME-01	GDA Issue Action Reference	GI-AP1000-ME-01.A4
GDA Issue Action	Generate and issue appropriate approved documentation to demonstrate the surveillance and EMIT regime is able to achieve the safety case requirements and assumptions. Given the 60 year design life of the AP1000, and the inability to stroke the squib valves during in service inspections, ONR considers that Westinghouse needs to specify a robust surveillance regime to ensure that the squib valve designs are capable of delivering their safety functions in accordance with the requirements of the safety case. ONR's expectation is for Westinghouse to finalise their designs and provide the formal approved design justification, which is to include an adequate surveillance and EMIT regime specification that is commensurate to the AP1000 NPP safety case and the safety role for each squib valve type. With agreement from the Regulator this action may be completed by alternative means.		

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Technical Area		MECHANICAL ENGINEERING	
Related Technical Areas		Probabilistic Safety Assessment Fault Studies	
GDA Issue Reference	GI-AP1000-ME-01	GDA Issue Action Reference	GI-AP1000-ME-01.A5
GDA Issue Action	<p>Westinghouse shall address the listed points, which have been identified as gaps in the safety justification of the squib valve designs as a result of undertaking the GDA from a Mechanical Engineering perspective:</p> <ul style="list-style-type: none"> • Westinghouse shall demonstrate the FMEA for the final squib valve designs includes an independent technical reviewer. • Westinghouse shall generate and issue an ALARP justification that each squib valve type as proposed is adequate to achieve its safety functional requirements and its design intent, in terms of position indication during normal operation. • Westinghouse shall generate and issue an ALARP statement on how the bracket design achieves the design intent of a guard. • Westinghouse shall generate and issue an ALARP statement on how the 14 inch ADS squib valve design achieves its design intent without the requirement of a cover. • Westinghouse shall provide confirmatory evidence of the described poka yoke features within the 8 inch valve detailed drawings. • Westinghouse shall provide evidence that adequate arrangements are in place to control and manage the supply of the squib valves, and tolerances for the technical parameters of critical components. • Westinghouse shall provide evidence that the squib valve Equipment Qualification tests adequately demonstrate that each squib valve type is able to achieve its design intent. <p>With agreement from the Regulator this action may be completed by alternative means.</p>		

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Technical Area		MECHANICAL ENGINEERING	
Related Technical Areas		Probabilistic Safety Assessment Fault Studies	
GDA Issue Reference	GI-AP1000-ME-01	GDA Issue Action Reference	GI-AP1000-ME-01.A6
GDA Issue Action	<p>Westinghouse shall address the listed points, which have been identified as gaps in the safety justification of the squib valve designs as a result of undertaking the GDA from a Pyrotechnics perspective:</p> <ul style="list-style-type: none"> • Westinghouse shall issue document (#35 (APP-PV70-GER-001)). • Westinghouse shall generate and issue the arguments and evidence regarding the following items: <ul style="list-style-type: none"> - Justify why different rationales have been adopted to select the pyrotechnic substances for the initiator and booster. - Demonstrate why good practice from aerospace is relevant within nuclear plants. - Justify the choice regarding the binder; notably, a comprehensive and well-argued analysis and supporting evidence requires to be provided. - Provide results of radiation exposure of the propellants, and the demonstration that reference environments used in the past are sufficiently similar to the environment expected within AP1000 reactors. - The relevance of the Summary Report, Appendix C in substantiating the pyrotechnics aspects. • Westinghouse shall generate an argument that demonstrates that: <ul style="list-style-type: none"> - Test data from carrying out initiator tests by others provides suitable reliability evidence for use with the AP1000 design given the variance in the AP1000 initiator design and the use of a binder. - Sufficient and relevant test evidence exists for the AP1000 booster design to support its reliability claim. • Westinghouse shall clarify the relevance and purpose of Development Report 17399(01)DR to the ballistic analysis. • Westinghouse shall provide: <ul style="list-style-type: none"> - A review of the advantages and disadvantages of each considered initiator concept. - An explanation of the selection criterion for the initiator ignition concept. 		

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Related Technical Areas		Probabilistic Safety Assessment Fault Studies	
GDA Issue Reference	GI-AP1000-ME-01	GDA Issue Action Reference	GI-AP1000-ME-01.A6
	<ul style="list-style-type: none"> - The analysis to support the selection of each considered initiator concept. • Westinghouse shall generate and issue the justification that: <ul style="list-style-type: none"> - Cartridges will not be liable to react to any electromagnetic environments, with adequate consideration to resonant harmonics that they will be exposed to throughout their life cycle. - EMIT requirements for EMI protection is suitable and adequate. • Westinghouse shall generate and issue the justification that all the relevant UK requirements for the design of cartridges and termination units have been adequately covered by the implementation of US standards and guidance. • Westinghouse shall generate and issue the following documentation: <ul style="list-style-type: none"> - Finalised requirements regarding the propellant neutron testing, by justifying the energy, the intensity, and the duration of exposure. - Qualification results, which includes the substantiation that actuators as proposed are adequate to achieve their safety functional requirements and their design intent. • Westinghouse shall provide the justification that C&I faults do not impact the properties of the initiator bridgewire. • Westinghouse shall generate and issue a further analysis to confirm that, in case of a fire in adjacent containment fire zones, the present design of cartridge peak temperature is maintained below the propellant auto-ignition temperature with an adequate margin. To date fires in surrounding rooms have not adequately considered. • Westinghouse shall generate and issue comprehensive justification that: <ul style="list-style-type: none"> - The safeguards that are provided within the termination units and cabinet interface modules are sufficient to reduce the spurious actuation probability at a level coherent with other potential sources of LOCA. - The absence of SADs within the pyrotechnic chain achieves the correct balance between the two competing demands of preventing spurious actuation of the squib valves, and yet ensuring they have a high reliability of actuation on demand to support the passive core cooling function. • In respect of the electrical current values Westinghouse shall provide: 		

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GDA Issue Reference	GI-AP1000-ME-01	GDA Issue Action Reference	GI-AP1000-ME-01.A6
	<ul style="list-style-type: none"> - A review of the advantages and disadvantages of each considered value. - An explanation of the selection criterion for the electrical current value. - The analysis to support the selection of each considered option. • Westinghouse shall generate and issue the justification that each squib valve termination unit type and terminal block is designed adequately to achieve its safety functional requirements and its design intent. This justification shall include: <ul style="list-style-type: none"> - The comprehensive list of safety and functional requirements, including surveillance monitoring requirements. - The detailed description of design solutions. - The qualification programme and its results. - The description of EMIT provisions required to maintain safety functions. <p>With agreement from the Regulator this action may be completed by alternative means.</p>		

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Technical Area		MECHANICAL ENGINEERING	
Related Technical Areas		Probabilistic Safety Assessment Fault Studies	
GDA Issue Reference	GI-AP1000-ME-01	GDA Issue Action Reference	GI-AP1000-ME-01.A7
GDA Issue Action	<p>Westinghouse shall address the listed points, which have been identified as gaps in the safety justification of the squib valve designs as a result of undertaking the GDA from a Surveillance and EMIT perspective:</p> <ul style="list-style-type: none"> • Westinghouse shall provide the detailed evidence that an adequate visual inspection can be carried out on the 8 inch squib valve design. • Westinghouse shall explicitly capture in the consolidated PCSR the requirement that if a cartridge taken out of a plant fails its test then all cartridges from that batch should be replaced. • Westinghouse shall generate and issue the justification that electrical testing EMIT requirements result from a process which has considered and analysed each option, with a suitable selection rationale. This justification shall demonstrate specifically the following items: <ul style="list-style-type: none"> - Testing every 24 months is sufficient to prove a high level of availability of the safety system using squib valves. - Insulation testing does not reduce the risk of failure. - Electrical currents supplied by digital voltmeters always stay lower than the threshold defined in bridgewire resistance test. - Reconnecting initiators to a circuit under voltage does not increase the risk. • Westinghouse shall identify in the safety case that every cartridge subjected to a significant mechanical shock loading during its lifetime must not be used, as a safety requirement. As part of this, Westinghouse shall also define the acceptance parameters in respect of this criterion. • Westinghouse shall generate evidence of recommending an adequate surveillance and EMIT regime that is commensurate to the AP1000 NPP safety case assumptions and the safety role of each squib valve type. <p>With agreement from the Regulator this action may be completed by alternative means.</p>		