

**ONR - Joint Programme Office
Nuclear New Build Programme**

██████████
Westinghouse Electric Company
New Power Plants
1000 Westinghouse Drive
Suite 117
Cranberry TWP
PA 16066
USA

Date 27 June 2011

4NG Redgrave Court
Merton Road
Bootle
Merseyside
L20 7HS

Tel: 0151 951 4029
Fax: 0151 951 3732

Email: new.reactor.build@hse.gsi.gov.uk

Your ref:

Unique No: WEC70328N

TRIM ref: 2011/339506

Dear ██████████

Closure of Regulatory Issue RI-AP1000-02 and associated Regulatory Observation RO-AP1000-079
Design Methodology for Steel-Concrete Composite Modules

We are notifying you by this letter of our confirmation of the close out of the following:

- Regulatory Issue RI-AP1000-002 and associated actions A1, A2 and A3.
- Regulatory Observation RO-AP1000-079 and associated actions A1 to A8.

The reason for this is that while there are some outstanding actions to complete, we are satisfied that you have addressed the majority of the key actions associated with the Regulatory Issue, and those that remain now equate to the status of a GDA Issue within the GDA process. We have raised GDA Issues GI-AP1000-CE-01 and GI-AP1000-CE-02 to record formally this position.

I have attached, in an annex to this letter, a high level description of the rationale for our judgment.

We recognize that Westinghouse Electric Company has put in a considerable amount of high quality work to get to this position. However I must remind you that resolution of the GDA Issues is still very challenging and will require a high level of your attention and resource to successfully meet your proposed resolution plans.

We will be placing this letter on HSE's website alongside the associated RI.

Yours sincerely

██████████
HM Superintending Inspector
Office for Nuclear Regulation

Annex

1.0 Background

In February 2010 the HSE's Nuclear Directorate, now the Office for Nuclear Regulation (ONR), placed a Regulatory Issue (RI) on Westinghouse on the topic of the AP1000 steel-concrete composite structural modules.

The AP1000 is a reactor design submitted by Westinghouse Electric Company (the Requesting Party) to the regulators for Generic Design Assessment (GDA). The outcome of the GDA for ONR is a decision whether to grant a Design Acceptance Confirmation (DAC). An RI is an assessment finding of sufficient concern that if left unresolved would likely result in the decision to not grant the DAC.

This annex provides the rationale for closing the RI and for the remaining open RI actions being recorded now as GDA Issue actions. A GDA Issue is at a lower level of importance than an RI while still a finding requiring resolution, the resolution is considered as achievable by the Regulator within the normal design process.

Regulatory Observation RO-AP1000-079 was raised by ONR in support of RI-AP1000-002 in May 2010. The associated actions provided specific queries on the design methodology which the Regulator expected to be addressed in the response the RI.

2.0 Scope of RI-AP1000-02

The RI was concerned with the methodology used for the design of concrete filled steel structural modules and of connections between and to such modules. The AP1000 module design is based on an analogy with reinforced concrete and claims that the American Concrete Institute (ACI) standard ACI 349-01, 'Code Requirements for Nuclear Safety Related Concrete Structures' can be conservatively used for the design of steel-concrete (SC) composite modules.

The position of the RI was that these types of structures were outside the scope of applicability of the substantive provisions of ACI 349-01. Further more, there was no applicable or relevant design code or standard for these structures and guidance for this eventuality is given in Safety Assessment Principle ECS.5.

The three following actions were associated with the RI:

RI-AP1000-02.A1 - Definition of design methodology for concrete filled steel structural modules and their connections.

The document submitted by Westinghouse to substantiate the design methodology for steel-concrete composite structures during GDA Step 3 was incomplete and outdated (APP-GW-SUP-001 Revision 0 dated 2003). At the time the RI was issued, ONR understood the same methodology was intended for both the enhanced shield building and for the internal civil modules, known as CA Modules.

This action required the design methodology document to be updated and resubmitted. The items highlighted in the action were the lack of conceptual connections, no revision in light of subsequent evolution of the design, major design changes to the enhanced shield building.

RI-AP1000-02.A2 - Demonstration of the adequacy of a non-code based methodology.

This action required Westinghouse to justify the adequacy of its specified design methodology, following its formal submission under Action A1.

The item highlighted in this action was the lack of any established code or standard for this type of structure. Therefore Westinghouse needed to demonstrate by whatever combination appears necessary of

- appropriate reference to relevant design guidance;
- analysis;
- structural testing;

that its design methodology, fabrication specification, installation and construction process provide equivalent reliability to that which would be achieved by an appropriate design standard.

RI-AP1000-02.A3 - Implications of design changes to the Enhanced Shield Wall for other nuclear safety related civil structures formed of concrete filled steel structural modules

This action required Westinghouse to review the implications of its design changes to the steel-concrete composite part of the enhanced shield building, resulting from the US NRC assessment, and whether similar design changes were required for all the nuclear safety related SC structures within the AP1000.

3.0 Scope of RO-AP1000-079

Regulatory Observation RO-AP1000-079 was raised by ONR in support of RI-AP1000-002 in May 2010. The associated actions provided specific queries on the design methodology which the Regulator expected to be addressed in the response to A2 and A3 of the RI.

4.0 The Response from Westinghouse

Westinghouse has satisfactorily addressed the RI and the RO by carrying out a substantive amount of confirmatory analyses and calculations, additional substantiation reports and laboratory testing to demonstrate that the capacity of the composite structures will have sufficient margin above the design loads placed upon them.

Taking each concern above in turn, the accepted response from Westinghouse has been as follows.

1. The design methodology document for CA Modules was updated and resubmitted in response to Action A1. It was also clarified that the enhanced shield building had a separate, although similar, design methodology which was detailed in the Enhanced Shield Building Design Report.
2. The actual structural elements have been sized using ACI-349-01 which is not fully applicable to this type of structure. However, Westinghouse has provided further justification by comparing the structure with other design codes, which although again are not fully applicable, never the less give a spread of methodologies. These comparisons have shown that there is considerable margin in the structure's capacity. Laboratory testing has also been carried out by Westinghouse in 2010, to increase confidence that the structure will perform as designed.
3. Westinghouse has confirmed that the Shield Building and the CA Modules are different structural types, albeit both are novel steel/concrete composites outside of the established design codes. Design changes made to the shield building, specifically providing transverse reinforcement (tie-bars) has brought this design in closer alignment to the claimed code ACI-349-01. Westinghouse has satisfied ONR concerns by committing to specifying reduced code limits to account for any shortfall in the applicability of the original code limits, and demonstrating there is still margin in the structure.

Specific queries on design methodology, structural performance and reliability were responded to under the eight actions of RO-AP1000-079. A schedule of the main

submissions is attached. In addition to these, more information was received in the form of detailed calculations, drawings and technical letters. These are referenced as appropriate in the Step 4 Assessment Report.

5.0 Summary

The above changes represent a major step forward in addressing satisfactorily ONR's concerns, and are the reason that we are now closing the RI-AP1000-002 and supporting RO-AP1000-079. The remaining outstanding items will be transferred to GDA Issue actions. ONR is confident that the remaining actions are resolvable under the GDA Issues process, and that the two types of composite structures can fulfil their safety functions.

Assessment Timeline for RI-AP1000-002		
Date	Item	Description
Sept 2009	ESB Report	APP-1200-S3R-003, Rev.0, Design Report for the AP1000 Enhanced Shield Building (Ref.W16)
Sept 2009		APP-GW-SUP-001 Rev0 (Ref.W20), Design Methodology for Structural Modules
16 th Feb 2010	RI-AP1000-002	Regulatory Issue raised, with three actions.
Feb 2010		Response to RI-AP1000-002.A1 APP-GW-SUP-001 Rev1 (Ref.W21), Design Methodology for Structural Modules
March 2010	ESB Report	APP-1200-S3R-003, Rev.1, Design Report for the AP1000 Enhanced Shield Building (Ref.W17)
May 2010	RO-AP1000-079	Regulatory Observation with eight actions.
May 2010	ESB Report	APP-1200-S3R-003, Rev.2, Design Report for the AP1000 Enhanced Shield Building (Ref.W18)
June 2010	US NRC Technical Meeting	ND attended this technical meeting on the ESB.
30 th June 2010	Letter WEC000254	Partial response to RI-AP1000-002.A2 plus plan for remainder.
16 th Aug 2010	Letter WEC000295	CA Modules Design Report APP-1000-S3R-002 Rev.A (Ref.W27)
19 th Aug 2010	Letter WEC000298	Clarification that APP-1000-S3R-002 Rev.A was partial response to RO-79 Actions A1, A2, A4, and A6.
25 th Aug 2010	ND Technical Meeting	Meeting held with Westinghouse in Preston to discuss SC design methodology.
15 th Sept 2010	ND Technical Meeting	Meeting held with Westinghouse in Pittsburgh to discuss SC design methodology.
30 th Sept 2010	Letter WEC000367 Letter WEC000369 Letter WEC000370	Partial response to RO-079.A3 Partial response to RO-079.A2 Partial response to RO-079.A7
Oct 2010	ESB Report	APP-1200-S3R-003, Rev.3, Design Report for the AP1000 Enhanced Shield Building (Ref.W19)
29 th Oct 2010	Letter WEC000403	UKP-GW-GLR-018 Rev0 (Ref.W28), Westinghouse Response to RI-002 and RO-079 APP-GW-SUP-001 Rev2 (Ref.W22), Design Methodology for Structural Modules
29 th Oct 2010	Letter WEC000405	List of 22 supporting documents to UKP-GW-GLR-018. 8 new received. 10 previously received. 4 to follow
30 th Nov/ 1 st Dec 2010	ND Level 3 Technical Meeting	Meeting held with Westinghouse in Pittsburgh to discuss SC design methodology.
23 rd Dec 2010	Letter WEC000457	8 pages of technical information in response to meeting of 30 th Nov 2010
30 th Dec 2010	Letter WEC000466	5 pages of technical information in response to meeting of 30 th Nov 2010
10 th Jan 2011	Letter WEC000469	71 pages of technical information in response to meeting of 30 th Nov 2010, plus 9 technical documents submitted.

Assessment Timeline for RI-AP1000-002		
Date	Item	Description
18 th Jan 2011	Letter WEC000481	Submittal of APP-CA20-S3C-002 Rev.4, CA20 Connection Design: Module Wall to Basemat APP-1000-T2R-027 Revision 0, Module Test Program Summary
26 th Jan 2011	Letter WEC000489	3 pages of technical information in response to Action 4.1 from meeting of 30 th Nov 2010
7 th Feb 2011	Letter WEC000498	2 pages of technical information in response to Action 12.1 from meeting of 30 th Nov 2010
1 st March 2011	Letter WEC000523	Submittal of APP-1000-T2R-027 Revision 1, Module Test Program Summary
June 2011	GDA Issues GI-AP1000-CE-01 and CE-02 raised	GI on outstanding items for CA Modules and ESB respectively.
June 2011	WEC Resolution Plans for GI-AP1000-CE-01 and CE-02	WEC plans for resolution of the GDA issues