Office for Nuclear Regulation

An agency of HSE

Generic Design Assessment – New Civil Reactor Build

GDA Close-out for the EDF and AREVA UK EPR™ Reactor

GDA Issue GI-UKEPR-EE-01 Revision 0 – PCSR Presentation of Claims Arguments and Evidence

Assessment Report: ONR-GDA-AR-12-021
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EXECUTIVE SUMMARY

GDA Issue GI-UKEPR-EE-01 requires EDF and AREVA to provide a revised PCSR containing the requisite claims, arguments and evidence to substantiate the design of the plant electrical distribution system. The claims made for the electrical system were required to be related to the overall safety claims for the plant.

The EDF and AREVA response consists of a Claims, Arguments and Evidence (CAE) document which present a hierarchical structure of claims as follows:

- Top level claim: the electrical system supports the safety functions of the UK EPR™.
- High level claims: claims articulated in a way that provides a structure below the top level claim.
- Key claims: claims that directly support the high level claims. These claims are topic based and directly relate to the UK EPR™ safety case.
- Sub-claims: claims needed to support the key claims or to support the arguments behind the key claims or other sub-claims. References are made to relevant ONR Safety Assessment Principles (SAP) for each sub-claim. For each sub-claim the arguments underpinning it and evidence supporting each argument are given.

Relevant electrical sections of the PCSR have been modified for consistency with the Claims, Arguments and Evidence document.

I have carried out an assessment of the EDF and AREVA submission to consider the adequacy of the presentation of the electrical systems safety case and its compliance with the ONR Safety Assessment Principles.

Regular meetings have taken place between ONR and EDF and AREVA to clarify claims, arguments and supporting evidence. EDF and AREVA have provided satisfactory responses to Technical Queries raised in order to address issues arising from my assessment.

For a number of claims the full supporting evidence will only become available as a result of detailed design work which will be undertaken by the Licensee after site licensing. In these instances EDF and AREVA have demonstrated the methodology for resolution. New Assessment Findings have been raised covering the detailed design work to be carried out to provide final substantiation.

I have assessed the safety claims submitted in the CAE document based on the ONR SAPs and consider that the claims represent a sound basis for the demonstration of the safety of the UK EPR™ design. I have assessed the evidence presented and find that it supports the safety claims and arguments.

Our work on the electrical engineering safety case together with our work on the fault studies GI-UKEPR-FS-05, fuel route GI-UKEPR-FS-03 and cross cutting issue GI-UKEPR-CC-01 has resulted in:

- The upgrading of the classification of the Ultimate Diesel Generators (UDG) from safety class 3 to safety class 2.
- The upgrading of critical parts of the electrical earth system to safety class 1.
- Inserting a deterministic requirement as a part of the fundamental UK EPR™ design that at least one of the Emergency Diesel Generators (EDG) will survive the

combined fault of Loss of Offsite Power (LOOP) and subsequent total load connection because of spurious failure of the reactor's control systems.

Overall, I conclude the documentation submitted by EDF and AREVA provides the requisite claims, arguments and evidence to substantiate the design of the plant electrical distribution system. This is satisfactory and sufficient for closing the GDA Issue.

LIST OF ABBREVIATIONS

ALARP	As low as is reasonably practicable
CAE	Claims Arguments and Evidence
CMF	Change Management Form
DAC	Design Acceptance Confirmation
EDF and AREVA	Electricité de France SA and AREVA NP SAS
EDG	Emergency Diesel Generator
EQT	Local Equipotential Bond
GDA	Generic Design Assessment
GIC	Geomagnetically Induced Current
HSE	Health and Safety Executive
HV	High Voltage
IAEA	International Atomic Energy Agency
LGN	Local Ground Network
LOOP	Loss of Offsite Power
LV	Low Voltage
ONR	Office for Nuclear Regulation (an agency of HSE)
OTS	Operating Technical Specification
PAS	Process Automation System
PSA	Probabilistic Safety Assessment
PCSR	Pre-construction Safety Report
SAP	Safety Assessment Principle(s) (HSE)
SAS	Safety Automation System
SSC	Structures Systems and Components
TAG	Technical Assessment Guide(s) (ONR)
TQ	Technical Query
WENRA	Western European Nuclear Regulators' Association
UDG	Ultimate Diesel Generator

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1 INTRODUCTION

1.1 BACKGROUND

1 This report presents the close-out of the Office for Nuclear Regulation's (an agency of HSE) Generic Design Assessment (GDA) within the area of Electrical Systems. More specifically it addresses the electrical GDA Issue **GI-UKEPR-EE-01** Revision 1 and associated GDA Issue Actions (Ref. 6) generated as a result of the GDA Step 4 Electrical Systems Assessment of the UK EPR™ (Ref. 7). My assessment has focussed on the deliverables identified within the EDF and AREVA Resolution Plan (Ref. 8) published in response to the electrical systems GDA Issue and on further assessment undertaken of those deliverables.

2 GDA followed a step-wise-approach in a claims, argument and evidence hierarchy. In Step 2 the claims made by EDF and AREVA were examined and in Step 3 the arguments that underpin those claims were examined. The Step 4 assessment reviewed the safety aspects of the UK EPR™ reactor in greater detail, by examining the evidence, supporting the claims and arguments made in the safety documentation.

3 My Step 4 Electrical Systems Assessment identified a GDA Issue and a number of Assessment Findings as part of my assessment of the evidence associated with the UK EPR™ reactor design. A GDA Issue is an observation of particular significance that requires resolution before the Office for Nuclear Regulation (ONR), an agency of HSE, would agree to the commencement of nuclear safety related construction of the UK EPR™ within the UK. An Assessment Finding results from a lack of detailed information (which cannot be provided until the more detailed site specific design phase) which has limited the extent of assessment and as a result the information is required to underpin the assessment. However, these Assessment Findings are to be carried forward as part of normal regulatory business.

4 The overall Step 4 Assessment concluded that the UK EPR™ reactor was suitable for construction in the UK subject to resolution of 31 GDA Issues. The purpose of this report is to provide the assessment which underpins the judgement made in closing GDA Issue **GI-UKEPR-EE-01**.

1.2 SCOPE

5 This report presents only the assessment undertaken to resolve GDA Issue **GI-UKEPR-EE-01** and it is recommended that this report be read in conjunction with the Step 4 Electrical Systems Assessment of the EDF and AREVA UK EPR™ (Ref. 7) in order to gain an appreciation of the totality of the assessment of the evidence undertaken as part of the GDA process.

6 This assessment report is not intended to revisit those aspects of assessment already undertaken and confirmed as being adequate during previous stages of the GDA. However, should evidence from the assessment of EDF and AREVA's responses to GDA Issues highlight shortfalls not previously identified during Step 4, there will be a need for these aspects of the assessment to be highlighted and addressed as part of the close-out phase or be identified as Assessment Findings to be taken forward to the site specific phase.

7 Further Assessment Findings have been generated as a result of my assessment where resolution of GDA Issues have left aspects of the assessment requiring further detailed evidence when the information becomes available at a later stage.

8 GDA Issue **GI-UKEPR-EE-01** (Ref.6) has been addressed by EDF and AREVA by the production of a Claims, Arguments and Evidence (CAE) Document and by amendments to Chapter 8 of the PCSR. The CAE document addresses electrical requirements from cross cutting GDA Issues **GI-UKEPR-CC-01** (Ref. 27) and **GI-UKEPR-CC-03** (Ref. 28) and Fault Studies GDA Issue **GI-UKEPR-FS-05** (Ref. 30).

1.3 METHODOLOGY

9 The methodology applied to this assessment is identical to the approach taken during Step 4 which followed the ONR HOW2 document PI/FWD, "Permissioning – Purpose and Scope of Permissioning" (Ref. 1), in relation to mechanics of assessment within ONR.

10 My assessment focussed primarily on the submissions relating to resolution of the GDA Issue as well as any further requests for information or justification derived from assessment of those specific deliverables.

11 The aim of this assessment is to provide a comprehensive assessment of the submissions provided in response to the GDA Issue to enable ONR to gain confidence that the concerns raised have been resolved sufficiently so that they can either be closed or, for lesser safety significant aspects be carried forward as Assessment Findings.

1.4 STRUCTURE

12 This Assessment Report structure differs slightly from the structure adopted for the previous reports produced within GDA, most notably the Step 4 Electrical Systems Assessment. My report has been structured to reflect the assessment of the individual GDA Issue rather than a report detailing the whole of the electrical systems technical area.

13 The reasoning behind adopting this report structure is to allow closure of GDA Issues as the work is completed rather than having to wait for the completion of all the GDA work in other technical areas.

2 ONR'S ASSESSMENT STRATEGY FOR ELECTRICAL SYSTEMS

14 My assessment strategy for GDA Close-out for the Electrical Systems topic area was set out in an assessment plan (Ref. 32) that identified the intended scope of the assessment and the standards and criteria that would be applied.

15 The overall basis for the assessment of the GDA Issue are the Electrical Systems elements of:

- Submissions made to ONR in accordance with the resolution plan.
- Update to the Pre-construction Safety Report (PCSR) and its supporting documentation.
- The Design Reference that relates to the submission and PCSR as set out in UK EPR™ GDA Project Instruction UKEPR-I-002 (Ref. 9) which will be updated throughout GDA Issue resolution. This includes Change Management Forms (CMF),.
- Design change submissions – proposed by EDF and AREVA and submitted in accordance with UK-EPR GDA Project Instruction UKEPR-I-003 (Ref. 10).

2.1 The Approach to Assessment for GDA Close-out

16 My approach to closure of electrical systems GDA Issue involved assessment of submissions made by EDF and AREVA in response to GDA Issues identified through the GDA process. These submissions are detailed within the EDF and AREVA resolution plans for each of the GDA Issues. In the event of requiring further supporting evidence for the assessment, Technical Queries (TQ) have been generated. When requests for further information through production of the aforementioned TQs did not adequately resolve the GDA Issue, formal notification in the form of a letter detailing the shortfall(s) in ONR expectations was sent to EDF and AREVA.

17 The objective of the Electrical Systems assessment has been to assess submissions made by EDF and AREVA in response to the GDA Issue identified and, if judged acceptable, clear the GDA Issue.

2.2 Standards and Criteria

18 The relevant standards and criteria adopted within this assessment are principally the Safety Assessment Principles (SAP), internal ONR Technical Assessment Guides (TAG), relevant national and international standards and relevant good practice informed from existing practices adopted on UK nuclear licensed sites. The key SAPs and relevant TAGs have been detailed within this section. National and international standards and guidance have been referenced where appropriate within this assessment report. Relevant good practice, where applicable, has also been cited within the body of the assessment.

2.3 Safety Assessment Principles

19 The key SAPs applied within the Electrical Systems assessment of the EDF and AREVA UK EPR™ are included within Table 3 of this report.

2.3.1 Technical Assessment Guides

20 The following Technical Assessment Guide has been used as part of this assessment (Ref. 3):

- T/AST/019 Essential Services

2.3.2 National and International Standards and Guidance

21 The following international standards and guidance have been used as part of this assessment (Refs 4, 5):

- Western European Nuclear Regulators' Association. Reactor Harmonization Group. WENRA Reactor Reference Safety Levels. WENRA. January 2008.
- Safety of Nuclear Power Plants: Design. Safety Requirements. International Atomic Energy Agency (IAEA). Safety Standards Series No. NS-R-1. IAEA. Vienna. 2000.

2.4 Use of Technical Support Contractors

22 No Technical Support Contractors have been used during this assessment.

2.5 Out-of-scope Items

23 The following items have been agreed with EDF and AREVA as being outside the scope of GDA:

- Detailed design and specification of electrical equipment.
- Detailed verification of electrical transient analysis based on site specific installation.
- Detailed verification of the robustness of the Electrical System to withstand fast transient disturbances.
- Detailed verification of the Electrical System to withstand ferro-resonant phenomena in the internal network.
- High Voltage (HV) and Low Voltage (LV) systems protection coordination.
- Grid connections and coordination with grid protection systems.

3 EDF AND AREVA DELIVERABLES IN RESPONSE TO THE GDA ISSUE

24 The information provided by EDF and AREVA in response to this GDA Issue, as detailed within their Resolution Plan (Ref. 8), was broken down into the component GDA Issue Actions and then further broken down into specific deliverables for detailed assessment:

Table 1: Deliverables for detailed assessment

GDA Issue Action	Technical Area	Deliverable	Ref.
A1	Electrical Systems	UKEPR GDA Electrical System CAE Document: 17074-709-000-RPT-0002	Ref.17
A1	Electrical Systems	PCSR Sub Chapter 8.1 – External Power Supply: UKEPR-0002-081	Ref.18
A1	Electrical Systems	PCSR Sub Chapter 8.2 - Power Supply to the Conventional Island and Balance of Plant: UKEPR-0002-082	Ref.19
A1	Electrical Systems	PCSR Sub Chapter 8.3 – Nuclear Island Power Supply: UKEPR-0002-083	Ref.20
A1	Electrical Systems	PCSR Sub Chapter 8.4 – Specific Design Principles: UKEPR-0002-084	Ref.21
A1	Electrical Systems	PCSR Sub Chapter 8.5 – Installation: UKEPR-0002-085	Ref.22
A1	Electrical Systems	PCSR Sub Chapter 8.6 – Prevention and Protection against Common Cause Failure: UKEPR-0002-086	Ref.23

25 An overview of each of the deliverables is provided within this section. It is important to note that this information is supplementary to the information provided within the November 2009 PCSR (Ref. 11) which has already been subject to assessment during Step 4 of GDA. In addition, it is important to note that the deliverables are not intended to provide the complete safety case for the Electrical Systems. Rather they form further detailed arguments and evidence to supplement those already provided during earlier steps within the GDA Process.

3.1 UK EPR GDA Electrical System CAE Document

26 This document provides a mechanism for presenting the claims in the safety case related to the electrical system whilst retaining consistency of approach and structure between Chapter 8 and the other chapters of the PCSR. The safety claims are identified together with the arguments and evidence to support these claims.

3.2 PCSR Sub Chapter 8.1 – External Power Supply

27 This has been updated for consistency with the electrical system CAE document.

3.3 PCSR Sub Chapter 8.2 – Power Supply to the Conventional Island and Balance of Plant

28 This has been updated for consistency with the electrical system CAE document.

3.4 PCSR Sub Chapter 8.3 – Nuclear Island Power Supply

29 This has been updated for consistency with the electrical system CAE document.

3.5 PCSR Sub Chapter 8.4 – Specific Design Principles

30 This has been updated for consistency with the electrical system CAE document.

3.6 PCSR Sub Chapter 8.5 – Installation

31 This has been updated for consistency with the electrical system CAE document.

3.7 PCSR Sub Chapter 8.6 – Prevention and Protection against Common Cause Failure

32 This has been restructured and new material has been added to the sections on Human Factors and Availability.

4 ONR ASSESSMENT

33 Further to the assessment work undertaken during GDA Step 4 (Ref. 7), and the resulting GDA Issue **GI-UKEPR-EE-01** (Ref. 6), this assessment has been focussed on the provision of a revised PCSR containing the requisite claims, arguments and evidence to substantiate the design of the plant electrical distribution system. EDF and AREVA have provided a CAE (Ref. 17) document to support the PCSR in order to substantiate the design. Identified deliverables intended to provide the requisite evidence were provided within the responses contained within the Resolution Plan (Ref. 8) provided by EDF and AREVA at the end of Step 4 of GDA.

34 This assessment has been carried out in accordance with the ONR HOW2 document PI/FWD, "Permissioning – Purpose and Scope of Permissioning" (Ref. 1).

4.1 Scope of Assessment Undertaken

35 The scope of the assessment has been to consider the expectations detailed in the GDA Issue, **GI-UKEPR-EE-01**, and the associated GDA Issue Actions. These are detailed within Annex 3 of this report.

36 The scope of this assessment has been to consider whether the submissions provide a rigorous justification for the completeness of the electrical power distribution system to perform its safety role by establishing the claims, arguments and evidence chain of reasoning.

4.2 Assessment of Safety Case

37 GDA Issue **GI-UKEPR-EE-01** (Ref. 6) requires the PCSR to incorporate a structure of claims, arguments and evidence to demonstrate that the electrical system fully meets the requirements of its safety role as specified in the other chapters of the PCSR. The ONR expectations for the PCSR are expressed as the following:

- The PCSR needs to provide a clear justification of the safety of the UK EPR™ electrical distribution system.
- The safety claims made need to be clear and unambiguous.
- The arguments and evidence presented in support of the safety claims are well presented. In particular, evidence should be based on documents that are produced during GDA, not on documents to be produced during the site specific phase.

4.2.1 CAE Submission

38 EDF and AREVA have presented the safety case in a CAE (Ref. 17) document which references existing PCSR sections. This presents a hierarchical structure of claims as follows:

- Top level claim: the electrical system supports the safety functions of the UK EPR™.
- High level claims: claims articulated in a way that provides a structure below the Top Level Claim.
- Key claims: claims that directly support the high level claims. These claims are topic based and directly relate to the UK EPR™ safety case.

- Sub-claims: claims needed to support the key claims or to support the arguments behind the key claims or other sub-claims. References are made to relevant ONR Safety Assessment Principles (SAP) (Ref. 2) for each sub-claim. For each sub-claim the arguments underpinning the sub-claim and evidence supporting each argument are given.

39 The CAE document is presented in a structured format with safety claims supported by arguments and references provided to the design evidence to support the claims. Where available, evidence in support of each claim and argument is referenced to documents submitted for GDA. In the instances where the evidence will only become available as the result of detail design activities by the Licensee during the site specific phase this is clearly referenced as a future document.

40 Sections of the PCSR have been updated as necessary for consistency with the CAE document.

4.2.2 ONR Assessment of CAE Submission

41 I have assessed the safety claims submitted in the CAE document against the ONR SAPs and consider that the claims represent a sound basis for the demonstration of the safety role of the electrical systems in the EPR design. The hierarchical structure used is clear and unambiguous.

42 I have assessed the arguments and evidence presented in support of the safety claims and I consider the presentation to be structured to adequately support the safety claims. I have assessed the evidence presented and find that it supports the safety claims and arguments.

43 My assessment of the presentation of the electrical systems safety case in the format of CAE Tables is that the ONR expectations for the presentation of the safety case are met. This is based on the hierarchical structure of claims being clear and unambiguous supported by arguments and evidence to provide a justification of the safety role of the UK EPR™ electrical system.

4.3 Technical Issues arising from Assessment

44 The presentation of the safety case in the CAE format has identified a number of technical matters to be resolved. In all cases EDF and AREVA have been able to either resolve the issues by the submission of appropriate documentation or they have been able to demonstrate an acceptable methodology for resolution. The implementations of these methodologies are the subjects of Assessment Findings for final resolution by the Licensee during the site specific phase.

45 The significant technical areas which have been addressed are described below.

4.3.1 Load Shedding During EDG Operation

46 In the event of loss of external AC supplies automatic load disconnection is carried out. The Emergency Diesel Generators (EDG) automatically start followed by sequential release of load shedding commands to enable the EDGs to supply the essential plant loads. The withstand capability of the Class 1 EDG system against common cause failure in the event of sudden connection of all loads under the control of the Process Automation

System (PAS) and Safety Automation System (SAS) have been demonstrated by EDF and AREVA in the following documents:

- EDF and AREVA response to TQ-EPR-1617 (Ref. 13).
- EDF Document ECEEL 120851 (Ref. 24).

47 In normal operation, in the case of a Loss of Offsite Power (LOOP) each of the four EDGs will supply the loads in its own division. When an EDG is taken out of service for maintenance the loads required by the OTS (Operating Technical Specification) in that division are connected to the twin division via cross connections. In case of LOOP the EDG of the twin division will supply the cross connected loads in addition to the loads of its division

48 EDF and AREVA have undertaken assessments of the simultaneous connection of all loads with the following scenarios:

- Normal mode with no maintenance cross-connections.
- Maintenance mode with only one generator out of service and cross-connections from the twin divisions in place to maintain supplies. The other two divisions remain independent.

49 EDF and AREVA conclude that in normal mode with all generators operating the sudden connection of loads will not result in the trip of any EDG. In maintenance mode with one EDG out of service at least one EDG will always remain in operation.

50 I have observed that the calculations to demonstrate the capability of the EDGs to withstand the sudden connection of loads are based on the anticipated EDG ratings of 9.3 MW for Hinkley Point C rather than the ratings of 7.5 MW for the design basis FA3 Flamanville plant. Assessment Finding **AF-UKEPR-EE-21** requires the Licensee to carry out studies to determine the diesel rating to meet worst case plant starting and running loads.

51 My assessment is that the methodology demonstrated by EDF and AREVA is acceptable as this ensures that the EDGs have the capability to withstand the sudden connection of all loads that can be connected to the EDG-based supplies by both the SAS and PAS. The ratings of the EDGs will require validation by the Licensee to demonstrate their capability to withstand the sudden connection of all loads based on actual site loadings and actual EDG ratings. I have raised Assessment Finding **AF-UKEPR-EE-21** requiring the Licensee to demonstrate that the EDG is capable of surviving the overload caused by the sudden connection of all loads under the control of the PAS and SAS and maintaining supplies in at least one division.

4.3.2 Classification of Electrical Equipment

52 In response to electrical GDA Issue **GI-UKEPR-EE-01** and Cross Cutting GDA Issue **GI-UKEPR-CC-01** (Ref. 27) EDF and AREVA have reviewed the classification of the electrical system and have reclassified certain parts of this system.

53 The following revised classifications have been incorporated in the safety claims in the CAE document by EDF and AREVA:

- The Ultimate Diesel Generators (UDG) and associated distribution system have been reclassified from Class 3 to Class 2.

- The contribution to plant safety of the earthing system has been assessed and classifications have been assigned as Table 2. Other parts of the earthing system which provide functional safety are not classified.

54 I am satisfied that the revised classifications are in accordance with the safety role of the electrical system as specified in other chapters of the PCSR.

55 I consider that the classifications applied to the earthing system are appropriate for the safety role of the system. I have raised Assessment Finding **AF-UKEPR-EE-23** for the Licensee to determine the detail design requirements to comply with the earthing system classification.

56 I consider that the classification of the UDG and its distribution system is appropriate for its function. I have raised Assessment Finding AF-UKEPR-EE-24 requiring implementation of the re-classification of the UDG and associated distribution equipment.

Table 2: Earthing System Classifications

Class	Individual System	Primary Role
1	Local Ground Networks (LGN). Local Equipotential Bonds (EQT)/ LGN.	Provide support to safety functions. Guarantee equipotentiality of C&I systems supporting Category A or B safety functions and exchanging A and B data.
2	Between metallic cabinet bonds. Bonds between metallic cable trays and cabinets.	Complementary means to achieve Category A. Guarantee equipotentiality of C&I system.
3	Faraday Cage. Down Conductors. Other non electrical equipment and earthing at building entry.	Prevent malfunction of safety functions in case of external hazards. Guide and divide lightning current passively. Minimise overvoltages below equipment immunity levels.

4.3.3 Connection of Non Classified Equipment to Classified Switchboards

57 ONR requested confirmation in TQ–EPR-1617 (Ref. 13) that no non-classified loads would be connected to safety grade electrical power supply systems. EDF and AREVA responded that the UK EPR™ design incorporates non-classified equipment required for investment protection which is supplied from the EDG sourced distribution system. This enables the investment protection loads to be supported by the EDGs.

58 The justification by EDF and AREVA for the connection of non classified loads to the EDG fed switchboards is presented in the following EDF documents:

- EDF document ECEEL 120873 (Ref.25).
- EDF document ECEEL 120814 (Ref.26).

59 EDF document ECEEL 120873 demonstrates that the load requirements for the investment protection loads are a small proportion of the total capacity of the EDGs, that these loads do not affect the capability of the EDGs to be able to support the classified loads under all operating conditions and that adequate margins are maintained under all loading conditions.

60 EDF document ECEEL 120814 considers the implications of providing alternative means to the use of EDGs for supplying the investment protection loads. This considers a number of alternative options for supplying the loads and demonstrates that all the options considered have significant design and cost implications on the EPR design. The document concludes that the additional complexity and design constraints associated with the alternative solutions would introduce cost and time penalties which would far outweigh the benefits.

61 I conclude that the case presented in the EDF documents for investment protection loads to be connected to the Class 1 EDG-based distribution system is justified on an as low as reasonably practicable (ALARP) basis as the costs involved with establishing a separate investment protection distribution system are grossly disproportionate. This, however, has the disadvantage of increasing the complexity of the electrical distribution system and therefore potentially introducing new failure modes. The implementation of this design will require that the means of isolating the non-classified equipment connected to the classified electrical distribution system must be designed to the same classification as the source switchboard. This principle is also applied where equipment of lower classification is connected to a higher classification switchboard. This will ensure that there is no potential for a fault on equipment of a lower classification causing loss of service to the higher classification equipment. I have raised Assessment Finding **AF-UKEPR-EE-22** for the licensee to demonstrate that the means of isolating all equipment of a class lower than the source switchboard is designed in accordance with the highest classified load connected to the switchboard.

62 I have also raised Assessment Finding **AF-UKEPR-EE-28** which requires the Licensee to substantiate the ALARP case for connecting non-classified equipment to the classified electrical distribution system to be verified based on the detailed design and actual equipment ratings.

4.3.4 Loss of a Voltage Level across Electrical Divisions

63 GDA Issue **GI-UKEPR-FS-05** (Ref. 30) required EDF and AREVA to provide a design base analysis of failures in the essential support systems. For the electrical systems this requires consideration to be given to the loss of a complete voltage level across all four divisions.

64 A deterministic sensitivity study by EDF and AREVA identified potentially severe consequences to the plant of postulated loss of the 690V emergency supply from the switchboards with designation LJ and the 400V uninterruptible supply from the switchboards designated LV.

65 As a result of the sensitivity study a detailed approach was adopted by EDF and AREVA for the initiating events of loss of 690V LJ switchboards and loss of 400V LV switchboards. This approach was based on:

- Identification of SSC/Safety Functions used in normal operation and impacted by the initiating event.
- Presentation of proposed design modifications to cope with the fault.
- Identification of required and available mitigation safety features/SSCs.
- Proposed mitigation strategy taking into account the proposed design changes.

66 The results of this assessment are covered in the following documents:

- EDF Document ECECS 121567 (Ref. 29)
- EDF Document ECESN 121088 (Ref. 31)

67 The detailed assessment determined design changes which included changing the operating voltage of some 690V equipment to 400V and transferring the supplies to appropriate 400V switchboards.

68 For the 400V system EDF and AREVA identified that a common cause failure of the LV switchboards would result in a loss of control of a large number of safety critical plant actuators which would result in a severe accident.

69 EDF and AREVA have proposed a design change to modify sixteen key plant actuators to operate from the 220V DC system so that they can be powered by other switchboards which provide a diverse source of supply. The claimed failure frequency of the remaining loads on the 400V uninterruptible power supply is $7.8x10^{-7}$ per year. I have assessed this claim against SAP EDR 3 which places a limit on any single technology of $1x10^{-5}$ per year unless a strong case can be by the duty holder for better figures. Due consideration has been given within ONR as to whether an acceptable case can be made for a failure frequency of $7.8x10^{-7}$ per year. We have determined that the following actions will be required from the Licensee as part of the case for acceptance of a failure frequency of $7.8x10^{-7}$ per year:

- The detailed design of the main switchboards, cables and supporting technology demonstrates that the system is simple and very robust.
- An ALARP analysis is undertaken by the Licensee at an early stage of detailed design to judge whether it is reasonably practicable to provide a diverse manufacturer of equipment for two out of the four trains.
- The detailed design analysis should show that sustained damage to the downstream switchboards from a major failure of the invertors which renders them unable to function can be ruled out deterministically.
- Through life support is at a level commensurate with the very high integrity required of the system.

70 I have raised Assessment Finding **AF-UKEPR-EE-25** which requires the Licensee to carry out the above actions in support of the substantiation of the design to comply with the requirements of SAP EDR 3.

71 Implementation of the changes to the electrical supply system will require changes to the power loadings on some switchboards. I have raised Assessment Finding **AF-UKEPR-EE-29** requiring the Licensee to assess the changes to the electrical system from the reallocation of loads and confirm that these changes can be accommodated within the plant layout.

4.3.5 Geomagnetically Induced Currents

72 The EDF and AREVA CAE document (Ref. 17) makes the claim that arrangements are made for addressing the effects of Geomagnetically Induced Currents (GIC) on the electrical system. The evidence for this claim is that GIC will be addressed in an update of PCSR Chapter 13.1. I have raised Assessment Finding **AF-UKEPR-EE-26** for the Licensee to consider and take appropriate measures to protect against the influence of GIC and other space weather related effects.

4.3.6 Starting of Diesel Generators

73 The EDF and AREVA CAE document (Ref. 17) has provided clear claims supported by arguments and evidence that in order to supply the electrical distribution system following loss of all electrical supplies the EDGs and UDGs can be started without any external source of electrical power from the grid or 12 hour or 2 hour batteries. In addition it is claimed that circuit breakers which connect the diesel generators to the plant electrical distribution network have the facility for manual closing with no requirement for electrical supplies. This demonstrates the capability to re-power the electrical system following loss of all electrical supplies.

4.3.7 Identification of Requirements for Support of operating staff action

74 The EDF and AREVA CAE document addresses the high level claim that the electrical system supports the operators in fulfilling their safety role. A series of claims are provided supported by arguments and evidence which cover the operator interface, human factors and procedures. The claims are high level in providing a structure for development by the Licensee of these areas during the detail design of the plant. I consider that this provides a sound structure for the development of detailed designs and procedures covering operator support.

4.3.8 Identification of Requirements for Through Life Activities

75 The EDF and AREVA CAE document addresses the high level claim that the electrical system will continue to meet its functional safety requirements throughout its operational life. A series of claims are provided supported by arguments and evidence which cover reliability and availability, in service management and periodic testing. The claims are high level in providing a structure for development by the Licensee of these areas during the detail design of the plant. I consider that this provides a sound structure for the development of detailed designs and procedures covering through life activities.

4.3.9 Loss of Offsite Power

76 The EDF and AREVA CAE document presents generic claims from the Probabilistic Safety Assessment (PSA) model for LOOP. The PSA figures used for LOOP are generic and require further development to take account of specific site grid connections. The PSA model of the electrical system will have to be developed from specific site data and in conjunction with National Grid.

77 TQ-EPR-1617 (Ref. 16) was raised requesting EDF and AREVA to carry out a PSA sensitivity study for LOOP for 24-192 hours and for greater than 192 hours in order to summarise the impact on core damage frequency. The results of study for the 24-192 hour period were provided but it was not considered possible to investigate the sensitivity to the maximum LOOP duration greater than 192 hours with the current GDA PSA model. The sensitivity studies should be repeated with a site specific PSA model, including examining the situation where the grid is assumed not to be present following a reactor trip. I have raised Assessment Finding **AF-UKEPR-EE-30** which requires the Licensee to perform the sensitivity study for a LOOP of greater than 192 hours.

78 I have raised Assessment Finding **AF-UKEPR-EE-31** which requires the PSA model of the electrical system to be developed by the Licensee based on the specific site data from detailed design.

4.3.10 Actions arising from the Fukushima Event

79 Cross cutting GDA Issue **GI-UKEPR-CC-03** (Ref. 28) requires EDF and AREVA to consider and action plans to address the lessons learnt from the Fukushima event. The resolution of this GDA Issue will involve the provision of electrical facilities to address loss of power due to extreme beyond design basis events. These additional provisions have not been considered in the CAE document submitted for resolution of **GI-UKEPR-EE-01**. However, as they are addressing beyond design basis events they do not affect the safety case presented in the CAE document.

80 I have raised Assessment Finding **AF-UKEPR-EE-27** which requires the Licensee to implement the recommendations from the resolution of cross cutting GDA Issue **GI-UKEPR-CC-03** in the detailed design of the plant.

5 ASSESSMENT CONCLUSIONS

5.1 Overall Conclusions

81 EDF and AREVA have addressed the GDA Issue by providing a CAE document (Ref. 17) and by updating of Chapter 8 of the PCSR (Refs.18-23) to achieve consistency with the CAE document. I have assessed the submission in accordance with the ONR Safety Assessment Principles. I also have assessed the submissions to consider the relationship to the overall safety claims of the plant and issues arising from cross cutting GDA Issues.

82 Technical issues which have arisen have been addressed by EDF and AREVA so that acceptable methodologies to achieve resolution have been provided in all instances. Where more detailed evidence is required to substantiate the design this is covered by Assessment Findings.

83 For a number of claims the supporting evidence will only become available as a result of detailed design work which will be undertaken by the Licensee. New Assessment Findings have been raised to require this work to be carried out to provide the evidence to substantiate the claims.

84 I conclude that EDF and Areva have provided the requisite claims arguments and evidence to substantiate the design of the electrical distribution system and recommend that the GDA Issue can be closed.

6 ASSESSMENT FINDINGS

6.1 Additional Assessment Findings

85 The following Assessment Findings additional to Step 4 have been raised:

AF-UKEPR-EE-21: The Licensee should demonstrate that the Class 1 EDG based system is adequately sized to meet the following criteria:

Capable of starting and supporting all Class 1 loads under all operating conditions.

Capable of surviving the overload caused by the sudden connection of all loads under the control of the PAS and SAS (both failing simultaneously) and maintaining loads in at least one division.

Required timescale: *Long Lead items and SSC procurement specifications.*

AF-UKEPR-EE-22: *The Licensee* should *demonstrate that all feeders connected to switchboards with a higher classification than the loads being supplied from the feeder* should *be isolated by a device meeting the requirements of the highest classification of load being supplied by that switchboard.*

Required timescale: *Long Lead items and SSC procurement specifications.*

AF-UKEPR-EE-23: *The Licensee* should *determine the detail design requirements required to comply with the earthing system classification.*

Required timescale: *Nuclear Island safety related concrete.*

AF-UKEPR-EE-24: *The Licensee* should *implement the reclassification from Class 3 to Class 2 of the Ultimate Diesel Generators (UDG) and associated distribution equipment.*

Required timescale: *Long Lead items and SSC procurement specifications.*

AF-UKEPR-EE-25: *The Licensee* should *demonstrate the suitability of the design of the 400V uninterruptible power supply to protect against common cause failure. The following actions are required in support of the design substantiation:*

:

- *Demonstrate that the detailed design of the main switchboards, cables and supporting technology is simple and robust.*
- *Undertake an ALARP analysis to establish whether it is reasonably practicable to provide a diverse manufacturer of equipment for two of the four trains.*

- *Carry out a design analysis to show deterministically that sustained damage to the downstream switchboards from a major failure of the invertors can be ruled out.*
- *Through life support is at a level commensurate with the very high integrity required of the system.*

Required timescale: *Long Lead items and SSC procurement specifications.*

AF-UKEPR-EE-26: *The licensee* should *make arrangements to address the influence of Geomagnetically Induced Currents (GIC) and other space weather related effects.*

Required timescale: *Long Lead items and SSC procurement specifications.*

AF-UKEPR-EE-27: *The Licensee* should *implement the recommendations from the resolution of cross cutting GDA Issue GI-UKEPR-CC-03 in the detailed design of the plant.*

Required timescale: *Long Lead items and SSC procurement specifications.*

AF-UKEPR-EE-28: *The Licensee* should *substantiate the case for connecting non-classified equipment to classified systems based on actual equipment ratings.*

Required timescale: *Long Lead items and SSC procurement specifications.*

AF-UKEPR-EE-29: *The Licensee* should *assess the changes to the electrical system from the reallocation of loads in response to GDA Issue GI-UKEPR-FS-05 and confirm that these changes can be accommodated within the plant layout.*

Required timescale: *Nuclear island safety related concrete.*

AF-UKEPR-EE-30 *The Licensee should perform sensitivity studies for Loss of Offsite Power (LOOP). This should include sensitivity studies to the frequencies of all defined LOOP durations and a sensitivity study to the assumed maximum period of the LOOP, assuming LOOP for significantly greater than 192 hours, but taking where necessary appropriate account of repair and recovery actions (where likely to be supported by documented procedures). This should identify the dominating contributions to the risk, any system vulnerabilities and any differences in the insights when compared with the base cases, and should be used as part of demonstrating a balanced design, without over-reliance on external sources of power, to demonstrate that the proposed design is ALARP.To risk inform the development of the design using PSA an iterative approach should be used. A preliminary study should be developed to support electrical design activities including the preparation of equipment purchase specifications.*

Required timescale: *Nuclear island safety related concrete.*

AF-UKEPR-EE-31 *The Licensee should develop the PSA model to reflect the design and operation, and provide an adequate representation of the electrical system reflecting the design and operation based on site specific data and features. To risk inform the development of the design using PSA an iterative approach should be used. A preliminary study should be developed to support electrical design activities including the preparation of equipment purchase specifications.*

Required timescale *Delivery to site of SSCs..*

6.1.1 Impacted Step 4 Assessment Findings

86 There are no impacts from this close out report on any of the Step 4 Assessment Findings

7 REFERENCES

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16 *EDF and AREVA UK EPR™ - Schedule of Technical Queries Raised during GDA Close-out.* Office for Nuclear Regulation. TRIM Ref. 2011/389411.

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Table 3

Relevant Safety Assessment Principles Considered for Close-out of GI-UKEPR-EE-01 Rev 0

SAP No.	SAP Title	Description
EQU.1	Qualification Procedures	Qualification procedures should be in place to confirm that structures, systems and components that are important to safety will perform their required safety function(s) throughout their operational lives
EDR.1	Failure to safety	Due account should be taken of the need for structures, systems and components important to safety to be designed to be inherently safe or to fail in a safe manner and potential failure modes should be identified, using a formal analysis where appropriate
EDR.2	Redundancy, diversity and segregation	Redundancy, diversity and segregation should be incorporated as appropriate within the designs of structures, systems and components important to safety
EDR.3	Common cause failure	Common cause failure (CCF) should be explicitly addressed where a structure, system or component important to safety employs redundant or diverse components, measurements or actions to provide high reliability
EDR.4	Single failure criterion	During any normally permissible state of plant availability no single random failure, assumed to occur anywhere within the systems provided to secure a safety function, should prevent the performance of that safety function.
ERL.2	Measures to achieve reliability	The measures whereby the claimed reliability of systems and components will be achieved in practice should be stated
ERL.4	Margins of conservatism	Where multiple safety-related systems and/or other means are claimed to reduce the frequency of a fault sequence, the reduction in frequency should have a margin of conservatism with allowance for uncertainties.
EMT.1	Identification of requirements	Safety requirements for in-service testing, inspection and other maintenance procedures and frequencies should be identified in the safety case.
EMT.3	Type-testing	Structures, systems and components important to safety should be type tested before they are installed to conditions equal to, at least, the most severe expected in all modes of normal operational service.

Table 3

Relevant Safety Assessment Principles Considered for Close-out of GI-UKEPR-EE-01 Rev 0

SAP No.	SAP Title	Description
EMT.6	Reliability claims	Provision should be made for testing, maintaining, monitoring and inspecting structures, systems and components important to safety in service or at intervals throughout plant life commensurate with the reliability required of each item.
EMT.7	Functional testing	In-service functional testing of systems, structures and components important to safety should prove the complete system and the safety-related function of each component
ELO.1	Access	The design and layout should facilitate access for necessary activities and minimise adverse interactions during such activities.
EHA.10	Electromagnetic interference	The design of facility should include protective measures against the effects of electromagnetic interference
ESS.1	Requirement for safety systems	All nuclear facilities should be provided with safety systems that reduce the frequency or limit the consequences of fault sequences, and that achieve and maintain a defined safe state
ESS.2	Determination of safety system requirements	The extent of safety system provisions, their functions, levels of protection necessary to achieve defence in depth and required reliabilities should be determined
ESS.3	Monitoring of plant safety	Adequate provisions should be made to enable the monitoring of the plant state in relation to safety and to enable the taking of any necessary safety actions.
ESS.7	Diversity in the detection of fault sequences	The protection system should employ diversity in the detection of fault sequences, preferably by the use of different variables, and in the initiation of the safety system action to terminate the sequences
ESS.8	Automatic initiation	A safety system should be automatically initiated and normally no human intervention should be necessary following the start of a requirement for protective action.
ESS.9	Time for Human Intervention	Where human intervention is necessary following the start of a requirement for protective action, then the time before such intervention is required should be demonstrated to be sufficient.
ESS.10	Definition of capability	The capability of a safety system, and of each of its constituent sub-systems and components, should be defined.

Table 3

Relevant Safety Assessment Principles Considered for Close-out of GI-UKEPR-EE-01 Rev 0

SAP No.	SAP Title	Description
ESS.11	Demonstration of adequacy	The adequacy of the system design as the means of achieving the specified function and reliability should be demonstrated for each system.
ESS.12	Prevention of service infringement	Adequate provisions should be made to prevent the infringement of any service requirement of a safety system, its sub-systems and components.
ESS.15	Alteration of configuration, operational logic or associated data	No means should be provided, or be readily available, by which the configuration of a safety system, its operational logic or the associated data (trip levels etc) may be altered, other than by specifically engineered and adequately secured maintenance/testing provisions used under strict administrative control
ESS.16	No dependency on external sources of energy	Where practicable, following a safety system action, maintaining a safe facility state should not depend on an external source of energy
ESS.19	Dedication to a single task	A safety system should be dedicated to the single task of performing its safety function
ESS.20	Avoidance of connections to other systems	Connections between any part of a safety system (other than the safety system support features) and a system external to the plant should be avoided
ESS.21	Reliability	The design of a safety system should avoid complexity, apply a fail-safe approach and incorporate the means of revealing internal faults from the time of their occurrence
ESS.23	Allowance for unavailability of equipment	In determining the safety system provisions, allowance should be made for the unavailability of equipment
ESS.24	Minimum operational equipment requirements	The minimum amount of operational safety system equipment for which any specified facility operation will be permitted should be defined and shown to meet the single failure criterion.

Table 3

Relevant Safety Assessment Principles Considered for Close-out of GI-UKEPR-EE-01 Rev 0

SAP No.	SAP Title	Description
EES.1	Provision	Essential services should be provided to ensure the maintenance of a safe plant state in normal operation and fault conditions
EES.2	Sources external to the site	Where a service is obtained from a source external to the nuclear site, that service should also be obtainable from a back-up source on the site.
EES.3	Capacity, duration, availability and reliability	Each back-up source should have the capacity, duration, availability and reliability to meet the maximum requirements of its dependent systems
EES.4	Sharing with other plants	Where essential services are shared with other plants on a multi-facility site, the effect of the sharing should be taken into account in assessing the adequacy of the supply
EES.5	Cross-connections to other services	The capacity of the essential services to meet the demands of the supported safety functional requirement(s) should not be undermined by making cross-connections to services provided for non-safety functions.
EES.6	Alternative sources	Alternative sources of essential services should be designed so that their reliability would not be prejudiced by adverse conditions in the services to which they provide a back-up
EES.7	Protection devices	Protection devices provided for essential service components or systems should be limited to those that are necessary and that are consistent with facility requirements
EES.8	Sources external to the site	Where a source external to the nuclear site is employed as the only source of the essential services needed to provide adequate protection, the specification and in particular the availability and reliability should be the same as for an on-site source.
EES.9	Loss of service	Essential services should be designed so that the simultaneous loss of both normal and back-up services will not lead to unacceptable consequences.
EKP.3	Defence in Depth	A nuclear facility should be so designed and operated that defence in depth against potentially significant faults or failures is achieved by the provision of several levels of protection

Table 3

Relevant Safety Assessment Principles Considered for Close-out of GI-UKEPR-EE-01 Rev 0

SAP No.	SAP Title	Description
EKP.5	Safety measures	Safety measures should be identified to deliver the required safety function(s).

Annex 1

Technical Queries Raised During Close-out Phase

GI-UKEPR-EE-01 Rev 0 – PCSR Presentation of Claims Arguments and Evidence – Technical Queries Raised

TQ Reference	GDA Issue Action	Related Submission	Description
TQ-EPR-1617	GI-UKEPR-EE-01-A1		Electrical Queries

Annex 2

GDA Assessment Findings Arising from GDA Close-out for Electrical Systems

Finding No.	Assessment Finding	MILESTONE (by which this item should be addressed)
AF-UKEPR-EE-21	The Licensee should demonstrate that the Class 1 EDG based system is adequately sized to meet the following criteria: • Capable of starting and supporting all Class I loads under all operating conditions. • Capable of surviving the overload caused by the sudden connection of all loads under the control of the PAS and SAS (both failing simultaneously) and maintaining loads in at least one division.	Long lead items and SSC procurement specifications.
AF-UKEPR-EE-22	The Licensee should demonstrate that all feeders connected to switchboards with a higher classification than the loads being supplied from the feeder should be isolated by a device meeting the requirements of the highest classification of load being supplied by that switchboard.	Long lead items and SSC procurement specifications.
AF-UKEPR-EE-23	The Licensee should determine the detail design requirements required to comply with the earthing system classification.	Nuclear island safety related concrete.
AF-UKEPR-EE-24	The Licensee should implement the reclassification from Class 3 to Class 2 of the Ultimate Diesel Generators (UDG) and associated distribution equipment.	Long lead items and SSC procurement specifications.
AF-UKEPR-EE-25	The Licensee should demonstrate the suitability of the design of the 400V uninterruptible power supply to protect against common cause failure. The following actions are required in support of the design substantiation: • Demonstrate that the detailed design of the main switchboards, cables and supporting technology is simple and robust. • Undertake an ALARP analysis to establish whether it is reasonably practicable to provide a diverse manufacturer of equipment for two of the four trains. • Carry out a design analysis to show deterministically that sustained damage to the downstream switchboards from a major failure of the invertors can be ruled out. • Through life support is at a level commensurate with the very high integrity required of the system.	Long lead items and SSC procurement specifications.

Annex 2

GDA Assessment Findings Arising from GDA Close-out for Electrical Systems

Finding No.	Assessment Finding	MILESTONE (by which this item should be addressed)
AF-UKEPR-EE-26	The licensee should make arrangements to address the influence of Geomagnetically Induced Currents (GIC) and other space weather related effects.	Long lead items and SSC procurement specifications.
AF-UKEPR-EE-27	The Licensee should implement the recommendations from the resolution of cross cutting GDA Issue GI-UKEPR-CC-03 in the detailed design of the plant.	Long lead items and SSC procurement specifications.
AF-UKEPR-EE-28	The Licensee should substantiate the case for connecting non-classified equipment to classified systems based on actual equipment ratings.	Long lead items and SSC procurement specifications.
AF-UKEPR-EE-29	The Licensee should assess the changes to the electrical system from the reallocation of loads in response to GDA Issue GI-UKEPR-FS-05 and confirm that these changes can be accommodated within the plant layout.	Nuclear island safety related concrete.
AF-UKEPR-EE-30	The Licensee should perform sensitivity studies for Loss of Offsite Power (LOOP). This should include sensitivity studies to the frequencies of all defined LOOP durations and a sensitivity study to the assumed maximum period of the LOOP, assuming LOOP for significantly greater than 192 hours, but taking where necessary appropriate account of repair and recovery actions (where likely to be supported by documented procedures). This should identify the dominating contributions to the risk, any system vulnerabilities and any differences in the insights when compared with the base cases, and should be used as part of demonstrating a balanced design, without over-reliance on external sources of power, to demonstrate that the proposed design is ALARP. To risk inform the development of the design using PSA an iterative approach should be used. A preliminary study should be developed to support electrical design activities including the preparation of equipment purchase specifications.	Nuclear Island safety related concrete

Annex 2

GDA Assessment Findings Arising from GDA Close-out for Electrical Systems

Finding No.	Assessment Finding	MILESTONE (by which this item should be addressed)
AF-UKEPR-EE-31	The Licensee should develop the PSA model to reflect the design and operation, and provide an adequate representation of the electrical system based on site specific data and features. To risk inform the development of the design using PSA an iterative approach should be used. A preliminary study should be developed to support electrical design activities including the preparation of equipment purchase specifications.	Delivery to site of SSCs.

Note: It is the responsibility of the Licensees / Operators to have adequate arrangements to address the Assessment Findings. Future Licensees / Operators can adopt alternative means to those indicated in the findings which give an equivalent level of safety.

For Assessment Findings relevant to the operational phase of the reactor, the Licensees / Operators must adequately address the findings during the operational phase. For other Assessment Findings, it is the regulators' expectation that the findings are adequately addressed no later than the milestones indicated above.

Annex 3

EDF AND AREVA UK EPR GENERIC DESIGN ASSESSMENT
GDA ISSUE
PCSR PRESENTATION OF CLAIMS ARGUMENTS AND EVIDENCE
GI-UKEPR-EE-01 REVISION 1

Technical Area		**ELECTRICAL ENGINEERING**	
Related Technical Areas		None	
GDA Issue Reference	**GI-UKEPR-EE-01**	**GDA Issue Action Reference**	**GI-UKEPR-EE-01.A1**
GDA Issue	Provide a revised PCSR containing the requisite claims, arguments, and evidence to substantiate the design of the plant electrical distribution system. The claims made for the electrical system need to be related to the overall safety claims for the plant.		
GDA Issue Action	Provide a revised PCSR Chapter 8 to substantiate the design of the complete plant electrical distribution system. This needs to incorporate a structure of claims, arguments and evidence in a narrative and/or tabular form to demonstrate that the electrical system fully meets the requirements of its safety role as specified in the other chapters of the PCSR. ONR's expectations are that the PCSR should provide a rigorous justification for the completeness of the electrical power distribution system to perform its safety role. It has been agreed with EDF and AREVA, from the early stages of this project, that this would be done in the PCSR by establishing the claims, arguments and evidence chain of reasoning. This requirement has been consistently presented to EDF and AREVA and comments have been made by ONR on presentations made by EDF and AREVA on the presentation of the safety case for the electrical distribution system. Within Step 4 EDF and AREVA have presented two example sections of the revised PCSR covering common cause failure and equipment qualification. These do not meet ONR expectations which are that: • The PCSR needs to provide a clear justification of the safety of the EPR electrical distribution system. • The safety claims made need to be clear and unambiguous. • The arguments and evidence presented in support of the safety claims are well presented. In particular evidence should be based on documents that are produced during GDA, not on documents that are to be produced during site licensing. • Presentation of other sections of the PCSR will not be adequate if the format demonstrated in the example sections is maintained. With agreement from the Regulator this action may be completed by alternative means.		