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WESTINGHOUSE AP1000® GENERIC DESIGN ASSESSMENT

GDA ISSUE

FURTHER JUSTIFICATION OF NOVEL FORM OF STRUCTURE FOR THE STEEL/ CONCRETE COMPOSITE WALL TO THE ENHANCED SHIELD BUILDING

GI-AP1000-CE-02 REVISION 1

Technical Area	**CIVIL ENGINEERING**		
Related Technical Areas	Internal Hazards PSA		
GDA Issue Reference	**GI-AP1000-CE-02**	**GDA Issue Action Reference**	**GI-AP1000-CE-02.A1**
GDA Issue	Further justification of the novel design used for the steel/concrete composite wall proposed for the Enhanced Shield Building within the nuclear island.		
GDA Issue Action	Provide further justification on the steel material used for the tie bars in the SC wall of the ESB. The tie bar material specified by Westinghouse to A496 does not appear to comply with the normal European requirements for reinforcement in seismic design specifically with respect to its ductility. It is the Regulator's view that more appropriate steel grades should be considered. Westinghouse must therefore either propose a more suitable grade or provide justification why the A496 material specified is appropriate to use as shear reinforcement in seismic design taking into account European expectations for seismic design. With agreement from the Regulator this action may be completed by alternative means.		

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Technical Area		**CIVIL ENGINEERING**	
Related Technical Areas		Internal Hazards PSA	
GDA Issue Reference	**GI-AP1000-CE-02**	**GDA Issue Action Reference**	**GI-AP1000-CE-02.A2**
GDA Issue	Further justification of the novel design used for the steel/concrete composite wall proposed for the Enhanced Shield Building within the nuclear island.		
GDA Issue Action	Provide further substantiation of the demand calculations for the tie bars to justify: • the total demand tensile force in the ties from simultaneous loads, including secondary effects. • the combination of tensile forces calculated above with simultaneous shear forces calculated under Action A5. • justification of the combined tensile strength and shear strength of the tie bars (tensile strength to be confirmed under Action A1. Shear strength to be confirmed under Action A5, Item 2). • provide demand versus capacity ratios. With agreement from the Regulator this action may be completed by alternative means.		

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Technical Area	**CIVIL ENGINEERING**		
Related Technical Areas	None		
GDA Issue Reference	**GI-AP1000-CE-02**	**GDA Issue Action Reference**	**GI-AP1000-CE-02.A3**
GDA Issue Action	Provide a clear statement in the methodology that the out of plane shear is taken on the reinforcement alone. Provide a comparison of the proposed ACI 349-01 design methodology for out of plane shear and provision of shear reinforcement with alternative codes. Provide further calculations to alternative codes: • JEAG 4618. • Draft AISC N690 App N9. • Any others deemed applicable by Westinghouse, including first principles. in order to justify that the provision of ties as shear reinforcement in the ESB SC wall. With agreement from the Regulator this action may be completed by alternative means.		

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Related Technical Areas	None		
GDA Issue Reference	**GI-AP1000-CE-02**	**GDA Issue Action Reference**	**GI-AP1000-CE-02.A4**
GDA Issue Action	Provide additional justification for the proposed design methodology for in-plane shear when combined with other loads. Provide further calculations for in-plane shear to alternative codes: • JEAG 4618. • Draft AISC N690 App N9. • Any others deemed applicable by Westinghouse, including first principles. in order to justify that the plates still have sufficient margin above the demand levels when these codes are used for design. These calculations should consider all the coincident loads present for each critical loadcase, such as those described in actions A2 and A5 of this GDA Issue. These calculations should also include the symmetric sharing of in plane shear stress used by these codes. Following the above, provide the limitations on combined loadings (e.g. moment and axial load) for which the Westinghouse methodology of asymmetric sharing of in-plane shear stress is applicable. With agreement from the Regulator this action may be completed by alternative means.		

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Technical Area	**CIVIL ENGINEERING**		
Related Technical Areas	None		
GDA Issue Reference	**GI-AP1000-CE-02**	**GDA Issue Action Reference**	**GI-AP1000-CE-02.A5**
GDA Issue Action	The adequacy of the shear connection between the face plates and the concrete needs to be verified for the general areas and the connection zones. Provide the following substantiation with respect to the shear connectors: • Justify that the strength reduction factor of 0.75 for shear studs taken from ACI 349-01 B.4.4 is appropriate and provide sensitivity of this. (This is an identical action to GI-AP1000-CE-01.A7 item 1). • Justify the nominal and design shear capacity for the tie bars. This is to be used in the capacity calculation in Action A2 of this GDA Issue. • Justification for omission of any tension force in the shear studs (resulting from restraining the plate in compression) is required, and, if a tension force is required, the effect on the stud shear capacity needs to be considered. • Provide calculations to justify that the development length will be satisfied for the re-calculated shear resistance of the ties and studs. With agreement from the Regulator this action may be completed by alternative means.		

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Related Technical Areas	None		
GDA Issue Reference	**GI-AP1000-CE-02**	**GDA Issue Action Reference**	**GI-AP1000-CE-02.A6**
GDA Issue Action	Westinghouse shall provide further justification for: • The base connection of the ESB to the RC wall below. • The connection between the Auxiliary Building roof and the ESB. • The calculation of stresses at the transition from the typical 3ft wall to the 4.5ft wall at the air inlet region, and the justification that the tie bar arrangement is sufficient to provide a competent transition. With agreement from the Regulator this action may be completed by alternative means.		

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Related Technical Areas	None		
GDA Issue Reference	**GI-AP1000-CE-02**	**GDA Issue Action Reference**	**GI-AP1000-CE-02.A7**
GDA Issue Action	Westinghouse is required to justify how the thermal analysis models transient thermal effects, such as environmentally induced transients. Justification should be provided that the plate and shear connector design will provide margin over the demand for the thermal loadcases. The concern is that frequent/daily thermal cycles could lead to cyclic forces on shear connections adjacent to cracks and degrade their capacity. The restraint forces in the studs/ties induced by restraining the compression plate against expansion must also be included in Actions A2 and A5. With agreement from the Regulator this action may be completed by alternative means.		

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Related Technical Areas	None		
GDA Issue Reference	**GI-AP1000-CE-02**	**GDA Issue Action Reference**	**GI-AP1000-CE-02.A8**
GDA Issue Action	Westinghouse is required to provide evidence on the effect of fire on the ESB SC wall generally. It is not claimed as a fire barrier. Westinghouse is also required to consider if vapour pressure within the ESB SC wall is a concern. This action is concerned with the structural stability of the ESB circular SC wall following a potential fire. Therefore, a quantification of the fire magnitude that the structure can withstand without structural collapse shall be provided. This should include possible fires outside the building and internal fires within the shield building annulus or in the auxiliary building adjacent to RC/SC connections. With agreement from the Regulator this action may be completed by alternative means.		

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Related Technical Areas	None		
GDA Issue Reference	**GI-AP1000-CE-02**	**GDA Issue Action Reference**	**GI-AP1000-CE-02.A9**
GDA Issue Action	Westinghouse is required to provide further substantiation on the reliability of the Enhanced Shield Building as follows: • Clearly identify the target reliability expected from the design of Class 1 and Seismic Class 1 civil structures which are SC modules. • Demonstrate that the reliabilities identified above can be provided using the design methodologies adopted. This demonstration can be undertaken using whatever methods are seen as appropriate, however the following should be addressed: - Reliability of the Code in terms of mechanistic representation of structural behaviour. - Assumptions over the reliability of the engineer using the code. - Suitability of partial safety factors adopted in the design for both materials and loads. - Comparison with other codes for Nuclear Work. - Assumptions over the quality of materials/ construction. - Assumptions made over the long term behaviour of materials. - Assumptions made over the probability of the loadings used in the design. • Assess the effects on the calculation of HCLPF for the ESB SC wall based on the completion of actions A1 to A8 of this GDA Issue. With agreement from the Regulator this action may be completed by alternative means.		