

Office for Nuclear Regulation

An agency of HSE

Redgrave Court Merton Road Bootle Merseyside L20 7HS

Tel: 0151 951 4000 www.hse.gov.uk/nuclear

EDF AND AREVA UK EPR GENERIC DESIGN ASSESSMENT

GDA ISSUE

STRUCTURAL INTEGRITY – AVOIDANCE OF FRACTURE

GI-UKEPR-SI-01 REVISION 2

Technical Area		STRUCTURAL INTEGRITY	
Related Technical Areas		None	
GDA Issue Reference	GI-UKEPR-SI-01	GDA Issue Action Reference	GI-UKEPR-SI-01.A1
GDA Issue	Avoidance of Fracture - Margins Based on Size of Crack-Like Defects. Demonstration of defect tolerance and the absence of planar defects in the High Integrity Components (HICs) which requires integration of qualified non-destructive examinations during manufacture and analyses for limiting sizes of crack-like defects using conservative material fracture toughness properties.		
GDA Issue Action	Support assessment of the fracture analysis approach by providing adequate responses to any questions arising from assessment by ONR of documents submitted during GDA Step 4 but not reviewed in detail at that time. A number of fracture assessment reports arrived later in the Step 4 assessment timeframe than had been originally planned. As a result ONR has been unable to undertake a full assessment of all the fracture assessment reports within the timescales allowed for GDA Step 4, but has undertaken a high level review of the reports where a full assessment was not possible in order to gain confidence in the approach. This GDA Issue Action has been created to support the full assessment of the reports not yet fully assessed. EDF and AREVA should: <ul style="list-style-type: none">• Provide adequate responses to questions arising from the ONR assessment of reports relating to this subject submitted during GDA Step 4 but not yet fully assessed. With agreement from the Regulator this action may be completed by alternative means.		

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Technical Area		STRUCTURAL INTEGRITY	
Related Technical Areas		None	
GDA Issue Reference	GI-UKEPR-SI-01	GDA Issue Action Reference	GI-UKEPR-SI-01.A2
GDA Issue Action	<p>Provide an improved definition and evidence of capability of manufacturing inspection techniques for the austenitic and dissimilar metal welds. Provide more detail of the NDT methods proposed for certain components and provide additional evidence that these are likely to be capable of detecting defects smaller by some margin than the calculated limiting defect sizes (e.g. a target margin of 2). This evidence must include confirmation that the design of components facilitates an adequate inspection.</p> <p>A high level review of the latest proposals from EDF and AREVA has identified gaps in the evidence required. Although two alternative ultrasonic inspection techniques are proposed, EDF and AREVA should provide the following information for at least one of these options:</p> <ul style="list-style-type: none"> • Evidence that the ultrasonic beams selected are able to detect defects of structural concern including those in the planes of the weld fusion faces over their full extent; • Evidence that the design is such that there are no significant restrictions to inspection from features such as counterbores, changes of section thickness, tapered or curved surfaces, error of form etc; • Evidence that, when fully developed, the ultrasonic detection and characterisation procedures are likely to have adequate capability for the expected sizes of the defects to be qualified. • Adequate responses to questions arising from ONR assessment of documents relating to this subject whether submitted already or as a result of the Resolution Plan for this Action. <p>With agreement from the Regulator this action may be completed by alternative means.</p>		

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Related Technical Areas		None	
GDA Issue Reference	GI-UKEPR-SI-01	GDA Issue Action Reference	GI-UKEPR-SI-01.A3
GDA Issue Action	<p>Provide additional evidence of capability for the main steam line welds. Provide more detail of the NDT methods proposed for certain components and provide additional evidence that these are likely to be capable of detecting defects smaller by some margin than the calculated limiting defect sizes (e.g. a target margin of 2). This evidence must include confirmation that the design of components facilitates an adequate inspection.</p> <p>A high level review of the latest proposals from EDF and AREVA has identified gaps in the evidence required and as a result EDF and AREVA should provide:</p> <ul style="list-style-type: none"> • Confirmation that the weld preparation angles are such that near-specular reflection is achievable over the full height of all welds. • Evidence confirming that the effects of any potentially significant restrictions to inspection (tapered or curved surfaces, counterbores, error of form etc) are acceptable; • Evidence that, when fully developed, the ultrasonic detection and characterisation procedures are likely to have adequate capability for the expected sizes (4-5mm) of the defects to be qualified. • Adequate responses to questions arising from ONR assessment of documents relating to this subject whether submitted already or as a result of the Resolution Plan for this Action. <p>With agreement from the Regulator this action may be completed by alternative means.</p>		

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Technical Area		STRUCTURAL INTEGRITY	
Related Technical Areas		None	
GDA Issue Reference	GI-UKEPR-SI-01	GDA Issue Action Reference	GI-UKEPR-SI-01.A4
GDA Issue Action	<p>Provide an improved definition of techniques and evidence of capability for inspection of repair welds in RCP casings. Provide more detail of the NDT methods proposed for certain components and provide additional evidence that these are likely to be capable of detecting defects smaller by some margin than the calculated limiting defect sizes (e.g. a target margin of 2). This evidence must include confirmation that the design of components facilitates an adequate inspection.</p> <p>A high level review of the latest proposals from EDF and AREVA has identified gaps in the evidence required. Activities by EDF and AREVA should comprise:</p> <ul style="list-style-type: none">• Submission of the detailed results from the inspection trials on the mock-up.• Evidence that, in addition to minimising the risk of any welding defects, the design of excavations for weld repairs will also take account of the need for NDT and particularly the need to ensure that the ultrasonic beams selected can achieve favourable angles of incidence on the fusion faces.• Adequate responses to questions arising from ONR assessment of documents relating to this subject whether submitted already or as a result of the Resolution Plan for this Action. <p>With agreement from the Regulator this action may be completed by alternative means.</p>		

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Related Technical Areas		None	
GDA Issue Reference	GI-UKEPR-SI-01	GDA Issue Action Reference	GI-UKEPR-SI-01.A5
GDA Issue Action	<p>Provide evidence justifying the manufacturing inspections of the RCP flywheel and the principles of ISI. Provide more detail of the NDT methods proposed for certain components and provide additional evidence that these are likely to be capable of detecting defects smaller by some margin than the calculated limiting defect sizes (e.g. a target margin of 2). This evidence must include confirmation that the design of components facilitates an adequate inspection.</p> <p>A high level review of the latest proposals from EDF and AREVA has identified gaps in the evidence required. Activities by EDF and AREVA should comprise:</p> <ul style="list-style-type: none"> • Justification of the maximum overspeed used to derive the limiting defect size and an analysis of potential in-service initiation or growth. • Evidence that the manufacturing inspections adequately cover all plausible defects of concern: e.g. this should include evidence that ultrasonic inspection from the outer curved surface of the plates is not required, that the inspection holes do not require inspection during manufacture, and that the ultrasonic and penetrant inspections have the required capability. • Justification of any ISI proposed in comparison with that required by US NRC Reg. Guide 1.14. • Adequate responses to questions arising from ONR assessment of documents relating to this subject whether submitted already or as a result of the Resolution Plan for this Action. <p>With agreement from the Regulator this action may be completed by alternative means.</p>		

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Related Technical Areas		None	
GDA Issue Reference	GI-UKEPR-SI-01	GDA Issue Action Reference	GI-UKEPR-SI-01.A6
GDA Issue Action	<p>Provide additional evidence to support the technical justification of the prototype application. Provide more detail of the NDT methods proposed for certain components and provide additional evidence that these are likely to be capable of detecting defects smaller by some margin than the calculated limiting defect sizes (e.g. a target margin of 2). This evidence must include confirmation that the design of components facilitates an adequate inspection.</p> <p>EDF and AREVA should provide:</p> <ul style="list-style-type: none"> • An explanation of how the defects proposed in the test piece will take into account the 'worst case defects' and will be sufficient to test the weaknesses identified in the inspection procedure. • An explanation of how the effects of the cladding (e.g. anisotropy, uneven interface with parent material) on the inspection capability will be taken into account, • Quantification of the maximum surface profile variations (error of form) on the surfaces of the weld and cladding and justification of its acceptability. • Clarification of how surface profile variations (error of form) are controlled and checked. • Clarification of the capability likely to be achieved using the flow charts for defect characterisation. • Adequate responses to questions arising from ONR assessment of documents relating to this subject whether submitted already or as a result of the Resolution Plan for this Action. <p>With agreement from the Regulator this action may be completed by alternative means.</p>		

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Technical Area		STRUCTURAL INTEGRITY	
Related Technical Areas		None	
GDA Issue Reference	GI-UKEPR-SI-01	GDA Issue Action Reference	GI-UKEPR-SI-01.A7
GDA Issue Action	Provide additional evidence to confirm design and accessibility for in-service inspection (ISI). Provide more detail of the NDT methods proposed for certain components and provide additional evidence that these are likely to be capable of detecting defects smaller by some margin than the calculated limiting defect sizes (e.g. a target margin of 2). This evidence must include confirmation that the design of components facilitates an adequate inspection. EDF and AREVA should provide: <ul style="list-style-type: none">• A systematic review of the locations proposed for ISI to confirm that, as well as being physically accessible, the design of all the HIC pipework welds facilitates inspections likely to have the required capability and that there are no undue restrictions from any local design features such as counterbores or tapered surfaces.• Adequate responses to questions arising from ONR assessment of documents relating to this subject whether submitted already or as a result of the Resolution Plan for this Action. With agreement from the Regulator this action may be completed by alternative means.		