

# Office for Nuclear Regulation

An agency of HSE

## **UK ONR ENSREG Related ‘National Action Plan’**

UK Office for Nuclear Regulation response to ENSREG Action Plan  
A Statement on ONR's Actions Extracted from the UK Post Japanese  
Earthquake and Tsunami Implementation Plan

**HM Chief Inspector of Nuclear Installations**

**31<sup>st</sup> December 2012**

## Foreword

This report has been produced in response to the ENSREG Action Plan that followed up the peer review of the stress tests performed on European Nuclear Power Plants. Specifically this statement answers the request for a regulators national action plan, associated with post-Fukushima lessons learned and stress test peer review recommendations and suggestions, to be presented by the end of 2012 to ENSREG in a form suitable for peer review by a common discussion.

This report draws from, and builds upon, the work already done by ONR and others within the UK following the Fukushima accident and is especially reliant on the ONR's most recent report "Japanese earthquake and tsunami: Implementing the lessons for the UK's nuclear industry" which explains how the UK nuclear industry is implementing the lessons from Fukushima.

I am satisfied that this is a comprehensive response that not only meets the requirements specified by ENSREG but also presents a statement of how the UK Office for Nuclear Regulation will be vigorous in ensuring the outcomes of this work, internally, with government and with the licensees will be followed up to completion and reported on.

I would finally like to thank the great efforts of the team that has put together this report in such a short timescale and alongside their other work

Colin Patchett  
Acting HM Chief Inspector of Nuclear Installations  
December 2012

## Executive Summary

This report is the UK's 'Regulators National Action Plan' (NAcP) for implementation of post Fukushima lessons learned produced in response to European Nuclear Safety Regulators Group (ENSREG) Action Plan (Ref. 9).

The UK is committed to ENSREG as the appropriate vehicle to advise the European Commission on matters of nuclear safety and radioactive waste management and with a goal of using existing resources effectively to promote enhancing standards for worldwide nuclear safety through continuous improvement showing a clear commitment to openness and transparency.

This report has been developed from a number of UK ONR reports produced in response to Fukushima (Ref 1, 2, 3 & 5), and is especially reliant on the ONR's most recent report (Ref. 5) on implementing the lessons from Fukushima for the UK nuclear industry. These reports are highlighted in the table below. The NAcP is therefore not a stand-alone report; rather it is a summary of the current status of, and future activities that are planned for, implementation of the lessons learnt.

Date	Report	No. recommendations or findings
May 2011	Interim Report by HM Chief Inspector to UK Govt <sup>(1)</sup>	26
Sept 2011	Final Report by HM Chief Inspector to UK Govt <sup>(2)</sup>	38 (inc those in Interim Report)
Dec 2011	UK National stress test report. <sup>(3)</sup> (note in addition to this report an equivalent report for non power generating facilities was published in May 2012)	19 (in addition to ~100 industry proposals)
Oct 2012	Implementation Report on progress in implementing lessons learned <sup>(5)</sup>	Covers all UK nuclear installations and all findings, recommendations & stress test peer review outcomes

The ENSREG action plan (Ref. 9) was published on 25<sup>th</sup> July 2012 with its objective to “assist in assuring that the conclusions from the stress tests and their peer review result in improvements in safety across European nuclear power plants. It will also assist, through further peer review, in ensuring that the recommendations and suggestions from the stress test peer review are addressed by national regulators and ENSREG in a consistent manner.”

The UK supports the ENSREG Action Plan and, in addition to providing detailed information on progress in implementing lessons learned, has volunteered nuclear sites for follow-up fact finding site visits “for information exchange, and to promote further cooperation and confidence building between European countries.”

As requested by ENSREG, ONR’s NAcP provides an update on:

- a. national regulator conclusions from their national stress tests as documented in their national reports;
- b. recommendations in the ENSREG main and country peer review reports;
- c. additional recommendations arising from the Convention of Nuclear Safety (CNS); and,
- d. Additional activities derived from national reviews and related decisions.

In addition the UK NAcP also takes account of the ENSREG compilation of recommendations and suggestions produced in September 2012 (Ref 4), and will, in common with all of ONR’s previous reports related to Fukushima, be made publicly available.

The report provides details of the current status in relation to all operating reactors and, where appropriate, the planned completion time of each individual item under points a to d above and for each individual item from ENSREG’s compilation of recommendations and suggestions. There is a degree of overlap between the various work streams that are addressing the HM Chief Inspector of Nuclear Installations (HMCINI) recommendations and the stress test outcomes; where this happens the NAcP clearly links these items to provide an auditable trail for all of the work.

As anticipated, there are a range of longer-term improvements or ongoing activities that will need to be delivered over timeframes extending beyond those for the production of this report.

ONR acknowledges the significant progress made by UK nuclear site licensees since work began to identify and learn lessons and the commitment to deliver the more significant improvements arising from lessons learnt from Fukushima by the end of 2014. Nevertheless, ONR will continue to act to ensure that these improvements are effective, and press for the delivery of these more significant improvements to this timescale.

ONR will monitor and assess the adequacy of progress made by the industry over the longer term, until it is satisfied that the significant lessons learnt from the Fukushima event have been adequately discharged and will, if necessary, use its regulatory powers to ensure that all reasonably practicable improvements are implemented.

ONR will deliver such oversight by embedding ongoing “Fukushima learning” oversight activities into its operational regulatory programme for Nuclear Power Plant (NPP).

This approach offers a number of distinct benefits in that it:

- secures longer term oversight by ONR of improvements relating to the lessons learnt from the Fukushima event;
- is both effective and efficient in terms of future use of regulatory resources;
- ensures that, in the overall interests of nuclear safety, such improvements are delivered taking into account the relative significance of all activities on the site; and

- 
- that such improvements are regulated, as appropriate, under the provisions of the licence conditions attached to each nuclear site licence.

ONR is committed to continuing to monitor and assess progress, to publish summary updates for stakeholders on our website and site stakeholder reports and to continue to advise government on the adequacy of progress made by the industry.

### **Conclusions**

Together with the supporting references, ONR's NAcP provides clear evidence that ONR and the UK nuclear power licensees have incorporated, or are in the process of incorporating, all the learning from the ENSREG peer review reports (individual UK report and the overall report) and compilation of recommendations into the existing programme of work aimed at lessons learnt from Fukushima.

Overall ONR is satisfied with the progress being made but recognises the need to sustain efforts to ensure that all of the relevant work items are satisfactorily closed out and that the timescales for close out are adhered to.

There is a formal process to embed the Fukushima work within ONR's normal business to ensure that compliance is appropriately tracked and monitored, that any necessary regulatory intervention to progress issues is undertaken, and that the outcomes are reported in the transparent and open manner established by ONR.

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## INTRODUCTION

1. This report is the UK's 'Regulators National Action Plan' (NACp) for implementation of post Fukushima lessons learned produced in response to ENSREG's Action Plan (Ref. 9). The NACp draws heavily on the pre-existing UK specific reports produced in response to Fukushima (Ref 1, 2, 3 and 5), and is especially reliant on the most recent report (Ref. 5) on implementing the lessons from Fukushima for the UK nuclear industry. The NACp is therefore a summary of the current status and future activities that are planned for implementation of the lessons learnt.

2. The ENSREG action plan (Ref. 9) was published on 25<sup>th</sup> July 2012 with its objective to "assist in assuring that the conclusions from the stress tests and their peer review result in improvements in safety across European NPP. It will also assist, through further peer review, in ensuring that the recommendations and suggestions from the stress test peer review are addressed by national regulators and ENSREG in a consistent manner."

3. The UK is committed to supporting the ENSREG Action Plan and as such has volunteered nuclear site (Sizewell B) for follow-up fact finding site visits "for information exchange, and to promote further cooperation and confidence building between European countries."

4. The ENSREG Action Plan requested that national regulators produce a NACp to provide an update on:

- national regulator conclusions from their national stress tests as documented in their national reports;
- recommendations in the ENSREG main and country peer review reports;
- additional recommendations arising from the CNS; and,
- additional activities derived from national reviews and related decisions.

5. In addition the NACp is expected to take account of the ENSREG compilation of recommendations and suggestions produced in September 2012 (Ref. 4), and to be made publicly available. This report also takes account of the NACp template issued by ENSREG in November 2012 by including information on:

- the process the regulator took to deliver the NACp, the approval process, and the approval level of the NACp
- the national approach to monitoring and achieving compliance / resolution including regulatory structure and intervention
- the proposed approach to transparency and public interaction

6. This information is included in Annex 2.

## UK National Action Plan Structure

7. The general approach to progressing the work described in this report has been the same for all types of the UK's NPP. These are Magnox, Advanced Gas Cooled (AGR) and Pressurised Water Reactors (PWR). All responses covered in this report are relevant to the two UK operating NPP licensees EDF NGL and Magnox. Differences do occur due to the shorter life of the last operating Magnox reactor these are specifically stated in paragraphs 205-225 of Ref. 5. Nevertheless, all of the recommendations and findings from Refs 2 and 3 are still applicable to Magnox.

8. This report has been presented under specific topics as detailed in Ref. 9. This reference also includes a request to cover the recommendations arising from the Convention on Nuclear

Safety (CNS) (Ref. 6). The result is the definition of six topics (topics 1-3 from Ref. 9 and 4-6 from Ref. 6). The topics are as follows:

- Topic 1 – External Events
- Topic 2 – Design Issues
- Topic 3 – Severe Accident Management and Recovery (On-site)
- Topic 4 – National Organisations
- Topic 5 – Emergency Preparedness and Response and Post-accident Management (Off-site)
- Topic 6 – International Co-operation

9. Topics 1 to 3 are dealt with in Section 1, covering progress in terms of national stress test findings, country and overall peer review outcomes and the ENSREG compilation of recommendations and suggestions. The latter is covered in more detail as the national stress test and peer review outcomes have been considered in detail in the earlier Implementation Report (Ref. 5) and so a summary is provided here. The status of Topics 4, 5 and 6 in the UK are also summarised in Section 2 of this report. Additional activities derived from national reviews and related decisions are discussed in Section 3. Finally Section 4 provides an overview of the work programme in tabular format. Any text in italics has been taken directly from the referenced reports.

## SECTION 1

### National Stress test Findings

10. In the UK's stress test report (Ref. 3) ONR identified 19 STFs in addition to the work already underway within licensees' organisations. Table 1 in Section 4 of this document (page 42) provides an update on the status of work being carried out by EDF NGL and Magnox to address these findings. Progress by licensees in completing the work that they themselves had identified is summarised in ONR's recent Implementation Report (Ref. 5). ONR is satisfied that adequate progress is being made by maintaining close regulatory oversight of both licensee's work streams. Of the 19 STFs, two have already been completed (STFs 1 and 19) whilst the other findings continue to move forwards.

### Peer Review Outcomes

11. The peer review outcomes from the ENSREG main and country peer review reports can be found on the ENSREG website ([www.ensreg.eu](http://www.ensreg.eu)) and have been incorporated within the wider UK learning from Fukushima, as shown in ONR's Implementation Report. The status of work aimed at addressing the peer review outcomes is summarised in Tables 2a and 2b of section 4 (pages 48 and 49). This also links the peer review outcomes with ONR's recommendations from the Implementation Report.

12. In September 2012, ENSREG produced a compilation of recommendations and suggestions derived from consideration of all of the national stress test reports and associated

peer reviews (Ref. 4). ONR and the NPP licensees have reviewed this compilation and addressed each issue in turn to see how it is, or can be addressed in the UK. The outcome of these reviews is summarised below in Section 1. The timescales and milestones against the compilation of recommendations is shown in Table 3 of Section 4 (page 50)

13. The implementation status of ONR's national stress test findings along with the peer review outcomes are described at the beginning of all the relevant topics prior to the progress update on ENSREG's compilations of recommendations (Ref. 4).

## 1.1 – External Events

14. All UK licensees have provided submissions against the ENSREG stress test specification (Ref. 4) as part of their responses to ONR's findings and recommendations. The ENSREG stress test specification required all European operators to demonstrate that:

- the existing design basis definition of external hazards is well founded and is fit-for-purpose.
- the existing safety cases are robust and adequate at the design basis level.
- there is safety margin beyond the design basis either by virtue of conservatism in methodology or over-design.

15. In areas where this cannot be demonstrated the licensees should have proposed additional analysis, plant enhancements or improved arrangements to address this shortfall.

### National Stress Test Report - Update

16. In addition to the wider programme of work driven by the Chief Inspector's recommendations and findings the UK national stress test report (Ref. 3) produced a total of 19 findings (STFs), which can be found in Table 1 of Section 4. Of these 19 findings 8 relate to External Events. These are STFs 2, 3, 4, 5, 6, 7 and 13 and 14 respectively. The status of all of the STFs is reported in the Implementation Report (Ref. 5). Examples of work addressing these STFs are provided below.

*“The review team noted that the UK regulator has raised a finding for additional review regarding the design basis approach and an adequate response regarding margins assessment beyond the design basis and identifies specific potential plant improvements” (Ref. 12).*

17. Plant modifications have been identified with respect to external hazards and outline specifications developed. Some modifications have commenced whilst others such as the installation of dam boards, which will be fitted where practicable to doorways, and entrances of buildings containing essential equipment, have commenced manufacture. All modifications are scheduled for completion by the end of 2013.

### ENSREG and Country Specific Peer Review for UK Stress Test Report – Update

*“For some specific external hazards, beyond design basis capability are inferred but not quantified and no specific evidence is provided that margins to cliff edge effects and potential specific improvements have been considered systematically for all NPP. In some cases there is no satisfactory evidence of capability of plant beyond design basis (e.g. tsunami, lightning)” (Ref. 12).*

18. ONR had already recognised this in its own stress test report (Ref. 3) and this is progressed by STF5 in the UK national report. This work is reflected in the main body of this report that gives updates on the ENSREG compilation of recommendations. ONR is maintaining strong

regulatory oversight in this area in line with both the ENSREG and country specific peer review recommendations. For each site a report has been produced addressing coastal, fluvial (from rivers) and pluvial (from direct rainfall) flooding for the  $10^{-4}$  pa flood event, using a consistent methodology for all stations.

19. These reports will form the basis for assessment of margins to cliff edge effects. Further studies are in progress, which will complete in 2013 and provide information necessary to support decisions in respect of enhancing the existing resilience of the sites to cope with beyond design basis events from external hazards.

20. The UK Meteorological Office (MO) has recently commenced its evaluation of revised design basis parameters and is investigating an assessment of weather hazards at a  $10^{-5}$  per annum return frequency. Consideration of the potential effect on structures, systems and components (SSCs) will follow from the results of this work during 2013.

### **ENSREG Compilation of Recommendations Update**

21. Progress in the following areas noted from Ref. 4 is shown along with a brief description of what Ref. 4 requires. Where relevant the accompanying recommendations or findings from Refs 1, 2 and/or 3 are also noted. The recommendations from Refs. 1-3 can be found in Tables 1 and 2 at the end of this document.

### **Hazard Frequency**

*ENSREG consideration 3.1.1: "The use of a return frequency of 10-4 per annum (0.1g minimum peak ground acceleration for earthquakes) for plant reviews/back-fitting with respect to external hazards safety cases."*

22. ONR's Safety Assessment Principles (SAPs) (Ref. 7) require protection against natural external hazards having a severity consistent with a  $10^{-4}$  per annum frequency evaluated on a conservative basis. Minimum peak ground acceleration for earthquakes varies from site to site but is assumed in excess of 0.1g in all cases. This criterion was historically established in the UK prior to the Fukushima accident and therefore UK NPPs meet this protection requirement either by design or by virtue of review and upgrade via the UK Periodic Safety Review (PSR) process. Compliance against this criterion was further reviewed as part of the ENSREG stress test process. As a result of this review, the licensee's are reviewing/updating the hazard severity/occurrence data to confirm its adequacy and to ensure a consistent approach is applied across all facilities. ONR is also currently carrying out a review of its SAPs document to ensure that the information contained within is consistent with information gathered from post Fukushima review documents.

### **Secondary Effects of Earthquakes**

*ENSREG consideration 3.1.2: "The possible secondary effects of seismic events, such as flood or fire arising as a result of the event, in future assessments."*

23. Seismically induced fire is being addressed by licensees in response to STF4 of Ref. 3. ONR notes that the initial approach taken by licensees is acceptable as is the forward work programme. Some workshops have been held and a project team of Suitably Qualified and Experienced Personnel (SQEP) has been formed. ONR has agreed that a program of work covering the review of fire and seismic safety cases with plant walk downs on all sites will be completed by the first quarter of 2014.

24. ONR has progressed flooding events with the licensees via IR 10 of Ref. 2. ONR has received an adequate description of the work to be undertaken at all sites in the UK. The work will involve an independent review of the current flood risk, in particular through wave over topping

events and a further assessment of plant items requiring further flood protection. Completion of this work is expected by March 2014.

### **Protected Volume Approach**

*ENSREG consideration 3.1.3: “The use of a protected volume approach to demonstrate flood protection for identified rooms or spaces.”*

25. ONR has impressed upon the licensees the need to consider this approach together with other work on flood protection and margins. ONR supports the licensees’ initial approach although it will review the detailed work scope when this becomes available. The current position is that the existing flooding hazards have been reviewed and follow-up work is in progress to evaluate and deal with uncertainties that have been identified. The program of work in this area runs in parallel with the other work surrounding flooding and is therefore scheduled for completion by the first quarter of 2014.

### **Early Warning Notifications**

*ENSREG consideration 3.1.4: “The implementation of advanced warning systems for deteriorating weather, as well as the provision of appropriate procedures to be followed by operators when warnings are made.”*

26. UK NPP licensees already have local monitoring systems and operational response procedures. Furthermore UK national warning systems are in place. However, the approach is not consistent across the fleet for all external hazards. ONR has engaged with licensees to ensure that the relevant ONR Chief Inspector's recommendations and questions that ONR raised during the stress test evaluation process, which includes that of early warning systems are addressed. The current status is that an assessment of existing forecasting arrangements will be completed and submitted to ONR by the first quarter of 2013 by EDF NGL. Magnox is developing a Company Standard for early warning of extreme events to further enhance its existing arrangements.

### **Seismic monitoring**

*ENSREG consideration 3.1.5: “The installation of seismic monitoring systems with related procedures and training.”*

27. ONR has progressed this area via STF3 of Ref. 3. All NPPs are currently equipped with local seismic monitoring instrumentation that is directly accessible to control room staff. In addition to this, the licensees and ONR have access to a national monitoring system run by the British Geological Survey. The current arrangements are judged by ONR to be adequate. A review of operator actions following a seismic event is due to be submitted to ONR during the second quarter of 2013 by EDF NGL. ONR will assess the adequacy of this review when it becomes available. Magnox has in place guidelines for post-seismic event operator actions and is reviewing accident management guidelines generally (these relate equally to beyond design basis seismic events as well as other initiating events).

### **Qualified Walk downs**

*ENSREG consideration 3.1.6: “The development of standards to address qualified plant walk downs with regard to earthquake, flooding and extreme weather – to provide a more systematic search for non-conformities and correct them (e.g. appropriate storage of equipment, particularly for temporary and mobile plant and tools used to mitigate beyond design basis (BDB) external events).”*

28. UK NPP licensees have conducted walk downs against all external hazards in response to HMCINI findings. The walk downs are consistent with approved processes and are undertaken to a set procedure, similar to that performed for PSR work. Plant walk downs for seismic assessments are done in adherence to the Electric Power Research Institute (EPRI) standard. More specific/targeted walk downs are planned to address specific post Fukushima STF, particularly in relation to beyond design basis events, and ONR is currently engaging with the licensee to ensure appropriate methods and standards are used. ONR has also carried out site inspections to ensure that due attention is paid to the ability of the operators to carry out remedial actions in response to beyond design basis events. ONR uses the standards set out in its SAPs (Ref. 7) for plant walk downs but is currently not involved with the development of standard to address qualified plant walk downs, however ONR would support any international initiatives in this area.

### **Flooding Margin Assessments**

*ENSREG consideration 3.1.7: “The analysis of incrementally increased flood levels beyond the design basis and identification of potential improvements, as required by the initial ENSREG specification for the stress tests.”*

29. ONR has progressed flooding events via IR10 and STF5 of Refs. 2 and 3. ONR has made similar progress as that recorded in the relevant section above. A full work scope is expected from EDF NGL in the near future with an ONR review to follow. The scope will include a full flooding margin assessment as required by STF5. The completion of this work is expected by the first quarter of 2014. Magnox does not intend to undertake full flooding margin assessments but has reviewed flooding resilience and is implementing appropriate resilience enhancements where necessary. ONR is satisfied with this approach.

### **External Hazard Margins**

*ENSREG consideration 3.1.8: “In conjunction with recommendation 2.1 and 3.1.7, the formal assessment of margins for all external hazards including, seismic, flooding and severe weather, and identification of potential improvements.”*

30. ONR has progressed this area via STF5 of Ref 3. For flooding hazards, independent reports have been commissioned which will aid the recalculation of the flooding risk from pluvial, fluvial and wave events. This pilot will form the basis for the assessment of flooding margins. For seismic hazards, a scope document has been updated with key milestones and for extreme weather EDF NGL has made contact with the MO and drafted an Engineering Advice Note (EAN) to consider causally linked weather events that may affect the hazard margins. Magnox has completed a review of resilience against extreme hazards and will complete the implementation of resilience enhancements by the end of 2013. Regarding recommendation 2.1 ONR is leading the development of guidance on natural hazards on behalf on the Western European Nuclear Regulators Association.

## 1.2 – Loss of Safety Systems

### National Stress Test Report – Update

31. The UK national stress test report (Ref. 3) produced a total of 19 findings (STFs), which can be found in Table 1 of Section 4. Of these 19 findings, 7 relate to Loss of Safety Systems. These are STFs 8-14 inclusive.

*“Inject water into the reactor core as an ultimate means to provide residual heat removal from the core without use of the boilers and identify the means/equipment that would be used, including filtering (AGR/Magnox)” (Ref. 12).*

32. For EDF NGL connection points will allow the connection of portable generators with delivery of mobile 200kVA off-site generators anticipated by end of quarter 2 in 2013. Mobile 150kVA on-site generators are also being investigated. Orders for these are scheduled by the first quarter of 2013.

33. The main focus for AGRs is to ensure water is provided to boilers via on site water stocks and reverse osmosis plant for extending on-site water stocks. Injecting water into the core as a last resort is currently under review. Work on reverse osmosis plant is due to commence at the start of 2013. A specification has been developed for the provision of compressed nitrogen gas and work is also expected to commence in this area at the start of 2013. Magnox has already procured appropriate mobile generators and has implemented enhancements to stocks of water, diesel fuel and CO<sub>2</sub> with further enhancements to fuel supplies being planned. Magnox is considering enhancements that may be necessary to increase the likelihood of success in implementing post-event accident management guidelines including water injection and filtering. Any enhancements would be subject to regulatory approval.

### ENSREG and Country Specific Peer Review for UK Stress Test Report - Update

*“Stocks of fuel etc for at least 72h” (Ref. 12)*

34. Wider arrangements for storage and deployment of equipment are under development, which would include the provision of fuel supplies. All sites currently have at least 72 hours of fuel and water supplies or will have the capability upon completion of the storage arrangements work.

### ENSREG Compilation of Recommendations Update

#### Alternate Cooling and Heat Sink

*ENSREG consideration 3.2.1: “The provision of alternative means of cooling including alternate heat sinks. Examples include steam generator (SG) gravity alternative feeding, alternate tanks or wells on the site, air-cooled cooling towers or water sources in the vicinity (reservoir, lakes, etc) as an additional way of enabling core cooling.”*

35. ONR has progressed this work via IR19 and STFs 8 and 9 of Refs 2 and 3. Detailed reviews across NPP sites have been undertaken and the sites have confirmed sufficient capacity for 72 hours supply of feed water. ONR will review the evidence that substantiates these claims. Practical enhancements and modifications resulting from the reviews will be implemented by the first quarter of 2014. Sea source reverse osmosis plant for extending on-site water stocks is also planned by EDF NGL with work commencing in 2013. Magnox has focussed on increasing on-site water stocks in hardened structures. This is proportionate with the remaining life of the plant.

## AC Power Supplies

*ENSREG consideration 3.2.2: "The enhancement of the on-site and off-site power supplies. Examples include adding layers of emergency power, adding independent and dedicated backup sources, the enhancement of the grid through agreements with the grid operator on rapid restoration of off-site power, additional and/or reinforced off-site power connections, arrangements for black start of co-located or nearby gas or hydro plants, replacing standard ceramic based items with plastic or other material that are more resistant to a seismic event. Another example is the possible utilisation of generator load shedding and house load operation for increased robustness, however, before introducing such arrangements the risks need to be properly understood."*

36. ONR has progressed this area via IRs17, 18 and STFs 8, 9, 10 and 11 of Refs 2 and 3. The licensees have accepted the need to consider enhancements in these areas. In respect of off-site power supplies, licensees have engaged the UK transmission system operator, National Grid, to co-ordinate a review of grid reliability and possible enhancements for coordination and restoration. The review will take place during the second quarter of 2013.

37. Licensees have reviewed the on-site diesel generator power supplies and confirmed that all are capable of a minimum of 72 hours operation. They are developing options for the deployment of backup generators should an event result all on-site and off-site power supplies be unavailable. Suitable electrical connection points are being identified at each site, with the intent to undertake modifications by the fourth quarter in 2014. ONR will review the evidence that substantiates their proposals.

## DC Power Supplies

*ENSREG consideration 3.2.3: "The enhancement of the DC power supply. Examples include improving the battery discharge time by upgrading the existing battery, changing/diversifying battery type (increasing resistance to common-mode failures), providing spare/replacement batteries, implementing well-prepared load shedding/staggering strategies, performing real load testing and on-line monitoring of the status of the batteries and preparing dedicated recharging options (e. g. using portable generators)."*

38. ONR considers that all the points in the consideration above are being progressed via STF9 of Ref. 3. Licensees are required to review autonomy times and consider opportunities to enhance these times. ONR expects the reviews to be complete by quarter four in 2013. ONR considers that operator action to reduce battery load is likely to be incompatible (in the short post trip period) with the operator's priority to establish adequate post-trip cooling. As part of the off-site backup equipment strategy, licensees are considering the requirement to re-energise certain DC systems. ONR will review the evidence that substantiates their proposals.

39. As part of the replacement of the battery charging diesel generators at the UK PWR, modifications are currently underway to the design to increase robustness to flooding and seismic hazards. This includes seismic qualification and the flood protection of the building that houses the generators. This work is due for completion by the end of 2013.

## Operational and Preparatory Actions

*ENSREG consideration 3.2.4: "Implementation of operational or preparatory actions with respect to the availability of operational consumables. Examples include, ensuring the supply of consumables such as fuel, lubrication oil, and water and ensuring adequate equipment, procedures, surveillance, drills and arrangements for the resupply from off-site are in place."*

40. ONR has progressed this area via IR9 and STFs 9 and 15 of Refs. 2 and 3. ONR considers the plans for on-site electrical and water supplies and consumables such as gas stocks (for AGRs) and fuel to be adequate, both in terms of on-site capacity and resupply from off-site.

The reviews produced a programme of work for enhancements as part of continuous improvement that should be in place by the first quarter of 2014.

### Instrumentation and Monitoring

*ENSREG consideration 3.2.5: “The enhancement of instrumentation and monitoring. Examples include separate instrumentation and/or power sources to enable monitoring of essential parameters under any circumstances for accident management and the ability to measure specific important parameters based on passive and simple principles.”*

41. ONR has progressed this area via IRs 22 and 23 and STFs 14 and 15 of Refs. 2 and 3. An ONR review of the licensee’s response that has taken into account these IRs and STFs is complete and further work is now planned to take forward the following issues:

- Additional information has been made available by the licensee stating that it is intended to re-energise existing systems and, as necessary, use pre-determined cable routes/connection points to utilise this equipment and provide direct feeds into control rooms from devices, such as, data loggers or cubicle mounted apparatus, and cameras that can be deployed post-event.
- Work is currently underway to determine reasonably practicable resilience enhancements to existing C&I systems and equipment to ensure that plant status information can be made available to plant control rooms and/or emergency management facilities (e.g. Emergency Control Centres (ECCs), Alternative Indication Centres (AICs) and Emergency Indication Centres (EICs)). Further feasibility studies are to be carried out on the reasonable practicability of capturing key plant parameters (e.g. reactor temperatures, pressure, boiler pressure and flow) by improving C&I systems and equipment. These studies will also look for alternative means of transmitting this information to plant control rooms and/or severe accident management facilities.
- Other related considerations arising from completion of the Licensee’s stress tests include the provision of additional evidence in relation to, for example, the specification for the aerial lighting and grab torches, including details of any relevant battery management regime. In addition, work is in-hand that will utilise existing sensors that may be energised via mobile 415V generators or batteries as part of the back-up equipment. All work covering instrumentation and monitoring is scheduled to be complete by the spring of 2014.

### Shutdown Improvements

*ENSREG consideration 3.2.6: “The enhancement of safety in shutdown states and mid-loop operation. Examples of improvements include, reducing or prohibiting mid-loop operation, adding dedicated hardware, procedures and drills, the use of other available water sources (e. g. from hydro-accumulators), requiring the availability of steam generators during shutdown operations and the availability of feedwater in all modes.”*

42. The ONR SAPs (Ref. 7) require safety cases to look at all operating modes for a given plant and this includes mid-loop operation where applicable. The UK specific reports on Fukushima and the stress tests were carried out in this light. In the UK, mid-loop operation is only relevant to the PWR at Sizewell B and was already recognised as a potentially higher-risk state when Sizewell B was designed. Existing Technical Specifications contain requirements for redundancy in both instrumentation and heat sinks. The heat sink arrangements include significant diversity in the form of a diverse air-cooled reserve ultimate heat sink, qualified against natural hazards. The provision of adequate electrical supplies to these systems has been considered elsewhere in this document as have battery-charging diesel generators. Upgrading the resistance of the associated buildings to natural hazards and connection of portable generators and pumps for diverse cooling should be achieved by the first quarter of 2014.

## Reactor Coolant Pump Seals

*“ENSREG consideration 3.2.7: “The use of temperature-resistant (leak-proof) primary pump seals.”*

43. In the UK this area is only relevant to Sizewell B. EDF examined the equipment available to allow improvements to the integrity of the main coolant pump seals. Replacement seal units were identified but EDF consider that this equipment is novel and the safety benefit of such seals is not yet proven. EDF plan to review operational experience from any plants that do adopt these seals, and may fit them at some future date.

44. Seal injection flow at Sizewell B is available from diverse sources (electrical and steam turbine equipment). The conservative approach to the plant change proposed is consistent with the practice generally adopted by Sizewell B. Since it is the only PWR in the UK, its policy is to be conservative in its adoption of technical changes. This is consistent with ONR guidance.

45. A failure of a gas circulator in a gas cooled reactor results in a depressurisation event. This scenario is covered by the depressurisation safety cases currently in place.

## Ventilation

*ENSREG consideration 3.2.8: “The enhancement of ventilation capacity during SBO to ensure equipment operability.”*

46. ONR has progressed this area via IR21 and STFs 18 of Refs. 2 and 3. ONR has seen good progress in this area with proposals for a program of work to install Passive Autocatalytic Recombiners and Filtered Containment Venting (FCV) at Sizewell B. The Passive Autocatalytic Recombiners are intended to provide safety benefits to the plant and if justified the intention is to carry out the modifications for the Passive Autocatalytic Recombiners during the 2013 statutory outage and by the end of 2014 for the FCV. ONR will assess the formal justification for this work when it is submitted. A review of the risk of combustible gas production on the AGR fleet has been completed and concludes that hydrogen generation is not possible in the way that occurred at Fukushima.

## Main and Emergency Control Rooms

*ENSREG consideration 3.2.9: “The enhancement of the main control room (MCR), the emergency control room (ECR) and emergency control centre (ECC) to ensure continued operability and adequate habitability conditions in the event of a station black-out (SBO) and in the event of the loss of DC.”*

47. ONR has progressed this area via IR22, FR2 and FR3 of Ref. 2. Appropriate programmes to implement reasonably practicable resilience enhancements to existing ECCs have commenced. This includes provision of diesel generators to ensure continued operability. However, reviews are still on going as is the discussion with the licensees surrounding emergency control rooms. These discussions include habitability in the event of radiological or major CO<sub>2</sub> releases. Completion is expected by the end of 2013.

48. The section on the spent fuel pool below describes the quicker response time required for PWR's. Due to this construction of a hardened emergency response centre at Sizewell B has commenced and ONR is in the process of agreeing a forward programme of work to introduce the capability to supply back-up emergency equipment from regional stores for the AGR reactors. The AGR reactors would utilize mobile pods to be brought to site as a source of back-up emergency equipment rather than the construction of a response centre as is the case at Sizewell B. Licensees are preparing detailed design proposals for enhancing the control functionality in some

existing alternative indication centres. ONR is in the process of agreeing a suitable work programme with the Licensee.

### Spent Fuel Pool

*ENSREG consideration 3.2.10: “The improvement of the robustness of the spent fuel pool (SFP). Examples include reassessment/upgrading SFP structural integrity, installation of qualified and power-independent monitoring, provisions for redundant and diverse sources of additional coolant resistant to external hazards (with procedures and drills), design of pools that prevents drainage, the use of racks made of borated steel to enable cooling with fresh (unborated) water without having to worry about possible recriticality, redundant and independent SFP cooling systems, provision for additional heat exchangers (e. g. submerged in the SFP), an external connection for refilling of the SFP (to reduce the need for an approach linked to high doses in the event of the water falling to a very low level) and the possibility of venting steam in a case of boiling in the SFP.”*

49. ONR considers that all of the above points are being progressed via the work being done in response to IRs 13, 14, 15 and 20 of Ref. 2. Reviews have been carried out across all NPPs with regard to reassessment/upgrading of SFP structural integrity. Full site walk downs have been undertaken along with ongoing work looking at earthquake responses of concrete structures. This work included considering pond thermal performance and cracking. ONR awaits the results of this work. Installation of power independent monitoring has focussed on post event emergency equipment rather than on looking at how monitoring could be continued, via installed equipment, in the event of power failure.

50. EDF NGL has completed a review of site contingency plans for pond water make-up under severe accident conditions. Various additional options have been identified which would allow operators to deliver pond water make-up if required in a severe event if normal water supplies and pumps were not available. These include plans for provision of additional emergency back-up equipment which can be deployed following a severe accident and emergency pond water/ buffer store make-up and cooling module provision with hoses and appropriate connections laid as necessary.

51. Reviews have been carried out across all NPPs with regard to siphoning faults and anti siphoning features currently installed. The results have been received by ONR and judged to be adequate. Further reviews are planned to consider the C&I features of SFPs and ONR awaits the results of this review. C&I equipment and systems that can be used to monitor pond water level and temperature require further review to establish the feasibility of providing these key plant parameters at the onset of a Beyond Design Basis Accident (BDBA). This review into the potential use of existing equipment in spent fuel storage pond area forms part of a broader feasibility study to identify further improvements.

52. In AGR cooling ponds borated steel is present in the skips. In addition the fixed fuel geometry in the skips ensures sub-criticality. Although the AGR fuel storage ponds are doped with boron this is not required to guarantee sub-criticality in normal operation. Therefore, provided the fuel geometry in the skips does not alter in the accident and the boronated stainless steel remains in place, then re-filling the pond with unborated water should not pose a criticality safety hazard. At Sizewell B the pond water is borated but this neutron poison is required to control the criticality hazard should an element be misplaced in the storage racks or should an element in transit be dropped. The main criticality controls in normal operations are the presence of solid absorber assemblies in one out of four rack storage positions and boral inserts in the fuel storage racks.

53. Most pond fault sequences have significant time periods before irradiated fuel temperatures can lead to nuclear safety hazards, hence proposals have been made to provide infra-red cameras that can be installed post-event. Licensees need to justify the integrity of the cameras and the accuracy of pond water level estimates. Additional mobile back-up equipment is proposed to include a pond cooling system that may also provide an indication of pond water temperature although details of this system are not yet finalised.

54. The review will tie in with other work areas that focus on the use of backup equipment and so the completion dates for this work will be consistent with the previously stated first quarter of 2014. ONR has recognised that the initial reviews show that AGR plants show a time for the onset of boiling significantly in excess of 72 hours (and longer for the Magnox fuel pool) even at the most onerous heat loadings. This time is significantly less for the PWR at Sizewell B so different strategies may be needed. ONR considers the adopted approach to SFPs as reasonable and will continue to give this area oversight as the work progresses.

### Separation and Independence

*ENSREG consideration 3.2.11: “The enhancement of the functional separation and independence of safety systems. Examples include the elimination of full dependence of important safety functions on auxiliary systems such as service water and the introduction of an alternate source of cooling.”*

55. ONR has progressed this area via STF14 of Ref. 3. Licensees have described the work to be carried out from the initial scoping exercises through to the installation and implementation of various measures. This includes interactions with off-site backup equipment, its storage at diverse locations, compatibility with existing equipment and its use by operators. However, EDF needs to provide justification that further diversity of the support systems for gas circulators, pressure vessel cooling systems, or the CO<sub>2</sub> pressure boundary are not required. When they become available, ONR will assess these justifications against Ref. 7 to ensure appropriate separation and independence. All modifications, such as the use of alternative cooling supplies, backup equipment provisions and hardened on-site stock supplies are scheduled to be completed by the end of 2013.

### Flow Path and Access Availability

*ENSREG consideration 3.2.12: “The verification of assured flow paths and access under Station Black Out (SBO) conditions. Ensure that the state in which isolation valves fail and remain, when motive and control power is lost, is carefully considered to maximise safety. Enhance and extend the availability of DC power and instrument air (e. g. by installing additional or larger accumulators on the valves). Ensure access to critical equipment in all circumstances, specifically when electrically operated turnstiles are interlocked.”*

56. ONR has progressed this area via IR25 and STF14 and 15 of Refs 2 and 3. The licensee is carrying out analysis and the results are being reviewed by ONR to agree suitable programmes of work. Studies are currently identifying the key plant systems necessary to control or mitigate severe accidents.

57. In respect of on-site personnel access under SBO conditions, EDF Energy NG will be assessing the feasibility of operator recovery actions following extreme weather (flooding and high winds) and seismic events. These assessments will consider aspects such as visibility, which may be impaired following such extreme events. The scope of these assessments is considered to adequately address the potential access concerns. The scope covers both internal and external critical plant associated with SBO. The programme of work is extensive and lengthy with the operator recovery aspects appearing in the latter stages of the programme. Work is currently directed to assessing the potential consequences of the extreme events above.

58. For gas cooled reactors in the event of a SBO, either on its own or accompanied by a severe external hazard, there are few isolation valves, which are required to close in order to support nuclear safety. Such valves are qualified (where required) for hazard conditions and operate immediately following a reactor trip supported by battery-backed control and motive power. (Some motive power is also hydraulically actuated.) Such valves are not required to subsequently change state (i.e. open) in any SBO condition that may subsequently develop. The establishment of core cooling via the boilers requires the introduction of feed water. In a SBO situation, feed water flow to the boilers may be established either via manual operation of valves normally in the closed position, or via manual operation of bypass valves. The long timescales (many hours) for such operations to be undertaken before core damage would occur, together with the high number of redundant feed water routes is considered to provide high confidence that manual recovery actions would be successful in a SBO.

59. At Sizewell B, in the event of a SBO, either on its own or accompanied by a severe external hazard, there are few isolation valves which are required to close in order to support nuclear safety. Where such valves do exist, they will be configured to fail to a 'safe-state' in the event of a loss of motive power. Valves are qualified (where required) for hazard conditions. A small number of valves are required to operate following a reactor trip in an SBO condition. These are either battery-backed or have dedicated motive air supplies. Key examples include flow control valves in the auxiliary feed water lines and variable set point power-operated relief valves in the main steam lines. However, steam-driven feed water pumps, feed water bypass lines and statutory steam relief valves enable continued safe shutdown of the plant even if supplies to these key valves are unavailable.

## Mobile Devices

*ENSREG consideration 3.2.13: "The provision of mobile pumps, power supplies and air compressors with prepared quick connections, procedures, and staff training with drills. Mobile devices are intended to enable the use of existing safety equipment, enable direct feeding of the primary or secondary side, allow extended use of instrumentation and operation of controls, allow effective fire fighting, and ensure continued emergency lighting. The equipment should be stored in locations that are safe and secure even in the event of general devastation caused by events significantly beyond the design basis."*

60. ONR has progressed this area via STF8, 10 and 15 of Ref. 3. On-going work, involving mobile devices has been described elsewhere in this report in terms of both demonstrating mobilisation of people and equipment (from both on and off-site) and the provision of on-site connections to allow use of mobile equipment. Such equipment includes back-up generators, off road vehicles, cooling and fuel supplies with compatible connections and welfare facilities. Aside from Sizewell B where this equipment would be held on-site in the hardened Emergency Response Centre (ERC) the AGRs will have such provisions available from pods that are stored at strategic locations within the UK in order to provide a response on a short timescale. All of this work is scheduled to be complete by the end of 2014, including any improvements or actions that may arise as the work goes forward.

## Bunkered/Hardened Systems

*ENSREG consideration 3.2.14: "The provision for a bunkered or "hardened" system to provide an additional level of protection with trained staff and procedures designed to cope with a wide variety of extreme events including those beyond the design basis."*

61. UK licensees are considering hardened systems as part of a holistic approach to accident prevention, management and mitigation. This includes consideration of the requirement for, and

degree of resilience of facilities such as EAIC, ECCs, main/central control rooms. Due to the different age and design of UK NPPs, different levels of inherent/designed resilience, redundancy and practicability of improvement are required. The appropriate levels of resilience are site specific and enhancements against hazards are being implemented where appropriate.

62. As part of this holistic approach, licensees are also developing enhancements to hardened site facilities where appropriate. This is in addition to the design basis considerations that were accounted for during construction. Off-site storage locations for mobile emergency equipment at locations such that equipment can be transported to site on timescales required for emergency response also provide a degree of separation and independence from on-site facilities that reside in hardened structures. The focus for the off-site emergency equipment includes the ability to mitigate against BDBA scenarios.

### Multiple Accidents

*ENSREG consideration 3.2.15: "The enhancement of the capability for addressing accidents occurring simultaneously on all plants of the site. Examples include assuring preparedness and sufficient supplies, adding mobile devices and fire trucks and increasing the number of trained and qualified staff."*

63. ONR has progressed this area via IR11 and 24 of Ref. 2. ONR considers that an acceptable programme of work is underway. The licensee's work programme includes enhancement of information management systems and command and control processes such that multi-plant events can be progressed simultaneously. Sufficient quantities of back-up equipment, located in regional stores, will also be provided in association with training of staff from other sites to ensure an adequate number of trained and qualified staff to deploy and operate back-up equipment. A multi-plant exercise is planned for the first quarter of 2014.

### Equipment Inspection and Training Programs

*ENSREG consideration 3.2.16: "The establishment of regular programs for inspections to ensure that a variety of additional equipment and mobile devices are properly installed and maintained, particularly for temporary and mobile equipment and tools used for mitigation of BDB external events. Development of relevant staff training programmes for deployment of such devices"*

64. ONR has progressed this area via STF15 of Ref. 3. ONR has adequate visibility of the licensee's programme to define and procure mobile back-up equipment intended to mitigate beyond design basis events. A corresponding programme of in-service support and staff training is planned and will be subject to appropriate regulatory oversight by ONR. This area of work is closely related to other work streams described above and will be complete by the end of 2014.

### Further Studies to Address Uncertainties

*ENSREG consideration 3.2.17: "The performance of further studies in areas where there are uncertainties."*

*Uncertainties may exist in the following areas:*

- The integrity of the SFP and its liner in the event of boiling or external impact.*
- The functionality of control equipment (feedwater control valves and SG relief valves, main steam safety valves, isolation condenser flow path, containment isolation valves as well as depressurisation valves) during the SBO to ensure that cooling using natural circulation would not be interrupted in a SBO.*

· *The performance of additional studies to assess operation in the event of widespread damage, for example, the need different equipment (e.g. bulldozers) to clear the route to the most critical locations or equipment. This includes the logistics of the external support and related arrangements (storage of equipment, use of national defence resources, etc.).”*

65. The progress of work surrounding boiling in the SFP is described in the relevant section above and ONR is satisfied with the licensees’ responses although ONR has requested further details from the licensees, which will be subject to assessment. Functionality of equipment under SBO conditions is also discussed in topics such as those that deal with electrical supplies and backup equipment. A fleet of off-road vehicles has also been procured, noting the problems experienced at Fukushima regarding the movement of vehicles around the site due to debris. Magnox has also procured debris removal equipment.

66. The licensees are also currently conducting further studies surrounding issues such as managing the traumatic, psychological, stress and family effects that staff and other responders may encounter during a severe and prolonged nuclear emergency. The scope of this is scheduled to be available during the first quarter of 2013.

## 1.3 – Severe Accident Management

### National Stress Test Report – Update

67. The UK national stress test report (Ref. 3) produced a total of 19 findings (STFs), which can be found in Table 1 of Section 4. Of these 19 findings 4 relate to severe accident management. These are STFs 15-18 inclusive.

68. EDF NGL have produced a human aspects key findings report. The report summarises key findings from desktop review of documentation, lessons learnt reports and review of arrangements. Areas that have been highlighted in the report include staff willingness to respond, staff availability during emergency response, enhancing responders’ resilience and stress management, managing traumatic events, addressing the human aspects of radiation incidents and recovery issues, including family and community support. The full report is currently undergoing verification and approval before being issued to ONR.

*“The SBERGs and SAGs should be further developed to cover fully all spectrums of accident scenarios, including plant shutdown conditions. Training and exercises for implementation of the procedures should be improved” (Ref. 12).*

69. Review and revision of reactor System Based Emergency Response Guidelines (SBERGs) is taking place with information gathering exercises at EDF NGL sites now complete. The main areas for review for reactor SBERGs include, safety case developments and plant modifications, structural integrity values, recent transient analysis development, existing SBERG review by station operations staff, simulator tutors and nuclear safety engineers and items relating to SBERGs that were identified from the PSR process.

70. New fuel route SBERGs are also being produced. Analyses of spent fuel storage areas, buffer store thermal analysis, pond thermal analysis and pond cracking analysis are nearing completion. The reports provided from these analyses will be used as the technical basis for the development of fuel route SBERGs. All revised SBERGs are scheduled for completion by the third quarter of 2013.

71. Review and revision of Severe Accident Guidelines (SAGs) is taking place. The intention is to separate out the parts of the existing SAGs which deal with recovery actions which new Back-up

Equipment (BUE) is designed to achieve, including the fuel route plant. This first document would provide accident management guidance to emergency controllers under circumstances in which the accident management strategy can be centred on deployment of the BUE. A second document would be an amended version of the existing SAGs with the advice having a greater level of detail. The intention would be to make the advice more useful in the event of a potential severe accident, so that less development would be needed in real time. All SAG documents are scheduled for completion by the end of 2013. It should be noted that Sizewell B does not have SBERGs and SAGs, instead it has prescriptive Station Operating Instructions (SOIs, series 8 for emergency operations) and separate Severe Accident Management Guidelines (SAMGs) respectively. These will be reviewed separately in 2014 following the major plant modifications planned.

72. Magnox has reviewed the reactor SBERGs and SAGs and is considering the findings with a view to implementing a programme of enhancements to be completed by the end of 2013. Magnox has recently commenced work on development of fuel route accident management guidelines again, the expectation is that this will be complete by the end of 2013.

### **ENSREG and Country Specific Peer Review for UK Stress Test Report – Update**

*Necessary implementation of measures allowing prevention of accidents and limitation of their consequences in case of extreme natural hazards is a finding of the peer review that national regulators should consider (Ref. 11).*

*“Urgent implementation of the recognised measures to protect containment integrity is a finding of the peer review that national regulators should consider” (Ref. 11).*

73. For AGRs the primary circuit pressure boundary comprises of a steel lined reinforced concrete pressure vessel. Direct damage to the primary circuit pressure boundary via external hazards is considered to be applicable to the seismic event only. A re-evaluation of the seismic robustness of the primary circuit pressure boundary is scheduled to be carried out in 2013. Further re-evaluations by the licensees are planned relating to indirect damage to the primary circuit pressure boundary either directly from a hazard, or via the loss of one or more of its supporting systems following a severe external hazard event. The robustness of the existing safety case for loss of Pressure Vessel Cooling Water (PVCW) will be reviewed. The PVCW system is important in ensuring pressure vessel integrity.

74. For the PWR at Sizewell B work is underway to substantiate the installation of Filtered Containment Venting (FCV). FCV allows for the release of the core over-pressure through a scrubber. In addition to FCV Passive Autocatalytic Recombiners are also being substantiated for use. The Passive Autocatalytic Recombiners oxidize hydrogen via catalysis in the event of containment damage and loss of coolant.

*“In accordance with the existing plans, the on-site emergency facilities should be strengthened in order to be resistant against external hazards and provide for working conditions in case of severe accident” (Ref. 12).*

75. EDF NGL is in the process of building the new Sizewell B ERC and the AGRs will be provided with portable ultimate backup ECCs. These have the advantage of flexibility of location and therefore are less prone to the hazard affecting their tenability. EDF NGL is also reviewing the capability of their current emergency facilities. Magnox are currently carrying out enhancements to emergency equipment availability at Wylfa including construction of a new compound in a secure location to house new and existing emergency plant and equipment.

*“Radiation conditions, which may potentially develop on-site in case of severe accident, possibly at several units, should be more comprehensively analysed and appropriate measures to address them implemented” (Ref. 12).*

76. ONR's work to improve the radiation protection of responders relates to the adoption of consistent arrangements for setting and implementing of emergency exposures. This work is ongoing and ONR forms part of a multi-agency group. Part of this work will involve the emergency services in the UK reviewing and revising their guidance in this area.

*“The peer review Board recommends that WENRA, involving the best available expertise from Europe, develop guidance on natural hazards assessments, including earthquake, flooding and extreme weather conditions, as well as corresponding guidance on the assessment of margins beyond the design basis and cliff-edge effects” (Ref. 11).*

77. ONR is leading the development of guidance on behalf of the WENRA within the working group (T1) on natural hazards via a nominated superintending inspector from ONR. In addition, it also has experienced inspectors participating in the three other WENRA working groups covering mutual assistance, containment in severe accidents and accident management.

## **ENSREG Compilation of Recommendations Update**

### **WENRA Reference Levels**

*“ENSREG consideration 3.3.1: “The incorporation of the WENRA reference levels related to severe accident management (SAM) into their national legal frameworks, and ensure their implementation in the installations as soon as possible. This would include:*

- Hydrogen mitigation in the containment - Demonstration of the feasibility and implementation of mitigation measures to prevent massive explosions in case of severe accidents.*
- Hydrogen monitoring system - Installation of qualified monitoring of the hydrogen concentration in order to avoid dangerous actions when concentrations that allow an explosion exist.*
- Reliable depressurization of the reactor coolant system – Hardware provisions with sufficient capacity and reliability to allow reactor coolant system depressurization to prevent high-pressure melt ejection and early containment failure, as well as to allow injection of coolant from low pressure sources.*
- Containment overpressure protection - Containment venting via the filters designed for severe accident conditions.*
- Molten corium stabilization - Analysis and selection of feasible strategies and implementation of provisions against containment degradation by molten corium.”*

78. The UK has an established process for adoption of WENRA reference levels, including those related to severe accident management, into its national legal framework. WENRA is currently updating the reference levels in light of the Fukushima accident and on completion of that work, which is expected in 2013, the UK will embark on the process of formally adopting them as national requirements within technical assessment guide (TAG) 005 (Ref. 10). This technical assessment guide details how the Health and Safety at Work Act 1974 sections 2 and 3 (which are the key legal requirements) are applied to the UK nuclear industry. In addition to including WENRA reference levels as requirements in TAG 005, ONR has a procedure for revision of all TAGs and there is a requirement on authors to include those WENRA reference levels relevant to the technical area within the TAG before they can be approved. The revised TAGs will be published on ONR's website.

79. The SAM measures noted in the bullets above are being considered already, and progress will not be related to the timescales for formal adoption of new WENRA reference levels.

## SAM Hardware Provisions

*ENSREG consideration 3.3.2: “Adequate hardware provisions that will survive external hazards (e.g. by means of qualification against extreme external hazards, storage in a safe location) and the severe accident environment (e.g. engineering substantiation and/or qualification against high pressures, temperatures, radiation levels, etc), in place, to perform the selected strategies.”*

80. ONR is progressing this area via FR3 of Ref. 2 and has been provided with updates of the work done so far by licensees in this area but requires more detail on actual plant improvements. ONR is currently engaging with the licensees to ensure appropriate work programmes are in place to deliver any necessary improvements.

81. Work has also been undertaken regarding the development of long-term severe accident exercises along with reviews of source terms and dose uptakes. In addition, there are other work programmes underway that will further analyse severe accident provisions (FR4 and IR25 from Ref. 2) and these analyses may in turn lead to additional plant enhancements. A flexibility of approach has been shown by EDF NGL by making provision for mobile back equipment in combination with hardened on-site structures to provide a degree of separation and independence. Magnox has embarked on substantiating an on site facility with due attention paid to engineering substantiation and suitable location. This work will be complete by the third quarter of 2013.

## Review of SAM Provisions Following Severe External Events

*ENSREG consideration 3.3.3: “The systematic review of SAM provisions focusing on the availability and appropriate operation of plant equipment in the relevant circumstances, taking account of accident initiating events, in particular extreme external hazards and the potential harsh working environment.”*

82. ONR has progressed this area via IR24 and STF16 of Refs. 2 and 3. The provision of plant and equipment has already been discussed. Both EDF NGL and Magnox have conducted reviews of their SAM provisions and have commenced work as described in the previous paragraph. In addition, ONR has a program of exercises to test these provisions via long timescale emergency exercises, which include sustainability of a capable response and appropriate operation of plant equipment. This programme of emergency exercises is published on the DECC (Department of Energy and Climate Change) website ([www.decc.gov.uk](http://www.decc.gov.uk)) and is an on going part of ONR normal business.

## Enhancement of Severe Accident Management Guidelines (SAMG)

*ENSREG consideration 3.3.4: “The enhancement of SAMGs taking into account additional scenarios, including, a significantly damaged infrastructure, including the disruption of plant level, corporate-level and national-level communication, long-duration accidents (several days) and accidents affecting multiple units and nearby industrial facilities at the same time.”*

83. ONR has progressed this area via IR 24 and STF 16 of Refs. 2 and 3. EDF NGL and Magnox have made enhancements to SBERGs including updates for consistency, better presentation, wider scope (e.g. fuel route SBERGs) and enhanced roll-out, training and exercising. EDF NGL have also redefined the scope of AGR SAGs to take account of enhanced SAGs, backup equipment, improved usability and enhanced roll-out, training and exercising.

84. Although Sizewell B does not have SAGs and SBERGs, specific modifications are under consideration with suitable and consistent SOIs being developed.

85. The future nuclear emergency exercise programme for fixed nuclear installations within the UK has secured opportunities to test the on-site and off-site response for prolonged periods. Such exercises are intended to test the prolonged delivery and sustainability of the on-site, the off-site and central government responses. The exercises are also intended to highlight areas for further

improvements, which will inform reviews of on-site and off-site emergency plans and feed into future work programmes. The findings will inform reviews of the duration of the future nuclear emergency exercises. Government involvement will be exercised more extensively than before in off-site emergency exercises, with ministers playing a role from time to time.

### **SAMG Validation**

*ENSREG consideration 3.3.5: "The validation of the enhanced SAMGs."*

86. ONR has progressed this area via IRs 24 and 25 and STF16 of Refs. 1 and 3. The licensee has provided an acceptable programme of work to ONR. The licensee is reviewing, updating and enhancing the guidance contained in the existing SBERGs, SAGs and SAMGs and these updated guidelines will be used as part of an on going exercise program. The planned training and exercising programme will allow independent validation from ONR. Documentation will be complete by the end of 2013. The exercise programme will form part of normal business and training will be complete by 2014.

### **SAM Exercises**

*ENSREG consideration 3.3.6: "Exercises aimed at checking the adequacy of SAM procedures and organisational measures, including extended aspects such as the need for corporate and nation level coordinated arrangements and long-duration events."*

87. ONR has progressed this area via IR6 and 7 of Ref. 2. The Fukushima accident identified scope for lessons learnt, particularly in ONR's capability to respond to a prolonged emergency. A review has since resulted in a proposal for improved arrangements for ONR's response to initial notifications of all nuclear emergencies, including severe accidents, and for ensuring the prompt deployment of trained staff to remote locations and to ONR's central emergency response centre - the Redgrave Court Incident Suite (RCIS). During deployment a senior nuclear inspector would be available to discuss the developing situation with the affected duty holder, ONR colleagues, the Government Technical Advisor, central government and other agencies.

88. ONR is working with nuclear operators and a range of government agencies to develop arrangements for early plotting of possible radioactive plumes and potential off-site doses using real-time weather. A programme to review and update the site and plant information held in the RCIS for all the licensed sites has already led to significant improvements in this area and will facilitate ONR's response, including the transmission of timely, authoritative data to the IAEA in accordance with international obligations.

89. Work is continuing in the area of exercise and response arrangements and the target for completion is April 2013.

### **SAM Training**

*ENSREG consideration 3.3.7: "Regular and realistic SAM training exercises aimed at training staff. Training exercises should include the use of equipment and the consideration of multi-unit accidents and long-duration events. The use of the existing NPP simulators is considered as being a useful tool but needs to be enhanced to cover all possible accident scenarios."*

90. ONR has progressed this area via IR 24 of Ref. 2. Part of the scope of work that reviews and updates the SBERGs, SAG and SOIs involves the training of licensee's staff. Part of this training will involve the use of newly procured backup equipment. In addition to the normal exercise programme a multi-site exercise at Heysham 1 and 2 power stations is planned for quarter one 2014. The new SBERGs and SAGs and the use of new backup equipment will be used in the exercise. Further assessment of SAM training will form part of normal ONR business.

### Extension of SAMGs to All Plant States

*ENSREG consideration 3.3.8: "The extension of existing SAMGs to all plant states (full and low-power, shutdown), including accidents initiated in SFPs."*

91. ONR has progressed this area via IR 24 and 25 of Ref. 2. The extension of existing SAMG to all plant states is being addressed as part of the wider review of severe accident contingency arrangements.

92. In particular, as part of the response to these recommendations EDF NGL is to revise the AGR fuel route SBERGs and SAGs. Other key aspects of the work include revising the SBERGs/SAGs to take into account the provision of improved backup equipment. Development of the AGR SBERGs and SAGs to cover all plant states is planned for completion by September 2013. Magnox Ltd are also reviewing their SBERGs and SAGs for the Magnox stations taking into account all phases of a site's lifecycle. This work is due for completion within the same timescale.

### Improved Communications

*ENSREG consideration 3.3.9: "The improvement of communication systems, both internal and external, including transfer of severe accident related plant parameters and radiological data to all emergency and technical support centre and regulatory premises."*

93. ONR has progressed this area via IR23 of Ref. 2. Work is presented in Section 2 of this report concerning the information exchange between ONR and the affected site, Central Emergency Support Centre (CESC) and wider nation/international organisations. Both EDF NGL and Magnox have procured satellite phones and are in the process of implementing their use. This work has been commenced after the production of recommendations from a licensee communication vulnerability report. A forward plan is nearing completion following a meeting to discuss the service possibility of a High Integrity Telecommunications System (HITS). Satellite communications would form part of this and the scheduled timescales for this to be implemented is the third quarter of 2013.

### Presence of Hydrogen in Unexpected Places

*ENSREG consideration 3.3.10: "The preparation for the potential for migration of hydrogen, with adequate countermeasures, into spaces beyond where it is produced in the primary containment, as well as hydrogen production in SFPs."*

94. ONR has progressed this area via IR21 and STF18 of Refs. 2 and 3. Reviews across reactors are underway and ONR will assess the results of these reviews when they become available. Although it is recognised that the gas cooled reactors cannot generate hydrogen in the same way as that which occurred at Fukushima the formation of carbon monoxide is credible and the fire/explosion risk will be assessed as part of the report. The installation of FCV, subject to ONR's technical assessment and Passive Autocatalytic Recombiners at Sizewell B will begin in 2013 and complete by the first quarter of 2014.

### Large Volumes of Contaminated Water

*ENSREG consideration 3.3.11: "The conceptual preparations of solutions for post-accident contamination and the treatment of potentially large volumes of contaminated water."*

95. ONR has progressed this area via IR25 of Ref. 2. ONR is in the process of agreeing a suitable work programme with the licensee. The current high-level plans for provision of back-up equipment to manage large volumes of contaminated effluent will be further developed once the output from recommendation IR25 becomes available. The initial approach will be to have centrally located storage facilities (bags) that will be deployed as necessary. Small scale storage will be available on site. The approach will be to leave water where it accumulates if secure, and only pump to bags if necessary.

## Radiation Protection

*ENSREG consideration 3.3.12: “The provision for radiation protection of operators and all other staff involved in the SAM and emergency arrangements.”*

96. ONR is progressing this area via STF16 of Ref. 3. ONR is working closely with DECC and other agencies to address capability gaps in radiological protection arrangements in response to severe radiation accidents. An example of ONR's work to improve the radiation protection of responders relates to the adoption of consistent arrangements for setting and implementing of emergency exposures. ONR is part of multi-agency group (NEPLG) that works together to ensure a consistent overall approach to nuclear emergencies. Part of the current work involves the emergency services in the UK reviewing and revising their guidance in this area. The police service has reviewed its guidance in England, Wales and Northern Ireland and has already started to roll out training in the new arrangements. The Fire and rescue service has reviewed its arrangements, published a generic risk assessment and have also produced a Hazardous Materials Manual which is yet to be published. The ambulance service is currently reviewing its arrangements. ONR is seeking to encourage early completion of this work and its extension to cover the police service in Scotland.

## On-site Emergency Centre

*ENSREG consideration 3.3.13: “The provision of an on-site emergency centre protected against severe natural hazards and radioactive releases, allowing operators to stay onsite to manage a severe accident.”*

97. ONR is progressing this area via IR22 of Ref. 2. ONR has been provided with good evidence that appropriate licensee programmes have commenced to implement reasonably practicable resilience enhancements to ECCs. This includes provision of battery charging diesel generators to ensure continued operability, improvements to ventilation systems, increased flood protection and the removal of glazing in the ECCs. Work continues across all sites to establish suitable ECCs. At Sizewell B planning permission has been granted for the new ERC and building work is scheduled to start at the beginning of 2013 with the hardened ERC to be operational during 2014. The AGRs will be provided with new portable ultimate back-up ERCs which have the advantage of flexibility of location and continued mobility and are therefore are less prone to the hazard or radiological conditions affecting their tenability. The backup ERCs should be available by the end of 2013. The AGR sites may utilize some existing facilities where appropriate as part of their ECC build project but will also store backup equipment and vehicles at regional support centres

## Support to Local Operators

*ENSREG consideration 3.3.14: “Rescue teams and adequate equipment to be quickly brought on-site in order to provide support to local operators in case of a severe situation.”*

98. ONR has progressed this area via IR25 of Ref. 2. ONR is in the process of agreeing a suitable work programme with the licensee. The licensee has adopted a strategy of storing back-up equipment in a number of regional stores. Optimum locations are being identified to ensure back-up equipment can be deployed to sites within the timescales required to mitigate progression of identified severe accidents. A separate training programme will ensure additional licensee resource can be quickly deployed from identified sites in order to provide support to local operators on affected sites. The work here relies heavily on the use of mobile devices and further detail is noted under that topic.

## Level 2 Probabilistic Safety Assessments (PSAs)

*“ENSREG consideration 3.3.16: “A comprehensive Level 2 Probabilistic Safety Analysis (PSA) as a tool for the identification of plant vulnerabilities, quantification of potential releases, determination*

*of candidate high-level actions and their effects and prioritizing the order of proposed safety improvements. Although PSA is an essential tool for screening and prioritising improvements and for assessing the completeness of SAM implementation, low numerical risk estimates should not be used as the basis for excluding scenarios from consideration of SAM especially if the consequences are very high.”*

99. ONR has progressed this area via FR4 of Ref. 2. ONR has been engaging with the licensees to ensure the development of an adequate level 2 PSA for the NPPs. Ongoing development work has been shared with ONR, including its AGR level 2 PSA methodology. ONR has reviewed and had discussions with licensees to influence further improvements. Regular engagement and review of the developing work will continue until recommendation FR 4 has been adequately addressed.

100. Sizewell B already has a full scope level 2 PSA.

101. For the AGRs, EDF NGL has agreed to develop a level 2 PSA for a lead reactor (Hunterston B), with the insights from this being used to determine the strategy for the remaining fleet. NGL has made good progress in developing a level 2 PSA methodology for the AGRs, and is progressing implementation of this methodology. Reasonable progress is being made in addressing gaps between EDF NGL's Level 2 PSA plans and ONR's expectation and a level 2 PSA for the lead AGR is expected by the second quarter of 2013.

102. Magnox has shared its initial plans of a level 2 PSA for its one generating reactor with ONR and these are considered adequate. ONR will continue to examine the outputs of the developing level 2 PSA, monitor progress against Magnox Ltd's programme and review the outcome of the programme to determine the adequacy of the resulting level 2 PSA.

### **Severe Accident Studies**

*ENSREG consideration 3.3.17: “The performance of further studies to improve SAMGs. Examples of areas that could be improved with further studies include:*

- The availability of safety functions required for SAM under different circumstances.*
- Accident timing, including core melt, reactor pressure vessel (RPV) failure, basemat melt-through, SFP fuel uncover, etc.*
- PSA analysis, including all plant states and external events for PSA levels 1 and 2.*
- Radiological conditions on the site and associated provisions necessary to ensure MCR and ECR habitability as well as the feasibility of AM measures in severe accident conditions, multi-unit accidents, containment venting, etc.*
- Core cooling modes prior to RPV failure and of re-criticality issues for partly damaged cores, with un-borated water supply.*
- Phenomena associated with cavity flooding and related steam explosion risks.*
- Engineered solutions regarding molten corium cooling and prevention of basemat melt-through.*
- Severe accident simulators appropriate for NPP staff training.”*

103. ONR has progressed this area via IRs 24 and 25, FR 4 and STFs 3, 5, 6 and 17 of Refs 2 and 3. This is a broad area of work and many of the aspects of it are covered under the topics listed above. A breakdown of the milestones and timescales for implementation in these work areas can be found in Section 4. None of the on-going work extends past the stated scheduled completion date of the first quarter of 2014. ONR has reviewed the ENSREG UK country peer review report and considers that the areas raised for consideration have been covered in the above section.

## SECTION 2

104. ENSREG's Action Plan also called for a discussion on additional recommendations arising from the CNS meeting (Ref. 6) and these are discussed under topics 2.1, 2.2 and 2.3 below

### 2.1 National Organisations

105. ONR has progressed this area via IR3, 8 and 25, FR6 and FR7 and STF 15 of Refs. 2 and 3. This topic has been addressed by obtaining additional information from UK government, regulators, operators and nuclear accident response organisations. Further, national organisations were considered within the HMCINI's reports on the Fukushima accident (Refs. 1 and 2).

106. To date there have been no organisational changes within the companies responsible for the UK nuclear power facilities as a result of the events in Fukushima, other than to establish teams to co-ordinate and manage the response to the event. The licensees have stated that they already have robust mechanisms in place to deal with severe events. However these mechanisms are being reviewed and will be enhanced as a result of the reviews performed in the aftermath of the events in Fukushima. So far, as a result of these reviews, there has been no benefit identified in making organisational changes. However, the licensees have stated that, as learning organisations, should the results of these reviews change they will make any necessary organisational changes.

#### Government organisations

107. Prior to the accident at Fukushima the UK government had already begun a process of establishing the ONR as a statutory corporation. The aim of which is to enable ONR to respond more quickly and effectively to civil nuclear issues by, for instance, ensuring it has the capability and resource expertise necessary to meet the challenges of a rapidly developing nuclear industry. However, the creation of ONR as a statutory body will not alter the regulatory standards that the nuclear industry is currently subject to.

108. In July 2011 the UK transposed the Council Directive 2009/71/EURATOM establishing a Community framework for the nuclear safety of nuclear installations. While transposition did not require any changes to UK legislation it does further commit the UK to periodic peer reviews, the establishment of national plans and programmes to manage and improve safety and the reporting of progress against those programmes. These plans include the roles of all stakeholders.

109. The work that is currently taking place on the creation of a statutory ONR has at its heart the transparency of the regulator and its relationship with government (including bodies concerned with the promotion or utilisation of nuclear energy).

#### Nuclear emergency planning preparedness and response

110. The UK has enacted the Radiation (Emergency Preparedness and Public Information) Regulations 2001 (REPPPIR) which implements in the UK the Articles of Council Directive 96/29/Euratom on intervention in cases of radiation (radiological) emergency. The Directive lays down the basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation (the BSS96 Directive). In addition, REPPPIR Regulation 17 (Duty of local authority to supply information to the public in the event of a radiation emergency) is made under the European Communities Act 1972 and is applicable to all Local Authorities (LAs).

111. REPIR also enabled the UK government to meet a recommendation made by the inspectors at the public inquiries at Sizewell B and Hinkley Point C, in that REPIR brings on-site and off-site emergency planning together in a coordinated manner. This ensures that the UK has a fully joined up multi-agency response plan with appropriate capability. For more information on this subject see Topic 2 in this section.

112. DECC co-ordinates emergency preparedness policy at national level, as the lead government department on arrangements for response to any emergency with off-site consequences from a licensed civil nuclear site in England and Wales. In the event of an emergency resulting from an accident at a civil nuclear site in Scotland, the lead government department responsible for the main national coordinating role would fall to the Scottish Government. DECC would still be responsible for briefing the Westminster Parliament and the UK's international partners.

113. DECC also chairs the Nuclear Emergency Planning Liaison Group (NEPLG), which brings together organisations with interests in off-site civil nuclear emergency planning. Members include representatives of the nuclear operators, the regulatory body, police, fire service, local authority emergency planning officers and government departments and agencies that would be involved in the response to an emergency.

114. NEPLG is a forum for discussing common issues, exchanging information and experience and agreeing improvements in planning, procedures and organisation. It has issued consolidated guidance (Ref. 8) to all organisations that may be involved in planning for a civil nuclear emergency. The guidance describes the underlying arrangements that have been developed for responding to an emergency in the UK over a number of years, and which have been adapted by NEPLG and its constituent organisations. The IAEA Integrated Regulatory Review Service (IRRS) mission to the UK in October 2009 considered the creation of NEPLG to be 'good practice' in supporting the multi agency response in the UK.

115. The UK government's response, on behalf of the NEPLG was to agree to conduct a review of the UK's national nuclear emergency arrangements in light of the experience of dealing with the prolonged event at Fukushima.

***IR 3 - The Nuclear Emergency Planning Liaison Group should instigate a review of the UK's national nuclear emergency arrangements in light of the experience of dealing with the prolonged Japanese event.***

*This information should include the practicability and effectiveness of the arrangements for extending countermeasures beyond the Detailed Emergency Planning Zone (DEPZ) in the event of more serious accidents.*

116. As part of that review and in further work the NEPLG examined the decisions and actions that were taken in Japan to protect the public, and considered any lessons that the UK could learn from those actions. This included a re-evaluation of radiation monitoring capacity/capability and recommended that central government clarify the requirements for delivering the data and information in the event of a prolonged incident in the UK and that these arrangements be tested annually. Exercises of off-site emergency plans are being reviewed so that they regularly include aspects such as extendibility, dealing with prolonged events and the deployment of reassurance monitoring units. The NEPLG work also assessed central government response arrangements and, in particular, the provision of scientific and technical advice in the event of a nuclear emergency in the UK or overseas. This was to ensure that the Cabinet Office Briefing Room (COBR) has one source of advice and recommended that the overseas nuclear emergency response plan be tested fully through the nuclear energy agency international exercise programme.

117. The report also recommended that ONR should enforce a stronger testing regime which includes extendibility arrangements and overseas nuclear accident response. A range of options for taking forward extendibility have been debated and discussed via the NEPLG Local Authority (LA) Sub Group. The current position with respect to radiation protection of the emergency services is given in paragraph 92 and Section 4 of this report. ONR's responsibilities under such a testing regime would be to assess the licensee's arrangements under the conditions of their site licence rather than assessment of any other participating agency. This would be done in line under arrangements described in paragraph 139.

118. The opportunities and recommendations identified by NEPLG form part of a wider programme of work being taken forward by the Department of Energy and Climate Change (DECC). In looking to answer the recommendations from the NEPLG work and other further work DECC has developed and agreed, with key delivery partners across government, industry and the regulator, a new national strategic framework. This framework significantly strengthens governance arrangements and, in particular, provides clear lines of tasking, communication and decision making between operational delivery and ministerial involvement. As mentioned in the report, and driven by the new strategic framework, initial comprehensive assessments have been completed for the UK's capacity to plan for and respond to nuclear emergencies – both at “reasonably foreseeable” and “reasonable worst case” scenario level and DECC/NEPLG are currently developing options for closing any gaps where they are found to exist.

119. Some of this work has still to be implemented. With regard to enhanced arrangements for extendibility, ONR will work with DECC, Ministry of Defence (MoD) and other interested parties to ensure we are able to provide the necessary regulatory oversight.

**FR-6:** *The nuclear industry with others should review available techniques for estimating radioactive source terms and undertake research to test the practicability of providing real-time information on the basic characteristics of radioactive releases to the environment to the responsible off-site authorities, taking account of the range of conditions that may exist on and off the site.*

120. ONR, MO, the Health Protection Agency (HPA) and the Radioactive Incident Monitoring Network (RIMNET) team at DECC continue to work together to further develop the capability to be able to respond quickly to any incident at a nuclear site anywhere in the world. The objective of this capability is for the UK to be able to draw upon the collective resources and expertise of the operators, regulators and others, as necessary. MO has the capability for providing atmospheric dispersion information in real time following any incident in the UK and worldwide. MO is part of a collaboration, co-ordinated by DECC, with contributions from ONR and HPA to develop a tool for estimating the spatial distribution of radiation doses in real time following a radiation release in the UK or elsewhere, the most appropriate pathways and other dose factors required to estimate doses to individuals.. The different initiatives should ensure that information is available to support decisions on emergency countermeasures.

121. The work has been building upon existing arrangements in place for incidents in the UK whilst developing an appropriate basis and supporting procedures for overseas responses. ONR and UK operators will advise on the plant status and potential source terms and progress has been made on the development of an initial set of pre-defined source terms in conjunction with the nuclear industry. MO have an inverse modelling capability and have further developed their tools to model dispersion of radioactive materials in the atmosphere based on guidance provided by HPA on ONR recognises the importance of this area and will continue to work with other parties to make further progress.

**FR-7:** *The Government should review the adequacy of arrangements for environmental dose measurements and for predicting dispersion and public doses and environmental impacts, and to*

*ensure that adequate up to date information is available to support decisions on emergency countermeasures.*

122. In the event of a radioactive release from a nuclear site, the operators are responsible for carrying out monitoring in the immediate vicinity with HPA co-ordinating monitoring further afield; this information together with emergency plans is used for the immediate emergency response. These arrangements are kept under review by NEPLG. There are a number of other initiatives in this area, including a review of RIMNET.

123. In addition, HPA, the Environment Agency, the Scottish Environment Protection Agency (SEPA) and the Northern Ireland Environment Agency (NIEA) all carry out or co-ordinate routine environmental monitoring for radionuclides. In the event of a radiological emergency, this routine monitoring would be enhanced if necessary and used to provide information that would support later decisions on emergency countermeasures.

124. There is still a need to ensure that adequate environmental dose measurements and predictions can be provided in the circumstances of severe external hazards. Much of the environmental monitoring equipment around Fukushima did not work satisfactorily after the earthquake and tsunami. ONR is aware that mobile monitoring teams from HPA, EA, SEPA and NIEA, and other government organisations, alongside volunteered industry and commercial personnel can be mobilised in the event of a nuclear emergency and that the HPA has a co-ordination role for these monitoring teams to ensure their most effective use. However, it is still to be firmly established that there would be sufficient capability following severe external hazards. Progress towards a tool for real-time dose estimation has been achieved, but it is not yet fully implemented and so work is continuing in this area to ensure this capability is realized.

***IR-8:*** *The UK nuclear industry should review the dependency of nuclear safety on off-site infrastructure in extreme conditions, and consider whether enhancements are necessary to sites' self sufficiency given for the reliability of the grid under such extreme circumstances.*

*This should include:*

- a) essential supplies such as food, water, conventional fuels, compressed gases and staff, as well as the safe off-site storage of any equipment that may be needed to support the site response to an accident; and*
- b) timescales required to transfer supplies or equipment to site.*

***IR-25:*** *The UK nuclear industry should review, and if necessary extend, analysis of accident sequences for long-term severe accidents. This should identify appropriate repair and recovery strategies to the point at which a stable state is achieved, identifying any enhanced requirements for central stocks of equipment and logistical support.*

***STF-15:*** *Licensees should complete the various reviews that they have highlighted so that ONR can assess their proposals and associated timescales. These reviews should look in detail at on-site emergency facilities and arrangements, off-site facilities, facilities for remote indication of plant status, communication systems, contents and location of beyond design basis containers and the adequacy of any arrangements necessary to get people and equipment on to and around site under severe accident conditions. Any changes to arrangements and equipment will require appropriate training and exercising.*

125. As part of the response to a number of recommendations and findings EDF NGL is in the process of identifying and procuring a range of back-up emergency equipment. This equipment will be stored in the three regional AGR depots that are being established along with the new Sizewell B ERC that is to be built. The locations of the regional depots will allow deployment of the equipment to sites on timescales that meet any claims made for the provision of backup equipment.

126. EDF NGL reports that these depots will contain equipment to enhance resilience including the following:

- Off-road vehicles
- Debris moving vehicles (route clearance for example)
- Personal protective equipment
- Diesel driven electricity generators
- Diesel driven water pumps – for reactor and fuel cooling
- Reverse osmosis equipment to supply clean water
- Damage repair equipment
- Diesel driven dewatering pumps
- Waste water treatment facilities
- Temporary structures for response coordination and staff welfare
- Mobile communications equipment, including deployable instrumentation facilities
- Inert gas supplies
- All necessary ancillary equipment required to use these facilities, including fuel stocks

127. ONR considers that the provision of such equipment and the associated storage locations will provide a significant improvement in EDF NGL's ability to provide resilience to cope with a wide range of events. ONR also notes that it is planned that delivery of this equipment and the associated facilities will be complete by the third quarter of 2013 with capability demonstrations planned for early in 2014.

128. By way of example ONR notes that as of August 2012 EDF NGL has placed an order for 60 all-terrain haulage lorries and that these vehicles are now in production. Additionally EDF NGL has placed an order for high pressure water pumps to support boiler feed. Delivery of the first of these pumps is planned for January 2013.

129. Whilst it is intended that the AGR back-up equipment storage locations will be at strategic locations around the UK it is noted that the Sizewell B ERC, construction of which is intended to be complete by the end of 2013, will be located within a few kilometres of Sizewell B. This is because the time available to provide protection for a PWR in the event of an extreme beyond design basis event is more limited than that for an AGR. It is noted that in addition to providing storage for back-up equipment the Sizewell ERC will also include a back-up ECC. ONR considers this strategy to be appropriate.

130. Overall, in the context of providing off-site back-up equipment, ONR considers that good progress is being made, which once complete, will provide EDF NGL with a significant improvement in its ability to provide resilience against a wide range of events.

131. Magnox has also made enhancements to emergency equipment availability at Wylfa including construction of a new compound in a secure location to house new and existing emergency plant and equipment. Magnox is also procuring containerised backup equipment including mobile diesel generators and isolation transformers that can be used to supply existing systems and equipment. This work is scheduled for completion by the second quarter of 2013.

## 2.2 - Emergency Response and Post Accident Management (off-site)

132. ONR has progressed this area via IRs 2, 6 and 7 and FR 5 of Ref. 2. The progress described in Section 2.1 – National Organisations is also relevant to this topic but is not described here in order to avoid duplication. In addressing this topic, the UK has sought to describe and conclude upon the appropriateness of its current emergency preparedness and response arrangements.

133. Within the UK any off-site emergency will be met by a multi-agency response consisting of the relevant UK government department, LAs, emergency services, nuclear operator/licensees and the regulatory authorities. Therefore, this section has been split into analysis performed by the UK government, who would lead the response of local bodies and emergency services; and nuclear operating organisations. The response of ONR is considered throughout this topic.

### National emergency response arrangements

134. The circumstances of the events at Fukushima were particularly demanding in that the threat of significant radiological release continued for weeks before some degree of reliable control was established, and it was in the context of massive infrastructure disruption. Such circumstances have the potential to stretch resources at all levels, both in the country affected and in other countries seeking to provide advice to their citizens at home and abroad.

*IR-2: The Government should consider carrying out a review of the Japanese response to the emergency to identify any lessons for UK public contingency planning for widespread emergencies, taking account of any social, cultural and organisational differences.*

135. ONR is contributing to a UK governmental review of the Japanese response to the widespread civil emergency that occurred following the great east Japan earthquake and subsequent tsunami. It will then compare the findings with the UK's own civil contingency planning to identify whether there are lessons that can be learnt from the Japanese experience to improve the UK's own planned response to emergencies. This review will consider:

- What happened in Japan, i.e. the earthquake as well as the subsequent tsunami and their impact.
- The Japanese response to the range of diverse impacts that occurred across a large geographical area.
- Current UK risk identification, contingency planning and capability building processes.
- Key issues arising from the Japanese experience which have read across with UK contingency planning – to enable the UK to identify lessons that may be learnt to make our planning even more robust.

136. As part of these broad categories, the UK government will also consider other cross-cutting issues which are crucial to ensuring the most efficient response possible.

137. ONR and the UK government have already consulted with, and gained valuable evidence from, the Japanese government and the Foreign and Commonwealth Office, as well as a range of publically available reports that have been written about the emergency. In order to complete its review in a timely way, the UK government will use the evidence currently available to inform current thinking. However, as the Japanese response to this crisis is still ongoing and further evidence continues to emerge, it is unlikely that final conclusions can be drawn before the Japanese have been able to complete and evaluate their response in full.

138. Experience in Japan indicates that further guidance is needed to plan for a multi-hazard event and multi-plant sites. This should include guidance on the resilience of response infrastructure including communications, information sharing, the location of the strategic co-ordination centre and other resources.

### Planning Controls

139. The practicability of implementing off-site countermeasures is inextricably linked to the density and distribution of people around the nuclear site. A site that was acceptable for emergency planning purposes when it was first established may not continue to be acceptable unless planning controls limit population growth in the site's locality, or action can be taken to ensure the off-site emergency countermeasures can cope with the changed demographic. In making decisions on planning consent for developments near to nuclear sites, it is therefore vital that ONR's expert advice on these matters continues to be given full consideration by the relevant planning authorities. In light of the events at Fukushima, it is timely for the relevant government department(s) in the UK to examine the existing system of planning controls for developments in the vicinity of nuclear sites and consider the need for improvements.

**FR-5:** *The relevant government departments in England, Wales and Scotland should examine the adequacy of the existing system of planning controls for commercial and residential developments off the nuclear licensed site.*

140. This review has confirmed the validity of existing extendibility planning principles to protect the public against the unlikely event of a severe nuclear emergency. Nevertheless, there is a need to learn from the experiences of all actual incidents to ensure that the supporting details required to provide outline planning for extendibility are still appropriate.

### Off-site Infrastructure Resilience

141. ONR's role is defined in legislation by the Nuclear Installations Act 1965 (NIA65) and (REPPiR). In consequence, it needs to ensure that the on-site and off-site emergency plans are joined up and fully integrate the multi-agency response for any given site. Thus, ONR has followed up the lessons learnt from Fukushima with all duty holders that make up the multi-agency response under REPPiR, in particular NEPLG and DECC (the lead Government Department).

142. ONR has reviewed the government / DECC and licensees planned actions and schedule. ONR is of the opinion that appropriate lessons are being learnt from Fukushima and that resolution of the planned activities should strengthen the multi-agency preparedness and response capability.

143. On being notified of an emergency affecting a licensed nuclear site, ONR would send inspectors, both to site and to the appropriate off-site facility, who would monitor the situation and review the activities of the operators. This is to ensure that they are taking all reasonable steps both to restore the plant to a safe state, to minimise the risk to the general public and to gather evidence for subsequent investigation or inquiry.

144. ONR would set up its RCIS to provide a technical assessment capability and to support the HMCINI or his representative and the ONR inspectors on the site, at the off-site facility or at the CESC. This would allow ONR to make independent assessments of the likely course of the accident and its consequences, and to consider any implications for other nuclear installations.

145. The GTA would act as advisor to central government in nuclear emergencies and would give advice based on ONR's assessments to government departments, devolved administrations, HSE, and the operators as appropriate.

146. The HMCINI's Final Report (Ref. 2) reported that the extensive and extended nature of the Fukushima accident indicates that there is a need to consider extending some emergency exercises in the UK to include severe (large-scale) accident scenarios. ONR's RCIS is at its headquarters in Bootle, Liverpool was staffed and operational for over two weeks, including

overnight working immediately following the accident at Fukushima. Similarly, the UK nuclear power industry established its own crisis centre. The use for such a long period has identified some areas where improvements may be made through exercising in real time such matters as: hand-over arrangements, sustainability of resourcing, the provision of technical advice in short timescales (tailored to the needs of different recipients), and the vital role of communications and the acquisition of reliable data. For effective response to any UK incident there may be benefits in the regulator having direct access to real time independent information of key parameters from the affected site, if practicable. This is the case in some other countries. Additionally, there would be advantages in having available for each site a more extensive suite of radiological release calculations, release categories and associated dose rate predictions as discussed previously in this section.

147. In light of the extended Japanese emergency, HMCINI Interim Report made the following recommendation:

**IR-6:** *ONR should consider to what extent long-term severe accidents can and should be covered by the programme of emergency exercises overseen by the regulator.*

*This should include:*

- *evaluation of how changes to exercise scenarios supported by longer exercise duration will permit exercising in real time such matters as hand-over arrangements, etc.;*
- *how automatic decisions taken to protect the public can be confirmed and supported by plant damage control data; and*
- *recommendations on what should be included in an appropriate UK exercise programme for testing nuclear emergency plans, with relevant guidance provided to REPPiR duty holders.*

148. Recommendation IR 6 was made on the basis that ONR considers to what extent long-term severe accidents can and should be covered by the programme of emergency exercises overseen by the regulator. The current aim is for ONR to produce a report on this review by the first quarter of 2013.

149. ONR has initiated a review of the existing programme of exercises to evaluate how changes to exercise scenarios supported by longer exercise duration will permit exercising in real time such matters as hand-over arrangements etc. It will also look closely at how automatic decisions taken to protect the public can be confirmed and supported by plant damage control data. It will then make recommendations on what should be included in an appropriate UK exercise programme for testing nuclear emergency plans. Relevant guidance will be provided to REPPiR duty holders.

150. To fully capture the learning from the Fukushima event, HMCINI's Final Report (Ref. 2) made the following recommendation:

**IR-7:** *ONR should review the arrangements for regulatory response to potential severe accidents in the UK to see whether more should be done to prepare for such very remote events.*

*This should include:*

- *enhancing access during an accident to relevant, current plant data on the status of critical safety functions, i.e. the control of criticality, cooling and containment, and releases of radioactivity to the environment, as it would greatly improve ONR's capability to provide independent advice to the authorities in the event of a severe accident; and*
- *review of the basic plant data needed by ONR – this has much in common with what we suggest should be held by an international organisation under Recommendation IR1.*

151. Although stakeholders have fed-back positively regarding ONR's response to the Fukushima accident, such as its provision of authoritative advice to government, the organisation is always striving to continuously improve. As such, improvement work-streams relevant to ONR's emergency arrangements function have been established:

- Proactively continuing to improve through its existing links and engagement with NEPLG and other emergency arrangements stakeholders, and through working with our emergency arrangements training provider. This work is ongoing.
- Deputy Chief Inspector lead response to Recommendation IR7: One of ONR's Deputy Chief Inspectors was given the lead to work with our business-as-usual function to conduct a lessons learnt exercise specifically regarding our response during Fukushima (and other times when the ONR RCIS has been operational, for example, during exercises) and our arrangements for responding to emergencies. This work was completed at the end of 2011. ONR's improved emergency response capability will be supported by existing "command and control" training supplemented by new role-specific training modules. A significant number of individuals will be trained in more than one role (for example, a command role in addition to a technical role) to help provide the flexibility needed in ONR's response to a severe accident or other prolonged emergency. Refresher training will be provided as a matter of course. ONR has worked with a specialist command and control consultancy to develop improved supporting documentation.

## 2.3 – International Cooperation

152. International co-operation required in the interest of nuclear safety was considered by the HMCINI's reports on the Fukushima accident (Refs. 1 and 2). ONR has progressed work in this area via IRs 1 and 3 and FR9 from Refs 1 and 2 and these are quoted where appropriate. This section considers operating organisations, regulatory organisations and UK government.

### International Recommendations for Response and Global Nuclear Safety

**IR1** - *The Government should approach IAEA, in co-operation with others, to ensure that improved arrangements are in place for the dissemination of timely authoritative information relevant to a nuclear event anywhere in the world.*

*This information should include:*

*a) basic data about the reactor design including reactor type, containment, thermal power, protection systems, operating history and condition of any nuclear materials such as spent fuel stored on the site should be held permanently in a central library maintained on behalf of the international community; and*

*b) data on accident progression and the prognosis for future accident development. The operator would provide such information as is available to its national authorities. International mechanisms for communicating this information between national governments should be strengthened. To ensure that priority is given to relevant information, international agreement should be sought on the type of information that needs to be provided.*

**FR9** - *The UK Government, nuclear industry and ONR should support international efforts to improve the process of review and implementation of IAEA and other relevant nuclear safety standards and initiatives in the light of the Fukushima-1 (Fukushima Dai-ichi) accident.*

The UK government has stated (Ref. 2) that UK is committed to working with our international partners to consider how dissemination of information under the Convention on Early Notification of a Nuclear Accident can be further improved in terms of both efficiency and substance.

There is existing good co-operation between ONR and nuclear regulators worldwide, including through various international nuclear bodies. This latter grouping includes:

- the IAEA;
- the Organisation for Economic Co-operation and Development's (OECD) Nuclear Energy Agency (NEA);
- ENSREG;
- the Western European Nuclear Regulators' Association (WENRA).

153. All have had meetings since the Fukushima accident at which lessons to be learnt were discussed. Additionally, at both the triennial Review Meeting of the CNS (April 2011) and the Review Meeting of the Joint Convention (May 2012) special attention was paid to the Fukushima accident and lessons learnt. ONR staff, led by the HMCINI, plays an active part in all these meetings, the outcomes of which include:

- IAEA - A ministerial conference convened by IAEA in June 2011 followed by the development of an action plan where ONR provided independent and objective advice to the UK government in support of its participation;
- NEA - A special conference under the auspices of NEA in Paris of nuclear regulators and stakeholders in June 2011;
- ENSREG - The development of European Council "Stress Tests", the submission of national reports and the subsequent peer review process;
- WENRA – The development of the technical content of the ENSREG stress tests and the process for peer review. A subsequent programme of further work including a review of safety reference levels;
- CNS - An Extraordinary Review Meeting of the Convention on Nuclear Safety to review contracting parties' responses to the Fukushima accident in August 2012. The UK National Report was delivered in May 2012 and ONR participated fully in the meeting.

154. In addition, ONR has close bilateral links with other nuclear regulators, in particular the French Autorité de Sûreté Nucléaire (ASN) and the United States Nuclear Regulatory Commission (US NRC). These links have been very useful in the immediate response to the accident and in co-ordinating work.

155. HMCINI has had bilateral discussions with several other chief nuclear regulators from around the world and with the director generals and senior staff of IAEA and NEA, and similarly with the Director General for Energy of the European Council.

156. ONR has led the UK's participation in the European stress test process. All UK licensees have produced a submission against the ENSREG stress test specification. Subsequently, ONR has published a national stress test report (Ref. 3). This report has undergone European peer review, the results of which are reported in an ENSREG country report and published on the ENSREG website.

157. Additionally, HMCINI led an IAEA high-level team of international nuclear experts to conduct a fact-finding mission to the Fukushima plant in Japan, initially to inform the IAEA Ministerial Conference. Subsequently under bilateral arrangements HMCINI has had meetings with the Japanese regulator, members of both sides of the Japanese Parliament and the Japanese Parliament's independent investigation team. Such co-operation has greatly enhanced ONR's ability to respond to the Fukushima accident. Such co-operation will continue.

158. Overall, ONR considers that the responses from the UK government, UK operating organisations and from within the regulatory body (ONR) are sufficient to demonstrate that support for international efforts to improve the process of review and implementation of IAEA and other

relevant nuclear safety standards and initiatives in the light of the Fukushima-1 accident have effectively become “normal business”.

159. In response to these recommendations the UK government has continued to work with its partners in the G8 governments, G20 governments and in other international fora to ensure better compliance with international conventions and push forward work on enhancing nuclear safety standards established under the auspices of the IAEA.

160. The UK has participated in the IAEA activities that led to the development of the Director General's action plan and will continue to work with the IAEA to help ensure the delivery mechanism for the action plan is both robust and realistic - especially bearing in mind the significance of the work it proposes.

161. In meeting the actions proposed by the plan the UK have already committed, through the UK's statement at the IAEA Ministerial Conference, to participate in further IRRS peer review missions.

162. The UK government is also committed to working with our international partners to consider how the dissemination of information under the Convention on Early Notification of a Nuclear Accident can be further improved in terms of both efficiency and substance.

163. Currently the UK is not proposing any changes to the existing suite of international conventions as it believes that there is a need to fully analyse the lessons learnt from events at Fukushima and the stress test initiatives being undertaken before any informed decisions can be made on how the International Nuclear Safety Framework could/should be enhanced. Nonetheless, in general the UK believes that the existing Conventions provide an adequate framework in which continuous improvement can be achieved.

164. The UK continues to be an active member of a range of international organisations including the IAEA, the NEA, the G8 Nuclear Safety and Security Group, and ENSREG. In addition the UK has established bilateral links at government level with our closest neighbours – primarily France – to ensure the maximum benefits are gained through cooperation and sharing of information and expertise in ensuring nuclear safety.

165. The UK continues to welcome periodic peer review of our regulatory approach to ensuring nuclear safety, and has already agreed a date for the next IRRS missions (follow-up missions and full mission). Also the UK has fully participated in the European stress test initiative which includes a peer review process – i.e. UK involved in the peer review of other states as well as subjecting UK regime to peer review.

166. In addition, as part of addressing IR3 (Ref. 1), DECC, under the new strategic framework, is also taking forward a number of international projects in order to better understand the risks the UK faces and strengthen our ability to respond. This work includes for example, a new joint UK-France framework on emergency planning and the international benchmarking of UK emergency arrangements. DECC is also working with NEPLG on the guidance for responding to malicious incidents and events overseas.

167. It is of note that within the IAEA action plan that, in response to member state prompting in this area (including UK), the IAEA Secretariat have committed to work to provide member states, international organizations and the general public with timely, clear, factually correct, objective and easily understandable information during a nuclear emergency on its potential consequences, including analysis of available information and prognosis of possible scenarios based on evidence, scientific knowledge and the capabilities of member states.

## **Section 3 - Additional Topics (Not in ENSREG or CNS consideration)**

### **3.1 Additional Topics**

168. This section deals with topics that aren't specifically covered elsewhere in the document but still play an important part in the UK's National Action Plan in response to the events at Fukushima.

169. Following the events at Fukushima the UK's HMCINI produced two substantial reports which contained 38 recommendations, these placed actions on the UK nuclear industry, ONR and the UK government. A number of these recommendations have been discussed throughout this report; however, the Chief Inspector's reports took a holistic approach to consider the whole nuclear sector and produced a number of Recommendations which have not been considered within the ENSREG specification. The table below provides information on the additional topic areas that have been considered in the Chief Inspector's reports and a summary of the relevant Recommendations.

Topic Area	Chief Inspector's Recommendation
Planning Controls	<b>Recommendation FR-5:</b> The relevant Government departments in England, Wales and Scotland should examine the adequacy of the existing system of planning controls for commercial and residential developments off the nuclear licensed site.
Safety Assessment Approach	<b>Recommendation IR-5:</b> Once further detailed information is available and studies are completed, ONR should undertake a formal review of the Safety Assessment Principles to determine whether any additional guidance is necessary in the light of the Fukushima accident, particularly for "cliff-edge" effects.  <i>The review of ONR's Safety Assessment Principles (SAP should also cover ONR's Technical Assessment Guides (TAG), including external hazards.</i>
Research	<b>Recommendation FR-10:</b> ONR should expand its oversight of nuclear safety-related research to provide a strategic oversight of its availability in the UK as well as the availability of national expertise, in particular that needed to take forward lessons from Fukushima. Part of this will be to ensure that ONR has access to sufficient relevant expertise to fulfil its duties in relation to a major incident anywhere in the world.
Spent Fuel Strategies	<b>Recommendation IR-12:</b> The UK nuclear industry should ensure the adequacy of any new spent fuel strategies compared with the expectations in the Safety Assessment Principles of passive safety and good engineering practice.  <i>Existing licensees are expected to review their current spent fuel strategies as part of their periodic review processes and make any reasonably practicable improvements, noting that any intended changes need to take account of wider strategic factors including the implications for the nuclear fuel cycle.</i>
Human Capabilities and Capacities	<b>Recommendation FR-11:</b> The UK nuclear industry should continue to promote sustained high levels of safety culture amongst all its employees, making use of the National Skills Academy for Nuclear and other schemes that promote "nuclear professionalism".

170. The reasoning behind these additional recommendations is provided in the two Chief Inspector's Reports (Refs. 1 & 2). For a more complete picture on the work done to address these recommendations please refer to the ONR's Fukushima Implementation Report (Ref. 5).

### Openness and Transparency

**Recommendation IR-4:** *Both the UK nuclear industry and ONR should consider ways of enhancing the drive to ensure more open, transparent and trusted communications, and relationships, with the public and other stakeholders.*

171. The UK nuclear regulator has been developing its openness and transparency agenda for nearly a decade. This was seen from the outset for the Generic Design Assessment (GDA) for potential new reactors with the publication of requesting parties' safety submissions and periodic reports from the regulator as the project proceeded. In addition, all of the GDA assessment reports produced so far have been placed in the public domain.

172. ONR has stated that openness and transparency means adopting a presumption of disclosure, and a specific work stream is in place to ensure more work is made publicly available. An example of improvements made include the online publication of over 100 executive summaries of project assessment reports (PAR) which explain the rationale for regulatory decisions on nuclear safety issues and demonstrate that decisions are balanced, consistent and evidence based. These provide a brief overview of the regulatory decision, and can be readily understood.

173. Following the success of these summaries, ONR has now moved towards publishing full PARs on its website ([www.hse.gov.uk/nuclear](http://www.hse.gov.uk/nuclear)). These contain significant technical details that are necessary to inform the regulatory decision. Details remain in the document, unless it is necessary to redact them under normal Freedom of Information (Fol) exemptions (e.g. for security reasons). For example, to date, full PARs have been published for many of our regulatory decisions and this is becoming a well embedded process as part of ONR's regulatory activity. ONR is continuing to build on this work and is striving to publish more of its output, covering aspects of all its regulatory activities.

174. Although ONR is intending to publish much more of its work, it is by no means the only way ONR communicates with its stakeholders. HMCINI and other senior managers in ONR meet on a twice-yearly basis with non-governmental organisations (NGO) to share information and listen to their concerns. The groups understand that they will not always agree but recognise that this has created an environment for sharing and engagement. The minutes of these meetings are published on ONR's website. At NGO meetings, and at the annual forum with leaders of the nuclear sector, openness and transparency has been on the agenda.

175. ONR has both attended, and held, events for members of the public interested in HMCINI's report on events at Fukushima and what it means for the UK. There has also been a general forum for communities living near to the Sizewell and Hinkley nuclear sites to hear from inspectors responsible for regulating safety and security at the plants. There are, in addition to the many presentations at conferences and other meetings, routine site inspection reports to local communities, which are also published on ONR's website

176. The website is a key channel for ONR with regards to its commitment to being open and transparent. Quarterly news, an online publication, gives an overview of ONR's work during the previous three months and every month an external eBulletin is sent to over 13,000 subscribers. As such the work from this recommendation is now considered to take place within "normal business"

177. ONR encourages licensees to be as open and transparent as possible within the bounds of security and commercial sensitivities. The licensees have been receptive to this and have published reports including those relating to Fukushima on their respective websites.

***Recommendation FR-8: The Government should consider ensuring that the legislation for the new statutory body requires ONR to be open and transparent about its decision-making, so that it may clearly demonstrate to stakeholders its effective independence from bodies or organisations concerned with the promotion or utilisation of nuclear energy.***

178. The work that is currently taking place on the creation of a statutory ONR has at its heart the transparency of the regulator and its relationship with government (including bodies concerned with the promotion or utilisation of nuclear energy). The intention is for the statutory ONR's five year strategy, annual plan, annual report and accounts to all be shown to Parliament as well as widely published by the statutory ONR itself. The Secretary of State will report to Parliament on any directions that he gives to the statutory ONR, as well as the use of his powers such as making appointments to the statutory ONR Board. In addition, the statutory ONR will report every five years to Parliament on the functioning of the nuclear regulatory regime. All of these measures, the creation of the statutory ONR's Board and giving the statutory ONR powers and duties over nuclear regulation in its own right (not currently the case), will lead to greater transparency. This will help to clearly demonstrate the statutory ONR's effective independence from anybody concerned with the promotion or utilisation of nuclear energy. The inclusion of an Energy Bill in the second session of Parliament was confirmed by the Queen in her speech at the state opening of Parliament on 9 May 2012. The Energy Bill will contain provisions to create the ONR as an independent statutory corporation. The Bill has now been laid before parliament.

179. Pending legislation, ONR was set up as a non-statutory agency of the Health and Safety Executive (HSE) on 1 April 2011. As a statutory body ONR will retain the best of current practice whilst creating a modern independent regulator based on the better regulation principles of transparency, accountability, proportionality and consistency. ONR will build on its current strengths as an effective regulator and will be better placed to respond quickly and flexibly to current and future regulatory challenges while retaining its core focus on securing the protection of people and society from the hazards of nuclear generation. As a result, there will be a more transparent statutory arrangement under which ONR will have legal responsibility for this core, and other, functions. Additionally, transparency and independence will be enhanced by creating the role of Chief Nuclear Inspector in statute for the first time and, in practice, delegating all of the regulatory functions to the Chief Nuclear Inspector.

## Research

**FR-10:** *ONR should expand its oversight of nuclear safety-related research to provide a strategic oversight of its availability in the UK as well as the availability of national expertise, in particular that needed to take forward lessons from Fukushima. Part of this will be to ensure that ONR has access to sufficient relevant expertise to fulfil its duties in relation to a major incident anywhere in the world.*

180. The Government has established an Independent Nuclear Research Board to advise on the development of a national research and development strategy. As the research board includes representatives from a broad range of interested parties, including HMCINI, it is able to provide high-level strategic review of UK nuclear research activities. To support the research board, and to provide additional oversight of relevant research activities, to identify opportunities for collaboration and to share good practice, the nuclear regulators have established a cross-cutting Research Working Group. The working group includes representatives from the Environment Agency, SEPA, Health and Safety Laboratory, HPA, the Nuclear Decommissioning Authority (NDA) and DECC.

181. Since the nuclear accident at Fukushima, ONR has undertaken a review of its strategic oversight of nuclear safety and security related research, and its arrangements for commissioning and managing research and specialist technical support. The review is being used to inform the development of an ONR Research & Technical Support Strategy, which was published in November. This strategy, which is supported by a detailed implementation plan, sets out the important role research and technical support plays in underpinning our regulatory decisions, the challenges we face going forward and how we plan to overcome these. A Chief Inspector's Independent Technical Advisory Group is to be established, and its role will include advising the Chief Nuclear Inspector on the adequacy and balance of ONR's research strategy and programme.

182. The main vehicle used by ONR to take forward its research priorities is the Nuclear Research Index (NRI), which represents ONR's view of what research is needed to support existing nuclear facilities. This is used by the nuclear site licensees to inform the development of their own research strategies. ONR will commission any research areas not taken forward by the nuclear site licensees and then recover the costs from the licensees via levy.

183. In addition to relying on our own technical specialists, there are occasions when we use external technical support, for example to validate risk data provided by industry. Due to the volume of confirmatory analysis needed for our GDA process, we established a framework agreement, including 31 technical support contractors, across a range of 15 technical areas using the Official Journal of the European Union (OJEU) process. The current framework comes to an end in 2013 and we are currently reviewing the changes needed to ensure it can be used effectively across the range of ONR's activities, and in particular to provide any technical support we might need in the event of a nuclear accident overseas.

## SECTION 4

### TIMESCALES AND MILESTONES

184. This section addresses the implementation of actions raised within Section 1 of this report. It aims to demonstrate the progress ONR has made with the UK licensees in addressing the lessons learnt from the events at Fukushima and the planned activities by both the licensees and the UK regulatory bodies in addressing these lessons.

185. The UK licensees have provided information about the progress they have made against the lessons learnt from the events at Fukushima. This information has included progress and plans to address the HMCINI recommendations, ONR stress test findings and the licensees own considerations.

186. These recommendations, findings and considerations form the basis of the UK's response to Fukushima. The Recommendations, Findings and Considerations have been linked to the ENSREG Compilation of recommendations and suggestions (Ref. 4). This linking has been described within Sections 1 to 3 of this report. ENSREG's Action Plan called for an update on the implementation status on the national regulators conclusions from the national stress tests. Table 1 provides an update on the status of work being carried out by EDF NGL and Magnox to address the stress test findings. Table 2 below shows the planned time scale for completion of the ENSREG compilation of recommendations and suggestions as well as any further work being undertaken to address the learning from the Fukushima events.

187. There are a range of longer-term improvements or ongoing activities that will need to be delivered over timeframes extending beyond those for the production of this report. ONR will monitor and assess the adequacy of progress made by the UK nuclear industry over the longer term, until it is satisfied that the significant lessons learnt from the Fukushima event have been adequately discharged and will, if necessary, use its regulatory powers to ensure that all reasonably practicable improvements are implemented.

188. ONR will secure such oversight by embedding ongoing "Fukushima learning" oversight activities into its operational regulatory programme for NPP.

This approach offers a number of distinct benefits in that it:

- secures longer term oversight by ONR of improvements relating to the lessons learnt from the Fukushima event;
- is both effective and efficient in terms of future use of regulatory resources;
- ensures that, in the overall interests of nuclear safety, such improvements are delivered taking into account the relative significance of all activities on the site; and
- that such improvements are regulated, as appropriate, under the provisions of the licence conditions attached to each nuclear site licence.

189. ONR is committed to continuing to monitor and assess progress, to publish summary updates for stakeholders on our website and site stakeholder reports and to continue to advise government on the adequacy of progress made by the industry.

## Conclusions

190. This report has been prepared by the UK regulator (ONR) in response to ENSREG's Action Plan (Ref 9). This NAcP draws heavily on the pre-existing UK specific reports produced in response to Fukushima (Ref 1, 2, 3 & 5), and is especially reliant on the most recent report (Ref 5) on implementing the lessons from Fukushima for the UK nuclear industry.

191. Together with the supporting references, ONR's NAcP provides clear evidence that ONR and the UK nuclear power licensees have incorporated, or are in the process of incorporating, all the learning from the ENSREG peer review reports (individual UK report and the overall report) and compilation of recommendations into the existing programme of work aimed at learning lessons from Fukushima.

192. Overall ONR is satisfied with the progress being made but recognises the need to sustain efforts to ensure that all of the relevant work items are satisfactorily closed out and that the timescales for close out are adhered to.

193. There is a formal process to embed the Fukushima work within in ONR's normal business to ensure that compliance is appropriately tracked and monitored, that any necessary regulatory intervention to progress issues is undertaken, and that the outcomes are reported in the transparent and open manner established by ONR.

194. The NAcP, together with its supporting references, is expected to provide an adequate basis for peer review by common discussion within the ENSREG community.

**Table 1: Update of Work Being Carried out by EDF NGL and Magnox to Address UK National Stress Tests**

Ref.	Stress Test Finding	Status	Progress to date	Completion Date
STF-1	Licensees should provide ONR with the decision-making process to be applied to their <i>Considerations</i> along with a report which describes the sentencing of all their <i>Considerations</i> . The report will need to demonstrate to ONR that the conclusions reached are appropriate.	Complete	The decision making process and the update detailing all of its Considerations has been delivered to the ONR by EDF NGL as part of this June 2012 submission.  EDF NGL will continue to provide information on the progress of the ONR recommendations and findings as well as its own Considerations as the JER Programme progresses.	June 2012
STF-2	The nuclear industry should establish a research programme to review the Seismic Hazard Working Party (SHWP) methodology against the latest approaches. This should include a gap analysis comparing the SHWP methodology with more recent approaches such as those developed by the Senior Seismic Hazard Analysis Committee (SSHAC).	Ongoing	Seismic hazard derivation methods that underpin the design basis seismic hazards for the EDF NGL sites are common with those employed by Magnox and Sellafield Ltd. EDF NGL is to commission a gap analysis, to be carried out by independent seismic hazard experts, comparing the SHWP and current methodologies including a procedural view of SSHAC.	A programme for undertaking the gap analysis including stakeholder engagement is being developed – Q2 2013
STF-3	Licensees should undertake a further review of the totality of the required actions from operators when they are claimed in mitigation within external hazards safety cases. This should also extend into beyond design basis events as appropriate.	Ongoing	The first phase of delivery is underway and a draft report assessing the feasibility of operator actions claimed in relation to the Hartlepool (HRA)/ Heysham 1 (HYA) extreme weather safety cases has begun. This will form the basis of a fleet wide review taking into account fuel route and the seismic hazard.	Initial operator action review: extreme weather - Q1 2013 Seismic - Q2 2013 Development of detailed phase 2 scope Q2 2013
STF-4	Licensees should undertake a further systematic review of the potential for seismically-induced fire which may disrupt the availability of safety-significant structures, systems and components (SSC) in the seismic safety case and access to plant areas.	Ongoing	All EDF NGL sites consider the possible occurrence of other hazards arising as a consequence of the initiating hazard. For the seismic case, fire is already recognised as a consequential hazard and in some cases is being considered more fully as part of the combined hazards safety cases.	Optioneering to identify any resolutions – complete by end Q1 2014

Ref.	Stress Test Finding	Status	Progress to date	Completion Date
STF-5	Licensees should further review the margins for all safety-significant structures, systems and components (SSC), including cooling ponds, in a structured systematic and comprehensive manner to understand the beyond design basis sequence of failure and any cliff-edges that apply for all external hazards.	Ongoing	<p>Flooding - Independent reports have been commissioned which will aid the recalculation of the flooding risk from pluvial, fluvial and wave events.</p> <p>Seismic hazard - The scope document has been updated with key milestones.</p> <p>Extreme Weather - EDF NGL has made contact with the Met Office and drafted an Engineering Advice Note (EAN) to consider causally-linked weather events that may affect the hazard margins.</p>	<p>Flooding Q1 2013 (Engineering Report)</p> <p>Seismic Q1 2014</p> <p>Extreme Weather Q1 2014</p>
STF-6	Licensees should review further the margin to failure of the containment boundary and the point at which containment pressure boundary integrity is lost should be clearly established for the advanced gas-cooled reactors (AGR) and Magnox stations.	Ongoing	The review will consider all aspects of the components required to sustain vessel pressure. This includes the pre-stressed concrete pressure vessel as well as the non isolatable penetrations into the vessel, for example the gas bypass lines, gas circulator seals and large numbers of the small bore pipes.	Completion of containment margin review and issue, by end of Q1 2014.
STF-7	Licensees should undertake a more structured and systematic study of the potential for floodwater entry to buildings containing safety-significant structures, systems and components (SSC) from extreme rainfall and / or overtopping of sea defences.	Ongoing	<p>Following an assessment of the magnitude of any such margins, reasonably practicable means of enhancing protection against flood water ingress into buildings will be considered. The aim of any enhancements will be to eliminate, where practicable, any clear outliers in the vulnerability of SSCs to water inundation.</p> <p>Where enhanced on-site resilience cannot be achieved through simple modifications the infrastructure will be assessed and the appropriate means employed to deploy backup equipment to site.</p>	<p>Completion of flooding studies - Q3 2013</p> <p>Completion of the Safety Case comparison - Q2 2013</p> <p>Implementation of site resilience modifications - Q1 2014</p>

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Ref.	Stress Test Finding	Status	Progress to date	Completion Date
STF-8	Licensees should further investigate the provision of suitable event-qualified connection points to facilitate the reconnection of supplies to essential equipment for beyond design basis events.	Ongoing	A number of site walkdowns have been carried out to review the practicability of providing connection points to facilitate the reconnection of supplies to essential equipment for beyond design basis events. A number of connection points have been identified across the 9 UK reactor sites and will be implemented to provide the necessary points to connect power generating equipment and increase essential water stocks.	STF-8 – Provision of plant connection points Installation of connection points - Q2-Q4 2013
STF-9	Licensees should further investigate the enhancement of stocks of essential supplies (cooling water, fuel, carbon dioxide, etc.) and extending the autonomy time of support systems (e.g. battery systems) that either provide essential safety functions or support emergency arrangements.	Ongoing	EDF NGL has completed a fleet wide assessment of the supply and demand of essential stocks on-site and plans have been made for enhancements with respect to beyond design basis events.	Modifications will be implemented - Q4 2013
STF-10	Licensees should identify safety-significant prime mover-driven generators and pumps that use shared support systems (including batteries, fuel, water and oil) and should consider modifying those prime movers systems to ensure they are capable of being self-sufficient.	Ongoing	EDF NGL aims to review the supporting and supported systems documentation at its stations to identify shared support systems of safety-significant prime movers.  EDF NGL does not believe that it will be practicable to remove entirely any reliance on shared supporting systems. However, where it is reasonably practicable to introduce a greater degree of self-sufficiency plant modifications will be considered.  Work is ongoing in Design Authority to look at liquid fuel (diesel/petrol/kerosene) driven pumps and generators.	Further work required to accurately define a work scope and programme to deliver an appropriate suite of nuclear safety benefits Q1 2014
STF-11	Licensees should further consider resilience improvements to equipment associated with the connection of the transmission system to the essential electrical systems (EES) for severe events.	Ongoing	After considering enhancements to this equipment combined with the likely condition of the national grid, EDF NGL have concluded that it is not appropriate to implement changes to the grid connection and therefore this does not form part of EDF NGL's strategy. The current strategy has therefore concentrated on getting on-site generation in place and appropriate plug in points identified and installed to support recovery efforts.	Further Physical Review and walk down of installation - complete  Review of current repair procedures Q2 2013  Procurement of spare parts Q2 2013.

Ref.	Stress Test Finding	Status	Progress to date	Completion Date
STF-12	Magnox Ltd should assess the progressive loss of electrical systems on all aspects of the fuel route and address any implications.	Ongoing	Magnox has commissioned an assessment of the effects of loss of power to fuel routes at all relevant sites.	Q1 2013
STF-13	Magnox Ltd should demonstrate that all reasonably practical means have been taken to ensure integrity of the fuel within the dry fuel stores in the extremely unlikely event of the natural draft air ducting becoming blocked.	Complete	Magnox has reviewed the potential for, and effects of, blockage of the dry fuel store ventilation ducts. Reasonably practicable enhancements have been implemented, in particular pumps to enable removal of water accumulation from the ducts have been provided.	N/A
STF-14	Licensees should confirm the extent to which resilience enhancements are to be made to existing equipment and systems that are currently installed at nuclear power plants. Information should be provided on the equipment and systems that may be affected and the nature of the resilience enhancements, including interconnectivity with mobile back-up equipment.	Ongoing	<p>The focus here is concerned with resilience enhancements to be made to existing equipment and systems.</p> <p>Modifications/ enhancements will be implemented to varying extents as considered necessary on a station by station basis.</p> <p>Identification of resilience measures for all stations covering hazard protection of back-up feed systems, electrical distribution and generator systems (to aid long term recovery of plant) is also being assessed.</p>	<p>Assessment of modifications will be determined by Q3 2012</p> <p>Specifications written for Interfaces and Resilience modification - Q4 2012</p> <p>Modifications will be implemented - Q4 2013</p>

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Ref.	Stress Test Finding	Status	Progress to date	Completion Date
STF-15	Licensees should complete the various reviews that they have highlighted so that ONR can assess their proposals and associated timescales. These reviews should look in detail at on-site emergency facilities and arrangements, off-site facilities, facilities for remote indication of plant status, communication systems, contents and location of beyond design basis containers and the adequacy of any arrangements necessary to get people and equipment on to and around site under severe accident conditions. Any changes to arrangements and equipment will require appropriate training and exercising.	Ongoing	<p>A review of structures, systems and components needed in the response to an accident have recently been completed.</p> <p>A review of station on-site and off-site communications resilience due to extreme conditions has been completed and resilience improvement plans are being made for any communications related enhancements and modifications</p> <p>A review has been carried out with regards to access to and around site as well as transporting mobile back-up modules to site in a severe event.</p> <p>Currently developing specifications to procure backup equipment to support stations for beyond design basis events. Some back-up equipment is already under procurement.</p> <p>Training and Exercising Significant progress across all task analysis areas – sufficient to enable early specification of training approach and principal components.</p>	<p>Reviews completed - Q3 2012.</p> <p>Fixed communications resilience issues and whether enhancements are feasible. Q1 2013</p> <p>Deployment strategy for each site Q1 2013.</p> <p>Expected capability will be shown in Q1 2013</p> <p>All back-up equipment delivered / full deployment capability - Q1 2014.</p>
STF-16	Licensees should review the symptom-based emergency response guidelines (SBERG) and severe accident guidelines (SAG) taking into account improvements to the understanding of severe accident progression, phenomena and the equipment available to mitigate severe accident. This review should also take into account the fuel route. Once completed, appropriate training and exercising should be arranged.	Ongoing	<p>The Review of the Technical Basis for the existing reactor SBERGs is underway in a number of areas, including station input to the review process.</p> <p>The Human Factors review has commenced, with background research underway and initial preparations for scenario workshops.</p> <p>The preparation of the Technical Basis for the Fuel Route SBERGs has been initiated with work to define of the Critical Safety Functions for the Fuel Route.</p>	<p>Demonstration through practical exercise – Q1 2014</p> <p>Training and Exercising of revised emergency procedures will be undertaken on a continuous basis as part of enhanced exercising strategy.</p>

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Ref.	Stress Test Finding	Status	Progress to date	Completion Date
STF-17	Licensees should further review the systems required to support long-term claims on the pre-stressed concrete pressure vessel containment capability in severe accident conditions.	Ongoing	Initial optioneering workshops were held in order to discuss mitigation options in the event that the multiple, redundant, diverse systems in existence were lost. Further internal meetings have been held.	The remainder of the work relevant to STF-17 is yet to be fully scoped
STF-18	EDF Energy Nuclear Generation Ltd should complete its feasibility study into the installation of filtered containment venting, installation of passive autocatalytic hydrogen recombiners and flexible means of injecting water into the Sizewell B containment.	Ongoing	<p>A Nuclear Safety Requirements Specification document has been prepared, the paper describes the Safety Case Approach &amp; Outline for containment venting. Technical specifications for the passive autocatalytic recombiners have been written for submission to suppliers.</p> <p>A method of introducing cooling water to containment will be provided. The penetration for water injection has been identified and the functional specifications for the necessary ancillary are being prepared.</p>	<p>Containment modifications - Q2 2013</p> <p>Install PARs - Q2 2013</p> <p>Modifications to allow for containment water injection - Q2 2013</p>
STF-19	Reports on the progress made in addressing the conclusions of the licensees <i>Considerations</i> and the ONR findings should be made available to ONR on the same timescale as that for HM Chief Inspector's recommendations (June 2012). These should include the status of plans and details of improvements that have been implemented.	Complete	EDF NGL responded to the ONR as expected in June 2012 where EDF NGL have provided updates on the Interim Recommendations, the Final Recommendations, the Stress Test Findings and EDF NGL's own Considerations.	N/A

**Table 2a: Status of Work Addressing the Peer Review Outcomes**

Item for follow up	UK recommendation, STF or consideration that bounds or includes the item
Full scope L2 PSAs not yet performed for AGRs (see below)	FR4
BDB capability – margins & cliff edges	IR 10, STF5
Current assessments have not accounted for recent tsunami research	IR10
No satisfactory evidence of capability of the plants beyond the design basis	STF5
Inclusion of defence in depth principle as part of margin an cliff edge work	STF5
Not all plants fully comply with WENRA Reference Levels yet (apart from the PSA issue, there were no other examples in this section of none or partial WRL compliance cited by the peer review team)	FR4
Consider injection of water in to AGR core to provide heat removal when boilers not available	IR25, IR24, STF16
Consider having 72 hr fuel and other stocks (eg CO2)	STF 9, IR8
Consider improving battery capacity	STF9
Consider increasing robustness of the operating environment of the SZB steam driven pumps	IR25, FR3
Strengthen on-site emergency facilities against ext. Hazards and severe accidents	STF15
Assessment of severe accident(s) at multiple facilities	IR11
Consider need for backup control room	IR 22, STF 15 (in part)
Further development of SBERGs and SAGs – all accident types and operating modes.	STF16
Improved training for “improved” SBERGs and SAGs	IR 24, IR 25, STF16
Analysis of severe accident radiation conditions on-site &	IR24, IR 25

development of measure to address them	
Consider operability issues for new SAM hardware in severe external hazard conditions & SBO	IR16, IR24, IR 25, FR2, FR3, STF8
Consider strengthening SFP coolant inventory top up capability	IR 19, IR 20, STF 9

**Table 2b: Overall Peer Review Report on European NPP**

ENSREG recommendation	ONR coverage
The peer review Board recommends that WENRA, involving the best available expertise from Europe, develop guidance on natural hazards assessments, including earthquake, flooding and extreme weather conditions, as well as corresponding guidance on the assessment of margins beyond the design basis and cliff-edge effects.	ONR is leading the WENRA task group on this topic. IR 10, STF 5
The peer review Board recommends that ENSREG underline the importance of periodic safety review. In particular, ENSREG should highlight the necessity to re-evaluate natural hazards and relevant plant provisions as often as appropriate but at least every 10 years.	ONR is participating in the WENRA task group looking at revising the PSR WRLs. FR1
Urgent implementation of the recognised measures to protect containment integrity is a finding of the peer review that national regulators should consider. The measures to be taken can vary depending on the design of the plants. For water cooled reactors, they include equipment, procedures and accident management guidelines to: <ul style="list-style-type: none"> <li>• depressurise the primary circuit in order to prevent high pressure core melt;</li> <li>• prevent hydrogen explosions;</li> <li>• prevent containment overpressure.</li> </ul>	STF 18
Necessary implementation of measures allowing prevention of accidents and limitation of their consequences in case of extreme natural hazards is a finding of the peer review that national regulators should consider.	IR 16, FR2, FR3

**Table 3: Planned Time Scales and Milestones for Completion of the ENSREG Compilation of Recommendations**

The table below provide details of the current status and, where appropriate, the planned completion time of each individual stress test finding, European peer review conclusions, above and for each individual item from ENSREG's compilation of recommendations and suggestions. There is a degree of overlap between the various work streams that are addressing the Chief Inspector's recommendations and the stress test outcomes; where this happens the tables clearly link these items to provide an auditable trail for all of the work.

Ref.	Site	Activity	Status	Activity Key Milestones	Complete
<b>Topic 1 – Natural Hazards</b>					
3.1.1	All UK NPP sites	Hazard Frequency The use a return frequency of 10-4 per annum (0.1g minimum peak ground acceleration for earthquakes) for plant reviews/back-fitting with respect to external hazards safety cases.	Completed	Covered by the SAPs 2006, this is been further considered during the SAPs reassessment due for publication 2013. Criteria reassessed during the UK Stress Test to reconfirm the compliance of all UK nuclear sites.	N/A
3.1.2	All UK NPP sites	Secondary Effects of Earthquakes The possible secondary effects of seismic events, such as flood or fire arising as a result of the event, in future assessments.	Ongoing	STF-4 - Systematic review of the potential for seismically induced fire: <ul style="list-style-type: none"> <li>• Production of subsequent station reviews</li> <li>• Optioneering to identify any resolutions.</li> </ul>	Q3 2013 Q1 2014
			Ongoing	STF-7 & IR-10– Review of flooding studies: <ul style="list-style-type: none"> <li>• Completion of flooding studies</li> <li>• Completion of the Safety Case comparison</li> <li>• Implementation of site resilience modifications</li> </ul> (Magnox) STF-4 - Systematic review of the potential for seismically induced fire at Wylfa	Q3 2013 Q2 2013 Q1 2014 Q2 2013
3.1.3	All UK NPP sites	Protected Volume Approach The use a protected volume approach to demonstrate flood protection for identified rooms or spaces.	Ongoing Ongoing	STF-7 & IR-10– Review of flooding studies: <ul style="list-style-type: none"> <li>• Completion of flooding studies</li> <li>• Completion of the Safety Case comparison</li> <li>• Implementation of site resilience modifications</li> </ul>	Q1 2013 Q2 2013 Q1 2014

Ref.	Site	Activity	Status	Activity Key Milestones	Complete
3.1.4	All UK NPP sites	Early Warning Notifications The implementation of advanced warning systems for deteriorating weather, as well as the provision of appropriate procedures to be followed by operators when warnings are made.	Ongoing	CSA030 – Assessment of current station forecasting arrangements.  (Magnox) Developing Company standard for early warning of extreme events	Q1 2013  Q1 2013
3.1.5	All UK NPP sites	Seismic Monitoring The installation of seismic monitoring systems with related procedures and training.	Complete  Ongoing	Seismic monitoring was considered within the assessment undertaken as part of the European Stress Tests.  STF-3 - Actions from operators in mitigation external hazards: <ul style="list-style-type: none"> <li>Initial operator action review – seismic</li> </ul> (Magnox) Seismic monitoring was considered within the assessment undertaken as part of the European Stress Tests and is already available at Wylfa together with appropriate procedures for post event operator actions.	Q2 2013  Complete
3.1.6	All UK NPP sites	Qualified Walkdowns The development of standards to address qualified plant walkdowns with regard to earthquake, flooding and extreme weather – to provide a more systematic search for non-conformities and correct them (e.g. appropriate storage of equipment, particularly for temporary and mobile plant and tools used to mitigate beyond design basis (BDB) external events).	Complete	Qualified Walkdowns of all NPP sites completed as part of the European stress tests.	June 2012
3.1.7	All UK NPP sites	Flooding Margin Assessments The analysis of incrementally increased flood levels beyond the design basis and identification of potential improvements, as required by the initial ENSREG specification for the stress tests.	Ongoing Ongoing	STF-7 & IR-10 – Review of flooding studies: <ul style="list-style-type: none"> <li>Completion of flooding studies</li> <li>Completion of the Safety Case comparison</li> <li>Implementation of site resilience modifications</li> </ul> (Magnox) STF-7 & IR-10– Review of flooding studies: <ul style="list-style-type: none"> <li>Review of flooding studies</li> <li>Implementation of site resilience modifications</li> </ul>	Q1 2013 Q2 2013 Q1 2014  Q1 2012 Q3 2013

Ref.	Site	Activity	Status	Activity Key Milestones	Complete
3.1.8	All UK NPP sites	External Hazard Margins In conjunction with recommendation 2.1 and 3.1.7, the formal assessment of margins for all external hazards including, seismic, flooding and severe weather, and identification of potential improvements.	Ongoing	STF-5 - External Hazards margin assessment: <ul style="list-style-type: none"> <li>• Seismic</li> <li>• Extreme Weather</li> <li>• Flooding</li> </ul> (Magnox) STF-5 - External Hazards margin assessment: <ul style="list-style-type: none"> <li>• Seismic margins study</li> <li>• Review of resilience against extreme hazards</li> <li>• Implementation of resilience enhancements</li> </ul>	Q1 2014 Q1 2014 Q2 2014  Complete Complete Q4 2013
<b>Topic 2 - Loss of Safety Systems</b>					
3.2.1	All UK NPP Sites	Alternate Cooling and Heat Sink The provision of alternative means of cooling including alternate heat sinks. Examples include steam generator (SG) gravity alternative feeding, alternate tanks or wells on the site, air-cooled cooling towers or water sources in the vicinity (reservoir, lakes, etc) as an additional way of enabling core cooling.	Ongoing	IR-19 – Long term cooling supplies: Back-up equipment provisions	Q1 2014
			Ongoing	STF-8 – Provision of plant connection points Installation of connection points.	Q2-Q4 2013
			Ongoing	STF-9 – Increasing hardened on-site stock.	Q4 2013

Ref.	Site	Activity	Status	Activity Key Milestones	Complete
3.2.2	All UK NPP Sites	AC Power Supplies The enhancement of the on-site and off-site power supplies. Examples include adding layers of emergency power, adding independent and dedicated backup sources, the enhancement of the grid through agreements with the grid operator on rapid restoration of off-site power, additional and/or reinforced off-site power connections, arrangements for black start of co-located or nearby gas or hydro plants, replacing standard ceramic based items with plastic or other material that are more resistant to a seismic event. Another example is the possible utilisation of generator load shedding and house load operation for increased robustness, however, before introducing such arrangements the risks need to be properly understood.	Ongoing	IR-17 - Resilience of national grid - National Grid resilience assessment.	Q1 2013
			Ongoing	STF-11 - Resilience improvements to equipment associated with the connection of the transmission grid.	Q2 2013
			Ongoing	IR-18 - Long-term independent electrical supplies on-sites.	Q4 2013
			Ongoing	STF-15 - All back-up equipment delivered / full deployment capability.	Q1 2014.
			Ongoing	STF-8 – Provision of plant connection points.	Q2-Q4 2013
			Ongoing	STF-10 – Self sufficiency of generation equipment. (Magnox)	programme continues to be developed
			Ongoing	IR-18 – Additional generators provided for emergency electrical on-site supplies (also for 3.2.3)	Complete
3.2.3	All UK NPP Sites	DC Power Supplies The enhancement of the DC power supply. Examples include improving the battery discharge time by upgrading the existing battery, changing/diversifying battery type (increasing resistance to common-mode failures), providing spare/replacement batteries, implementing well-prepared loadshedding/ staggering strategies, performing real load testing and on-line monitoring of the status of the batteries and preparing dedicated recharging options (e. g. using portable generators).	Ongoing	STF-9 - Autonomy time of support systems (e.g. battery systems): Review of battery autonomy times and identification of possible enhancements.	Q4 2013
			Ongoing	Sizewell B - Battery charging diesel generators are being upgraded	Q4 2013

Ref.	Site	Activity	Status	Activity Key Milestones	Complete
3.2.4	All UK NPP Sites	Operational and Preparatory Actions Implementation of operational or preparatory actions with respect to the availability of operational consumables. Examples include, ensuring the supply of consumables such as fuel, lubrication oil, and water and ensuring adequate equipment, procedures, surveillance, drills and arrangements for the resupply from off-site are in place.	Ongoing	IR-19 - On-site supplies or greater off-site capability.  STF-9 - Enhancement of stocks of essential supplies.  STF-15 - Getting people and equipment on to and around site under severe accident conditions.	Q4 2013  Q4 2013  Q2 2013
3.2.5	All UK NPP Sites	Instrumentation and Monitoring The enhancement of instrumentation and monitoring. Examples include separate instrumentation and/or power sources to enable monitoring of essential parameters under any circumstances for accident management and the ability to measure specific important parameters based on passive and simple principles.	Ongoing	IR-22 - Provision on-site of emergency control, instrumentation and communication  STF-15 - Facilities for remote indication of plant status	Q3 2013  Q3 2013
3.2.6	Sizewell B	Shutdown Improvements The enhancement of safety in shutdown states and mid-loop operation. Examples of improvements include, reducing or prohibiting mid-loop operation, adding dedicated hardware, procedures and drills, the use of other available water sources (e. g. from hydro-accumulators), requiring the availability of SGs during shutdown operations and the availability of feedwater in all modes.	Ongoing	STF-18 - Filtered Containment Venting and PARs  STF-9 - Battery-charging diesel generators and upgrading the resistance of the associated buildings to natural hazards  STF-8 - Connection points for Sizewell B	Q3 2014  Q3 2013  Q3 2014
3.2.7	Sizewell B	Reactor Coolant Pump Seals The use of temperature-resistant (leak-proof) primary pump seals.	Complete	EDF NGL initial review complete  EDF NGL plans to review Operational Experience from any plants that do adopt these seals, and may choose to fit them at some future date.	Q4 2012
3.2.8	Sizewell B  AGRs	Ventilation The enhancement of ventilation capacity during SBO to ensure equipment operability.	Ongoing  Ongoing	STF-18 – Installation of Filtered Containment Venting: <ul style="list-style-type: none"> <li>• Containment modifications</li> <li>• Install PARs</li> <li>• Modifications to allow for containment water injection</li> </ul> IR-21 - review the ventilation and venting routes for nuclear facilities - Review of AGR ventilation equipment and routes.	Q2 2013 Q2 2013 Q2 2013  Q3 2012 (Start)

Ref.	Site	Activity	Status	Activity Key Milestones	Complete
3.2.9	All UK NPP Sites (excluding Wylfa)	Main and Emergency Control Rooms The enhancement of the main control room (MCR), the emergency control room (ECR) and emergency control centre (ECC) to ensure continued operability and adequate habitability conditions in the event of a station black-out (SBO) and in the event of the loss of DC (this also applies to Topic 3 recommendations).	Ongoing  Ongoing	IR-22 - review the provision on-site of emergency control, instrumentation and communications: <ul style="list-style-type: none"> <li>• Sizewell B ERC site work</li> <li>• AGR site modifications</li> </ul> FR-2 & FR-3 - Protection of control rooms against hazards: <ul style="list-style-type: none"> <li>• On-site resilience enhancements to emergency control facilities</li> </ul>	Q4 2013 Q4 2013  Q2 2013
3.2.10	All UK NPP Sites (excluding Wylfa)	Spent Fuel Pool The improvement of the robustness of the spent fuel pool (SFP). Examples include reassessment/upgrading SFP structural integrity, installation of qualified and power-independent monitoring, provisions for redundant and diverse sources of additional coolant resistant to external hazards (with procedures and drills), design of pools that prevents drainage, the use of racks made of borated steel to enable cooling with fresh (unborated) water without having to worry about possible recriticality, redundant and independent SFP cooling systems, provision for additional heat exchangers (e. g. submerged in the SFP), an external connection for refilling of the SFP (to reduce the need for an approach linked to high doses in the event of the water falling to a very low level) and the possibility of venting steam in a case of boiling in the SFP.	Ongoing	IR-20 - Site contingency plans for pond water: <ul style="list-style-type: none"> <li>• Implementation of backup equipment</li> </ul>	Q1 2014
3.2.11	All UK NPP Sites	Separation and Independence The enhancement of the functional separation and independence of safety systems. Examples include the elimination of full dependence of important safety functions on auxiliary systems such as service water and the introduction of an alternate source of cooling.	Ongoing	Separation and Independence is covered by the SAPs 2006 (Ref. 7)  Alternate source of cooling is discussed at 3.2.1  Diverse locations of back-up equipment is discussed at 3.2.13	N/A

Ref.	Site	Activity	Status	Activity Key Milestones	Complete
3.2.12	All UK NPP Sites	Flow Path and Access Availability The verification of assured flow paths and access under SBO conditions. Ensure that the state in which isolation valves fail and remain, when motive and control power is lost, is carefully considered to maximise safety. Enhance and extend the availability of DC power and instrument air (e. g. by installing additional or larger accumulators on the valves). Ensure access to critical equipment in all circumstances, specifically when electrically operated turnstiles are interlocked.	Ongoing	STF-15 - adequacy of any arrangements necessary to get people and equipment on to and around site under severe accident conditions.  (Magnox) STF-15 – Resilience enhancements implemented to assist operator access	Q1 2014 (Demonstration of capability)  Q4 2013
3.2.13	All UK NPP Sites	Mobile Devices The provision of mobile pumps, power supplies and air compressors with prepared quick connections, procedures, and staff training with drills. Mobile devices are intended to enable the use of existing safety equipment, enable direct feeding of the primary or secondary side, allow extended use of instrumentation and operation of controls, allow effective fire-fighting, and ensure continued emergency lighting. The equipment should be stored in locations that are safe and secure even in the event of general devastation caused by events significantly beyond the design basis (this also applies to Topic 3 recommendations).	Ongoing	STF-15 - adequacy of any arrangements necessary to get people and equipment on to and around site under severe accident conditions.  SFT-8 – Provision of plant connection points.  (Magnox) STF-15 – Additional pumps provided to support reactor boiler feed and general duties	Q1 2014 (Demonstration of capability)  Q2-Q4 2013  Q4 2013

Ref.	Site	Activity	Status	Activity Key Milestones	Complete
3.2.14	All UK NPP Sites	<b>Bunkered/Hardened Systems</b> The provision for a bunkered or "hardened" system to provide an additional level of protection with trained staff and procedures designed to cope with a wide variety of extreme events including those beyond the design basis (this also applies to Topic 3 recommendations).	Ongoing	IR 22 – Review the provision on-site of emergency control, instrumentation and communications: <ul style="list-style-type: none"> <li>• Sizewell B ERC site work complete</li> <li>• Completion of AGR site modifications</li> </ul> IR-23 necessary off-site communications for severe accidents: <ul style="list-style-type: none"> <li>• Provision of satellite phones as well a feasibility study regarding increasing the resilience of telephone exchanges.</li> </ul> (Magnox) IR-22 – Resilience enhancements implemented	Q4 2013  Q3 2013  Q3 2014
3.2.15	All UK NPP Sites (except Wylfa)	<b>Multiple Accidents</b> The enhancement of the capability for addressing accidents occurring simultaneously on all plants of the site. Examples include assuring preparedness and sufficient supplies, adding mobile devices and fire trucks and increasing the number of trained and qualified staff (this also applies to Topic 3 recommendations).	Ongoing	IR-11 - Adequately demonstrate the capability for dealing with multiple serious concurrent events.  Construction of new ECC and Back-up equipment garage for Heysham	Detailed timescales for this are not yet finalised
3.2.16	All UK NPP Sites	<b>Equipment Inspection and Training Programs</b> The establishment of regular programs for inspections to ensure that a variety of additional equipment and mobile devices are properly installed and maintained, particularly for temporary and mobile equipment and tools used for mitigation of BDB external events. Development of relevant staff training programmes for deployment of such devices.	Ongoing	STF-15 - adequacy of any arrangements necessary to get people and equipment on to and around site under severe accident conditions.  (Magnox) STF-15 – Programme of training and maintenance to be established	Q1 2014 (Demonstration of capability)  Q3 2014
3.2.17	All UK NPP Sites	<b>Further Studies to Address Uncertainties</b> The performance of further studies in areas where there are uncertainties. Uncertainties may exist in the following areas:	Ongoing	Managing the traumatic, psychological, stress and family effects that staff and other responders may encounter during a severe and prolonged nuclear emergency.	Q1 2014
3.2.17a	All UK NPP Sites (except Wylfa)	The integrity of the SFP and its liner in the event of boiling or external impact.	Ongoing	IR-20 - Site contingency plans for pond water make up: Implementation of backup equipment.	Q1 2014

Ref.	Site	Activity	Status	Activity Key Milestones	Complete
3.2.17b		The functionality of control equipment (feed water control valves and SG relief valves, main steam safety valves, isolation condenser flow path, containment isolation valves as well as depressurisation valves) during the SBO to ensure that cooling using natural circulation would not be interrupted in a SBO (this is partially addressed in recommendation 3.2.10).	Complete	Assessment of SBO of all NPP sites completed as part of the European stress tests.	June 2012
3.2.17c		The performance of additional studies to assess operation in the event of widespread damage, for example, the need different equipment (e.g. bulldozers) to clear the route to the most critical locations or equipment. This includes the logistics of the external support and related arrangements (storage of equipment, use of national defence resources, etc.).	Ongoing	STF-15 - Adequacy of any arrangements necessary to get people and equipment on to and around site under severe accident conditions.  (Magnox)  STF-15 Resilience enhancements implemented to assist operator access	Q1 2014 (Demonstration of capability)  Q4 2013
<b>Topic 3 - Severe Accident Management</b>					
3.3.1	All UK NPP Sites	WENRA Reference Levels The incorporation of the WENRA reference levels related to severe accident management (SAM) into their national legal frameworks, and ensure their implementation in the installations as soon as possible.	Complete  Complete	Current WENRA reference levels are incorporated into the UK's national requirements. There is an established mechanism for incorporation of any formal revision of reference levels.  FR-1 - Completing Periodic Reviews (PSR) to the required standards and timescales, & to implementing identified reasonably practicable plant improvements.	Part of normal business

Ref.	Site	Activity	Status	Activity Key Milestones	Complete
3.3.2	All UK NPP Sites	SAM Hardware Provisions Adequate hardware provisions that will survive external hazards (e.g. by means of qualification against extreme external hazards, storage in a safe location) and the severe accident environment (e.g. engineering substantiation and/or qualification against high pressures, temperatures, radiation levels, etc), in place, to perform the selected strategies.	Ongoing	IR-6 - Extend long-term severe accidents emergency exercises.  FR-6 & 7 - Estimating radioactive source terms and dose  IR-24 & STF-16 - SBERGs and SAGs: <ul style="list-style-type: none"> <li>SBERGs and SAGs Review and Revision</li> <li>Human Aspects</li> <li>Beyond Design Basis Task Analysis</li> <li>Weather and Seismic Human Factors</li> <li>Back-up Equipment – Equipment, training and exercising</li> </ul> (Magnox) IR-24 & STF-16 - SBERGs and SAGs: <ul style="list-style-type: none"> <li>SBERGs and SAGs Review and Revision</li> <li>Human Aspects</li> <li>Back-up equipment – equipment, training and exercising</li> </ul> (Also applicable for 3.3.3-3.3.8)	Q1 2013  To be Finalised  Q3 2013 Q3 2013 Q3 2013 Q3 2013 Q1 2014.  Q4 2013 Q4 2013 Q4 2013
3.3.3	All UK NPP Sites	Review of SAM Provisions Following Severe External Events The systematic review of SAM provisions focusing on the availability and appropriate operation of plant equipment in the relevant circumstances, taking account of accident initiating events, in particular extreme external hazards and the potential harsh working environment.	Ongoing	IR-24 & STF-16 - SBERGs and SAGs: <ul style="list-style-type: none"> <li>SBERGs and SAGs Review and Revision</li> <li>Human Aspects</li> <li>Beyond Design Basis Task Analysis</li> <li>Weather and Seismic Human Factors</li> <li>Back-up Equipment – Equipment, training and exercising</li> </ul>	Q3 2013 Q3 2013 Q3 2013 Q3 2013 Q1 2014.
3.3.4	All UK NPP Sites except Sizewell B	3.3.4 Enhancement of Severe Accident Management Guidelines (SAMG) In conjunction with the recommendation 2.4, the enhancement of SAMGs taking into account additional scenarios, including, a significantly damaged infrastructure, including the disruption of plant level, corporate-level and national-level communication, long-duration accidents (several days) and accidents affecting multiple units and nearby industrial facilities at the same time.	Ongoing	IR-24 & STF-16 - SBERGs and SAGs: <ul style="list-style-type: none"> <li>SBERGs and SAGs Review and Revision</li> <li>Human Aspects</li> <li>Beyond Design Basis Task Analysis</li> <li>Weather and Seismic Human Factors</li> <li>Back-up Equipment – Equipment, training and exercising</li> </ul>	Q3 2013 Q3 2013 Q3 2013 Q3 2013 Q1 2014.

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Ref.	Site	Activity	Status	Activity Key Milestones	Complete
3.3.5	All UK NPP Sites	SAMG Validation The validation of the enhanced SAMGs.	Ongoing	IR-24 & STF-16 - SBERGs and SAGs: <ul style="list-style-type: none"> <li>• SBERGs and SAGs Review and Revision</li> <li>• Human Aspects</li> <li>• Beyond Design Basis Task Analysis</li> <li>• Weather and Seismic Human Factors</li> <li>• Back-up Equipment – Equipment, training and exercising</li> </ul>	Q3 2013 Q3 2013 Q3 2013 Q3 2013 Q1 2014.
3.3.6	All UK NPP Sites	SAM Exercises Exercises aimed at checking the adequacy of SAM procedures and organisational measures, including extended aspects such as the need for corporate and nation level coordinated arrangements and long-duration events.	Ongoing	IR-24 & STF-16 - SBERGs and SAGs: <ul style="list-style-type: none"> <li>• SBERGs and SAGs Review and Revision</li> <li>• Human Aspects</li> <li>• Beyond Design Basis Task Analysis</li> <li>• Weather and Seismic Human Factors</li> <li>• Back-up Equipment – Equipment, training and exercising</li> </ul>	Q3 2013 Q3 2013 Q3 2013 Q3 2013 Q1 2014.
3.3.7	All UK NPP Sites	SAM Training Regular and realistic SAM training exercises aimed at training staff. Training exercises should include the use of equipment and the consideration of multi-unit accidents and long-duration events. The use of the existing NPP simulators is considered as being a useful tool but needs to be enhanced to cover all possible accident scenarios.	Ongoing	IR-24 & STF-16 - SBERGs and SAGs: <ul style="list-style-type: none"> <li>• SBERGs and SAGs Review and Revision</li> <li>• Human Aspects</li> <li>• Beyond Design Basis Task Analysis</li> <li>• Weather and Seismic Human Factors</li> <li>• Back-up Equipment – Equipment, training and exercising</li> </ul>	Q3 2013 Q3 2013 Q3 2013 Q3 2013 Q1 2014.
3.3.8	All UK NPP Sites	Extension of SAMGs to All Plant States The extension of existing SAMGs to all plant states (full and low-power, shutdown), including accidents initiated in SFPs.	Ongoing	IR-24 & STF-16 - SBERGs and SAGs: <ul style="list-style-type: none"> <li>• SBERGs and SAGs Review and Revision</li> <li>• Human Aspects</li> <li>• Beyond Design Basis Task Analysis</li> <li>• Weather and Seismic Human Factors</li> <li>• Back-up Equipment – Equipment, training and exercising</li> </ul>	Q3 2013 Q3 2013 Q3 2013 Q3 2013 Q1 2014.

Ref.	Site	Activity	Status	Activity Key Milestones	Complete
3.3.9	All UK NPP Sites	<p>Improved Communications</p> <p>The improvement of communication systems, both internal and external, including transfer of severe accident related plant parameters and radiological data to all emergency and technical support centre and regulatory premises.</p>	Completed Ongoing	<p>IR-23 - Necessary off-site communications for severe accidents:</p> <ul style="list-style-type: none"> <li>• Circulation of communication vulnerability report</li> <li>• Distribution of satellite phones to stations</li> <li>• Meeting with Paradigm for HITS service possibility</li> </ul> <p>(Magnox) IR-23 necessary off-site communications for severe accidents:</p> <ul style="list-style-type: none"> <li>• Distribution of satellite phones to stations</li> </ul>	<p>Q2 2012</p> <p>Q3 2012</p> <p>Q3 2012</p> <p>Complete</p>
3.3.10	All UK NPP Sites	<p>Presence of Hydrogen in Unexpected Places</p> <p>The preparation for the potential for migration of hydrogen, with adequate countermeasures, into spaces beyond where it is produced in the primary containment, as well as hydrogen production in SFPs.</p>	Ongoing	<p>IR-21 - Review the ventilation and venting routes for nuclear facilities - Review of AGR ventilation equipment and routes</p> <p>STF-18 – Installation of filtered containment venting:</p> <ul style="list-style-type: none"> <li>• Modifications planned for the FCV.</li> <li>• Target Installation of PARs</li> </ul> <p>(Magnox) IR-21 – Review of sources of combustible gases</p>	<p>Q3 2012 (start)</p> <p>Q1 2013</p> <p>Q2 2013</p> <p>Q2 2013</p>
3.3.11	All UK NPP Sites (except Wylfa)	<p>Large Volumes of Contaminated Water</p> <p>The conceptual preparations of solutions for post-accident contamination and the treatment of potentially large volumes of contaminated water.</p>	Ongoing	IR-25 - Centrally located storage facilities (bags) that will be deployed as necessary. Small scale storage will be available on site.	Q4 2013

Ref.	Site	Activity	Status	Activity Key Milestones	Complete
3.3.12	All UK NPP Sites	Radiation Protection The provision for radiation protection of operators and all other staff involved in the SAM and emergency arrangements.	Ongoing	FR-6 - Estimating radioactive source terms  STF-16 - Review of the SBERGs and SAGs taking into account improvements to the understanding of severe accident progression, phenomena and the equipment available to mitigate severe accident, including the use of backup equipment  (Magnox) STF-15 – Additional Health Physics and Personal Protective Equipment provided	To be finalised  Training and Exercising undertaken on a continuous basis.  Q4 2013
3.3.13	All UK NPP Sites	On-site Emergency Centre The provision of an on-site emergency centre protected against severe natural hazards and radioactive releases, allowing operators to stay onsite to manage a severe accident.	Ongoing	IR-22 - Review the provision on-site of emergency control, instrumentation and communications: <ul style="list-style-type: none"> <li>• Sizewell B ERC site work complete</li> <li>• Completion of AGR site modifications</li> </ul> (Magnox) IR-22 – Review of existing emergency facilities	Q4 2013 Q4 2013  Q2 2013
3.3.14	All UK NPP Sites	Support to Local Operators Rescue teams and adequate equipment to be quickly brought on-site in order to provide support to local operators in case of a severe situation.	Ongoing	STF-15 - Adequacy of any arrangements necessary to get people and equipment on to and around site under severe accident conditions.	Q1 2014 (Demonstration of capability)
3.3.15	All UK NPP Sites	Level 2 Probabilistic Safety Assessments (PSAs) A comprehensive Level 2 PSA as a tool for the identification of plant vulnerabilities, quantification of potential releases, determination of candidate high-level actions and their effects and prioritizing the order of proposed safety improvements. Although PSA is an essential tool for screening and prioritising improvements and for assessing the completeness of SAM implementation, low numerical risk estimates should not be used as the basis for excluding scenarios from consideration of SAM especially if the consequences are very high.	Ongoing	FR-4 - Level 2 Probabilistic Safety Analyses (PSA): Pilot study on a single AGR Station.  (Magnox) Limited scope Level PSA for Wylfa	Q2 2013  Q3 2013

Ref.	Site	Activity	Status	Activity Key Milestones	Complete
3.3.16	All UK NPP Sites	<p>Severe Accident Studies</p> <p>The performance of further studies to improve SAMGs. Examples of areas that could be improved with further studies include:</p> <ul style="list-style-type: none"> <li>The availability of safety functions required for SAM under different circumstances.</li> <li>Accident timing, including core melt, reactor pressure vessel (RPV) failure, basemat melt-through, SFP fuel uncover, etc.</li> <li>PSA analysis, including all plant states and external events for PSA levels 1 and 2.</li> <li>Radiological conditions on the site and associated provisions necessary to ensure MCR and ECR habitability as well as the feasibility of AM measures in severe accident conditions, multi-unit accidents, containment venting, etc.</li> <li>Core cooling modes prior to RPV failure and of re-criticality issues for partly damaged cores, with unborated water supply.</li> <li>Phenomena associated with cavity flooding and related steam explosion risks.</li> <li>Engineered solutions regarding molten corium cooling and prevention of basemat melt-through.</li> <li>Severe accident simulators appropriate for NPP staff training.</li> </ul>	Ongoing	<p>IR-25 - Review, and if necessary extend, analysis of accident sequences for long-term severe accidents. This is covered by the Recommendations and Findings below:</p> <p>STF-3</p> <ul style="list-style-type: none"> <li>Initial operator action review – extreme weather</li> <li>Initial operator action review – seismic</li> <li>Development of detailed phase 2 scope</li> </ul> <p>STF-5 and STF-7</p> <ul style="list-style-type: none"> <li>Flooding Review and Consolidation</li> <li>Flooding Margin Report</li> <li>Seismic Methods and Safety Case</li> <li>Extreme Weather Review</li> </ul> <p>FR-4</p> <ul style="list-style-type: none"> <li>Selected Station PSA Analysis</li> </ul> <p>IR-24</p> <ul style="list-style-type: none"> <li>SBERGs and SAGs Review and Revision</li> <li>Human Aspects (Emergency Response)</li> <li>Beyond Design Basis Task Analysis</li> <li>Weather and Seismic Human Factors</li> <li>Back-up Equipment – Equipment, training and exercising.</li> </ul> <p>(Magnox) STF-5 and STF-7:</p> <ul style="list-style-type: none"> <li>Seismic margins study</li> <li>Review of resilience against extreme hazards</li> <li>Implementation of resilience enhancements</li> </ul> <p>FR-4</p> <ul style="list-style-type: none"> <li>Limited scope Level PSA for Wylfa</li> </ul> <p>IR-24 &amp; STF-16 - SBERGs and SAGs:</p> <ul style="list-style-type: none"> <li>SBERGs and SAGs Review and Revision</li> <li>Human Aspects</li> <li>Back-up equipment – equipment, training and exercising</li> </ul>	<p>Q1 2013</p> <p>Q2 2013</p> <p>Q2 2013</p> <p>Q1 2013</p> <p>Q2 2013</p> <p>Q1 2014</p> <p>Q1 2014</p> <p>Q2 2013</p> <p>Q3 2013</p> <p>Q3 2013</p> <p>Q3 2013</p> <p>Q3 2013</p> <p>Q1 2014</p> <p>Complete</p> <p>Complete</p> <p>Q4 2013</p> <p>Q3 2013</p> <p>Q4 2013</p> <p>Q4 2013</p> <p>Q4 2013</p>

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## ABBREVIATIONS

AC	Alternating Current
AGR	Advanced Gas-cooled Reactor
ASN	Autorité de Sûreté Nucléaire (French nuclear safety authority)
BDB	Beyond Design Basis
BDBA	Beyond Design Basis Accident
C&I	Control and Instrumentation
CESC	Central Emergency Support Centre
CNS	Convention on Nuclear Safety
COBR	Cabinet Office Briefing Room
DC	Direct Current
DECC	Department of Energy and Climate Change
DEPZ	Detailed Emergency Planning Zone
ECC	Emergency Control Centre
EDF	NGL Electricité de France Nuclear Generation Limited
EIC	Emergency Indication Centre
ENSREG	European Nuclear Safety Regulators Group
EPRI	Electric Power Research Institute
ERC	Emergency Response Centre
FCO	Foreign and Commonwealth Office
FCV	Filtered Containment Venting
FR	Final Recommendation
GCR	Gas Cooled Reactor
GDA	Generic Design Assessment
GTA	Government Technical Advisor
HMCINI	HM Chief Inspector of Nuclear Installations
HPA	Health Protection Agency
IAEA	International Atomic Energy Agency
INPO	Institute of Nuclear Power Operations
IR	Interim Recommendation
IRRS	International Regulatory Review Service
LA	Local Authority
MO	Meteorological Office
MoD	Ministry of Defence
NDA	Nuclear Decommissioning Authority
NEA	Nuclear Energy Agency (of the OECD)

## ABBREVIATIONS

NEPLG	Nuclear Emergency Planning Liaison Group
NGO	Non-Governmental Organisation
NIA	Nuclear Industrial Association
NIEA	Northern Ireland Environment Agency
NPP	Nuclear Power Plant
NRI	Nuclear Research Index
OECD	Organisation for Economic Co-operation and Development
OJEU	Official Journal of the European Union
ONR	Office for Nuclear Regulation (formerly the Nuclear Directorate of the HSE)
PAR (ONR)	Project Assessment Report
PSA	Probabilistic Safety Analysis
PSR	Periodic Safety Review
PVCW	Pressure Vessel Cooling Water
PWR	Pressurised Water Reactor
RCIS (ONR)	Redgrave Court Incident Suite
REPPIR	Radiation (Emergency Preparedness and Public Information) Regulations 2001
RIMNET	Radioactive Incident Monitoring Network
R&D	Research and Development
RMU	Re-assurance Monitoring Unit
SAG	Severe Accident Guidelines
SAMG	Severe Accident Management Guidelines
SBERG	System Based Emergency Response Guidelines
SAP (ONR)	Safety Assessment Principle(s) (HSE)
SBO	Station Blackout
SEPA	Scottish Environment Protection Agency
STF	Stress Test Finding
TAG (ONR)	Technical Assessment Guide
TIIMS	The Incident Information Management System
TSol	Treasury Solicitors
US NRC	United States Nuclear Regulatory Commission
WANO	World Association of Nuclear Operators

## ANNEX 1 – ONR RECOMMENDATIONS AND FINDINGS

Below is a list of the recommendations and findings from the HMCINI's Interim (Ref. 1), Final (Ref. 2) and stress test (Ref. 3) reports.

### INTERIM AND FINAL RECOMMENDATIONS

International Arrangements for Response	<p><b>Recommendation IR-1:</b> The Government should approach IAEA, in co-operation with others, to ensure that improved arrangements are in place for the dissemination of timely authoritative information relevant to a nuclear event anywhere in the world.</p> <p><i>This information should include:</i></p> <p>a) <i>basic data about the reactor design including reactor type, containment, thermal power, protection systems, operating history and condition of any nuclear materials such as spent fuel stored on the site should be held permanently in a central library maintained on behalf of the international community; and</i></p> <p>b) <i>data on accident progression and the prognosis for future accident development. The operator would provide such information as is available to its national authorities. International mechanisms for communicating this information between national governments should be strengthened. To ensure that priority is given to relevant information, international agreement should be sought on the type of information that needs to be provided.</i></p>
Global Nuclear Safety	<p><b>Recommendation FR-9:</b> The UK Government, nuclear industry and ONR should support international efforts to improve the process of review and implementation of IAEA and other relevant nuclear safety standards and initiatives in the light of the Fukushima-1 (Fukushima Dai-ichi) accident.</p>
National Emergency Response Arrangements	<p><b>Recommendation IR-2:</b> The Government should consider carrying out a review of the Japanese response to the emergency to identify any lessons for UK public contingency planning for widespread emergencies, taking account of any social, cultural and organisational differences.</p> <p><b>Recommendation IR-3:</b> The Nuclear Emergency Planning Liaison Group should instigate a review of the UK's national nuclear emergency arrangements in light of the experience of dealing with the prolonged Japanese event.</p> <p><i>This information should include the practicability and effectiveness of the arrangements for extending countermeasures beyond the Detailed Emergency Planning Zone (DEPZ) in the event of more serious accidents.</i></p> <p><b>Recommendation FR-6:</b> The nuclear industry with others should review available techniques for estimating radioactive source terms and undertake research to test the practicability of providing real-time information on the basic characteristics of radioactive releases to the environment to the responsible off-site authorities, taking account of the range of conditions that may exist on and off the site.</p> <p><b>Recommendation FR-7:</b> The Government should review the adequacy of arrangements for environmental dose measurements and for predicting dispersion and public doses and environmental impacts, and to ensure that adequate up to date information is available to support decisions on emergency countermeasures.</p>
Planning Controls	<p><b>Recommendation FR-5:</b> The relevant Government departments in England, Wales and Scotland should examine the adequacy of the existing system of planning controls for commercial and residential developments off the nuclear licensed site.</p>
Openness and Transparency	<p><b>Recommendation IR-4:</b> Both the UK nuclear industry and ONR should consider ways of enhancing the drive to ensure more open, transparent and trusted communications, and relationships, with the public and other stakeholders.</p> <p><b>Recommendation FR-8:</b> The Government should consider ensuring that the legislation for the new statutory body requires ONR to be open and transparent about its decision-making, so that it may clearly demonstrate to stakeholders its effective independence from bodies or organisations concerned with the promotion or utilisation of nuclear energy.</p>
Safety Assessment Approach	<p><b>Recommendation IR-5:</b> Once further detailed information is available and studies are completed, ONR should undertake a formal review of the Safety Assessment</p>

## INTERIM AND FINAL RECOMMENDATIONS

Emergency Response Arrangements and Exercises	<p>Principles to determine whether any additional guidance is necessary in the light of the Fukushima accident, particularly for “cliff-edge” effects.  <i>The review of ONR’s Safety Assessment Principles (SAP should also cover ONR’s Technical Assessment Guides (TAG), including external hazards.</i></p> <p><b>Recommendation IR-6:</b> ONR should consider to what extent long-term severe accidents can and should be covered by the programme of emergency exercises overseen by the regulator.  <i>This should include:</i></p> <p><i>a) evaluation of how changes to exercise scenarios supported by longer exercise duration will permit exercising in real time such matters as hand-over arrangements, etc.;</i></p> <p><i>b) how automatic decisions taken to protect the public can be confirmed and supported by plant damage control data; and</i></p> <p><i>c) recommendations on what should be included in an appropriate UK exercise programme for testing nuclear emergency plans, with relevant guidance provided to Radiation (Emergency Preparedness and Public Information) Regulations 2001 (REPPiR) duty holders.</i></p> <p><b>Recommendation IR-7:</b> ONR should review the arrangements for regulatory response to potential severe accidents in the UK to see whether more should be done to prepare for such very remote events.  <i>This should include:</i></p> <p><i>a) enhancing access during an accident to relevant, current plant data on the status of critical safety functions, i.e. the control of criticality, cooling and containment, and releases of radioactivity to the environment, as it would greatly improve ONR’s capability to provide independent advice to the authorities in the event of a severe accident; and</i></p> <p><i>b) review of the basic plant data needed by ONR – this has much in common with what we suggest should be held by an international organisation under Recommendation IR-1.</i></p>
Research	<p><b>Recommendation FR-10:</b> ONR should expand its oversight of nuclear safety-related research to provide a strategic oversight of its availability in the UK as well as the availability of national expertise, in particular that needed to take forward lessons from Fukushima. Part of this will be to ensure that ONR has access to sufficient relevant expertise to fulfil its duties in relation to a major incident anywhere in the world.</p>
Off-site Infrastructure Resilience	<p><b>Recommendation IR-8:</b> The UK nuclear industry should review the dependency of nuclear safety on off-site infrastructure in extreme conditions, and consider whether enhancements are necessary to sites’ self sufficiency given for the reliability of the grid under such extreme circumstances.  <i>This should include:</i></p> <p><i>a) essential supplies such as food, water, conventional fuels, compressed gases and staff, as well as the safe off-site storage of any equipment that may be needed to support the site response to an accident; and</i></p> <p><i>b) timescales required to transfer supplies or equipment to site.</i></p> <p><b>Recommendation IR-9:</b> Once further relevant information becomes available, the UK nuclear industry should review what lessons can be learnt from the comparison of the events at the Fukushima-1 (Fukushima Dai-ichi) and Fukushima-2 (Fukushima Dai-ni) sites.</p>
Impact of Natural Hazards	<p><b>Recommendation IR-10:</b> The UK nuclear industry should initiate a review of flooding studies, including from tsunamis, in light of the Japanese experience, to confirm the design basis and margins for flooding at UK nuclear sites, and whether there is a need to improve further site-specific flood risk assessments as part of the periodic safety review programme, and for any new reactors. This should include sea-level protection.</p>
Multi-reactor Sites	<p><b>Recommendation IR-11:</b> The UK nuclear industry should ensure that safety cases for new sites for multiple reactors adequately demonstrate the capability for dealing with multiple serious concurrent events induced by extreme off-site hazards.</p>
Spent Fuel Strategies	<p><b>Recommendation IR-12:</b> The UK nuclear industry should ensure the adequacy of any new spent fuel strategies compared with the expectations in the Safety Assessment Principles of passive safety and good engineering practice.  <i>Existing licensees are expected to review their current spent fuel strategies as part of</i></p>

## INTERIM AND FINAL RECOMMENDATIONS

*their periodic review processes and make any reasonably practicable improvements, noting that any intended changes need to take account of wider strategic factors including the implications for the nuclear fuel cycle.*

Site and Plant Layout	<p><b>Recommendation IR-13:</b> The UK nuclear industry should review the plant and site layouts of existing plants and any proposed new designs to ensure that safety systems and their essential supplies and controls have adequate robustness against severe flooding and other extreme external events.</p> <p><i>This recommendation is related to Recommendation IR-25 and should be considered along with the provisions put in place under that recommendation. It should include, for example, the operator's capability to undertake repairs and the availability of spare parts and components.</i></p>
Fuel Pond Design	<p><b>Recommendation IR-14:</b> The UK nuclear industry should ensure that the design of new spent fuel ponds close to reactors minimises the need for bottom penetrations and lines that are prone to siphoning faults. Any that are necessary should be as robust to faults as are the ponds themselves.</p>
Seismic Resilience	<p><b>Recommendation IR-15:</b> Once detailed information becomes available on the performance of concrete, other structures and equipment, the UK nuclear industry should consider any implications for improved understanding of the relevant design and analyses.</p> <p><i>The industry focus on this recommendation should be on future studies regarding the continuing validation of methodologies for analysing the seismic performance of structures, systems and components important to safety. This should include concrete structures and those fabricated from other materials.</i></p>
Extreme External Events	<p><b>Recommendation IR-16:</b> When considering the recommendations in this report the UK nuclear industry should consider them in the light of all extreme hazards, particularly for plant layout and design of safety-related plant.</p> <p><b>Recommendation FR-2:</b> The UK nuclear industry should ensure that structures, systems and components needed for managing and controlling actions in response to an accident, including plant control rooms, on-site emergency control centres and offsite emergency centres, are adequately protected against hazards that could affect several simultaneously.</p> <p><b>Recommendation FR-3:</b> Structures, systems and components needed for managing and controlling actions in response to an accident, including plant control rooms, onsite emergency control centres and off-site emergency centres, should be capable of operating adequately in the conditions, and for the duration, for which they could be needed, including possible severe accident conditions.</p>
Off-site Electricity Supplies	<p><b>Recommendation IR-17:</b> The UK nuclear industry should undertake further work with the National Grid to establish the robustness and potential unavailability of off-site electrical supplies under severe hazard conditions.</p>
On-site Electricity Supplies	<p><b>Recommendation IR-18:</b> The UK nuclear industry should review any need for the provision of additional, diverse means of providing robust sufficiently long-term independent electrical supplies on-sites, reflecting the loss of availability of off-site electrical supplies under severe conditions.</p> <p><i>This should be considered along with Recommendation IR-8 within the wider context of "on-site resilience".</i></p>
Cooling Supplies	<p><b>Recommendation IR-19:</b> The UK nuclear industry should review the need for, and if required, the ability to provide longer term coolant supplies to nuclear sites in the UK in the event of a severe off-site disruption, considering whether further on-site supplies or greater off-site capability is needed. This relates to both carbon dioxide and fresh water supplies, and for existing and proposed new plants.</p> <p><b>Recommendation IR-20:</b> The UK nuclear industry should review the site contingency plans for pond water make up under severe accident conditions to see whether they can and should be enhanced given the experience at Fukushima.</p>
Combustible Gases	<p><b>Recommendation IR-21:</b> The UK nuclear industry should review the ventilation and venting routes for nuclear facilities where significant concentrations of combustible gases may be flowing or accumulating to determine whether more should be done to protect them.</p>

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Emergency Control Centres, Instrumentation and Communications

**Recommendation IR-22:** The UK nuclear industry should review the provision on-site of emergency control, instrumentation and communications in light of the circumstances of the Fukushima accident including long timescales, wide spread on and off-site disruption, and the environment on-site associated with a severe accident. *In particular, the review should consider that the Fukushima-1 site was equipped with a seismically robust building housing the site emergency response centre which had: adequate provisions to ensure its habitability in the event of a radiological release; and communication facilities with on-site plant control rooms and external agencies, such as TEPCO headquarters in Tokyo.*

**Recommendation IR-23:** The UK nuclear industry, in conjunction with other organisations as necessary, should review the robustness of necessary off-site communications for severe accidents involving widespread disruption. *In addition to impacting communications, it is possible that external events could also affect off-site centres used to support at site in an emergency. Alternative locations should be available and they should be capable of being commissioned in an appropriate timescale.*

Human Capabilities and Capacities

**Recommendation IR-24:** The UK nuclear industry should review existing severe accident contingency arrangements and training, giving particular consideration to the physical, organisational, behavioural, emotional and cultural aspects for workers having to take actions on-site, especially over long periods. This should take account of the impact of using contractors for some aspects on-site such as maintenance and their possible response.

*This is a wide ranging recommendation and there are a number of aspects that need to be included:*

- a) the reviews need to acknowledge design differences between individual nuclear facilities and consider whether corporate Severe Accident Guidelines need to be customised;*
- b) adequacy of trained personnel numbers for long-term emergencies, particularly for multi-unit sites, and taking into account the potential impact of infrastructure damage and societal issues on the ability to mobilise large numbers of personnel;*
- c) the time windows for availability of off-site support may be challenged hence the role of on-site personnel may change, which has implications for procedures and training;*
- d) the review of Severe Accident Management Guidelines (SAMG) should consider not only critical safety functions prioritisation, but also whether and how SAMGs support any dynamic reprioritisation based on emerging information;*
- e) consideration should also be given to operator support requirements relating to tactical and strategic decision making; and*
- f) in addition to the acute phase of a severe accident, consideration also needs to be given to stabilisation, recovery and clean-up, and the personnel involved from the many organisations involved.*

**Recommendation FR-11:** The UK nuclear industry should continue to promote sustained high levels of safety culture amongst all its employees, making use of the National Skills Academy for Nuclear and other schemes that promote “nuclear professionalism”.

Safety Case

**Recommendation IR-25:** The UK nuclear industry should review, and if necessary extend, analysis of accident sequences for long-term severe accidents. This should identify appropriate repair and recovery strategies to the point at which a stable state is achieved, identifying any enhanced requirements for central stocks of equipment and logistical support.

*Recommendation IR-25 is linked with Recommendation IR-13. Combining these two recommendations means that we would expect industry to:*

- a) identify potential strategies and contingency measures for dealing with situations in which the main lines of defence are lost. Considerations might include, for example, the operator's capability to undertake repairs and the availability of spares (capability includes the availability of personnel trained in the use of emergency equipment along with necessary supporting resources);*
- b) consider the optimum location for emergency equipment, so as to limit the likelihood of it being damaged by any external event or the effects of a severe nuclear accident;*
- c) consider the impact of potential initiating events on the utilisation of such*

## INTERIM AND FINAL RECOMMENDATIONS

equipment;

d) consider the need for remotely controlled equipment including valves; and

e) consider in the layout of the site effective segregation and bunding of areas where radioactive liquors from accident management may accumulate.

Regarding other aspects of Recommendation IR-25, the industry needs to:

f) ensure it has the capability to analyse severe accidents to properly inform and support on-site severe accident management actions and off-site emergency planning.

Further research and modelling development may be required;

g) ensure that sufficient severe accident analysis has been performed for all facilities with the potential for accidents with significant off-site consequences, in order to identify severe accident management and contingency measures. Such measures must be implemented where reasonably practicable and staff trained in their use; and

h) examine how the continued availability of sufficient on-site personnel can be ensured in severe accident situations, as well as considering how account can be taken of acute and chronic stress at both an individual and team level (this is linked to Recommendation IR-24).

**Recommendation FR-1:** All nuclear site licensees should give appropriate and consistent priority to completing Periodic Safety Reviews (PSR) to the required standards and timescales, and to implementing identified reasonably practicable plant improvements.

**Recommendation FR-4:** The nuclear industry should ensure that adequate Level 2 Probabilistic Safety Analyses (PSA) are provided for all nuclear facilities that could have accidents with significant off-site consequences and use the results to inform further consideration of severe accident management measures. The PSAs should consider a full range of external events including “beyond design basis” events and extended mission times.

## ANNEX 2 - INFORMATION REQUESTED IN THE NACP TEMPLATE

The UK is committed to ENSREG as the appropriate vehicle to advise the European Commission on matters of nuclear safety and radioactive waste management and with a goal of using existing resources effectively to promote enhancing standards for worldwide nuclear safety through continuous improvement, showing a clear commitment to openness and transparency.

Further activities from the ENSREG Action Plan for national regulators were:

- To consider the results of the peer review as they are published in the ENSREG main and country reports
- To develop and make public the national action plan associated with post-Fukushima lessons learned and stress test peer review recommendations and suggestions by the end of 2012.
- The final content of the national action plan should also take account of relevant output from the extraordinary meeting of the CNS
- To take into account the ENSREG “consistent compilation of stress test peer review recommendations and suggestions”

### Overview of UK National Action Plan

The ENSREG Action Plan requests a UK Regulator National Action Plan. Clearly, the UK’s Post Japanese Earthquake and Tsunami Implementation Plan covers this request and much more. As a consequence ONR considers that it would not appropriate to present the full UK plan to ENSREG.

Instead, this report has been produced as a current statement of UK Regulators Actions related to Post-Fukushima lessons learnt and stress test peer review recommendations and suggestions contained within the UK post Japanese earthquake and tsunami implementation plan. It has been prepared by abstracting relevant details from the UK plan which may be found via the ONR website (<http://www.hse.gov.uk/nuclear>) and represents progress made by ONR up to the end of November 2012.

The report has been prepared in accordance with the NAcP template issued by ENSREG in November 2012 (<http://www.ensreg.eu>) which requests that the National regulator considers presenting:

- Details of the process the regulator took to deliver the NAcP
- The national approach to monitoring and achieving compliance / resolution including regulatory structure and intervention
- State the proposed approach to transparency and public interaction

These requirements from ENSREG have been addressed and will be found in relevant sections within this report.

In addition to the work surrounding the ENSREG Stress Tests and the production of this report ONR is undertaking a wider programme of work that is based upon the UK Stress Tests and Chief Inspector’s reports. ONR will continue to satisfy itself that these improvements are effectively implemented and will monitor and assess the adequacy of progress made by the industry over the longer term. Ongoing activity will be tracked and recorded until ONR is satisfied that the significant lessons learnt from the Fukushima event have been adequately discharged and will, if necessary, use its regulatory powers to ensure that reasonably practicable improvements are implemented. ONR will deliver and secure such oversight by embedding ongoing “Fukushima learning” oversight activities into its operational regulatory programmes. This approach offers a number of distinct benefits in that it:

- Secures longer term oversight by ONR of improvements relating to the lessons learnt from the Fukushima event;
- Is both effective and efficient in terms of future use of regulatory resources;
- Ensures that, in the overall interests of nuclear safety, such improvements are delivered taking into account the relative significance of all activities on the site; and
- That such improvements are regulated, as appropriate, under the provisions of the licence conditions attached to each nuclear site licence.

Whilst ONR does not intend to produce further discrete Fukushima Implementations reports or Action Plans, it is committed to continuing to monitor and assess progress through normal business, to publish summary updates for stakeholders on our website and site stakeholder reports and to continue to advise government on the adequacy of progress made by the industry.

In the immediate aftermath of the Fukushima accident ONR and UK nuclear industry began work on identifying potential lessons that could be learned to enhance safety for UK nuclear power plants (and other nuclear installations). This work predated the European wide Stress Test process, with the HMCINI Interim Report (Ref. 1) being published mid-May 2011 and final report (Ref. 2) in September 2011. A strong focus of the work by licensees was to try and identify ways in which safety improvements could be implemented within a relatively short time, taking into account the longer timescales available at GCR sites which represent the majority of the UK NPPs. This strategy has been supported by ONR. As a result major efforts have been focussed on the provision of backup equipment and the means to deploy that backup equipment early in potential severe accident sequences or in the event of an extreme external hazard event. This remains a significant part of the planned Fukushima related enhancements but is by no means the totality.

The UK has taken a full and active role in the stress test process. Whilst many of the topics covered in the stress test work replicated those already contained in the UK specific reports (Refs 1 & 2), the stress test process has enabled further improvement measures to be considered in the UK and given confidence regarding the measures already identified.

This report has been presented under specific topics, and has been supplemented and updated where necessary to meet the guidance for the contents of this report as detailed in Refs. 4, 6 and 9. These references describe 6 topics (topics 1-3 from Ref. 4 and 4-6 from Ref. 6). Topics 1-3 were covered in Section 1 with topics 4-6 described in Section 2. Many of the work items are inter-related and timescales for implementation are necessarily linked. The topics also have links to the wider recommendations and findings from the HMCINI Interim (Ref. 1) and Final (Ref. 2) Reports. Relevant interim recommendations (IRs) and final recommendations (FRs) are stated throughout the topic updates. The six topics are as follows:

### **Topic 1 – External Events (Section 1)**

Topic 1 has been addressed by the licensees' submissions which provide their conclusions against the external hazard sections of the ENSREG stress test specification (Ref. 4). These were reported in ONR's National Report on stress tests (Ref. 3) which gave ONR's view on the adequacy of the licensees' submissions. Further progress to the end of November 2012 is reported here to reflect the steps made by ONR in ensuring that the findings from these reports are implemented. 2012.

### **Topic 2 – Design Issues (Section 1)**

Topic 2 has been addressed by the licensees' submissions which provide their conclusions against progressive loss of electrical supplies and cooling capability irrespective of the initiating event and

the severe accident progression sections of the ENSREG stress test specification (Ref. 4). These were reported in ONR's National Report on stress tests (Ref. 3), which gave ONR's view on the adequacy of the licensees' submissions. Further progress to the end of November 2012 is reported here to reflect the steps made by ONR in ensuring that the findings from these reports are implemented. 2012.

### **Topic 3 – Severe Accident Management and Recovery (On-site) (Section 1)**

Topic 3 has been addressed by the licensees' submissions which provide their conclusions against the severe accident management sections of the ENSREG stress test specification (Ref. 3). These were reported in ONR's National Report on stress tests (Ref. 4) which gave ONR's view on the adequacy of the licensees' submissions. This report systematically explored the organisational and management measures that are in place to deal with emergencies, including severe accidents, and identified areas where it may be beneficial to enhance current arrangements in order to mitigate consequences. The progress in enhancing the current arrangements to the end of November 2012 is described in this report.

### **Topic 4 – National Organisations (Section 2)**

Topic 4 falls outside of the requirements of the ENSREG stress test specification but is specified in Ref 6. It has been addressed by obtaining additional information from UK government, regulators and licensees. Further, national organisations were considered within the HMCINI's reports on the Fukushima accident (Refs 1 and 2).

### **Topic 5 – Emergency Preparedness and Response and Post-accident Management (Off-site) (Section 2)**

Topic 5 was addressed within the HMCINI's Final Report (Ref. 2) which considered the UK's response to a nuclear accident as well as the requirements of the responding organisations.

This topic has also been addressed by the licensees' submissions, which provide their conclusions against the severe accident management sections of the ENSREG stress test specification (Ref. 4). These were reported in ONR's National Report on stress tests (Ref. 3) which gave ONR's view on the adequacy of the licensees' submissions. This report systematically explored the organisational and management measures that are in place to deal with emergencies, including severe accidents, and identified areas where it may be beneficial to enhance current arrangements in order to mitigate consequences. The progress in enhancing the current arrangements to the end of November 2012 is described in this report.

### **Topic 6 – International Co-operation (Section 2)**

This topic area falls outside of the requirements of the ENSREG stress test specification but is specified in Ref 6. It has been addressed by obtaining additional information from UK government, regulators and licensees. However, international co-operation required in the interest of nuclear safety was considered by the HMCINI's reports on the Fukushima accident (Refs 1 and 2).

These six topics cover the first two sections of this report with further sections on Additional Topics and Implementation of Activities. The first two sections and any additional topics cover aspects of design basis analysis, fault analysis, severe accident management, periodic safety review and continuous improvement. This aligns with both the ENSREG proposed document structure and with the recommendations and findings noted in Refs 1, 2 and 3.

Section 3 deals with topics that aren't specifically covered elsewhere in the document but still play an important part in the UK's National Action Plan in response to the events at Fukushima.

The Chief Inspector's reports (Refs 1 and 2) took a holistic approach to consider the whole nuclear sector and produced a number of Recommendations which have not been considered within the ENSREG specification and so are discussed in Section 3.

These particular requests from ENSREG have been summarised below:

**Process taken to deliver the NAcP.** The NAcP has been produced by extracting information from key UK specific publications (Ref 1, 2, 3 & 5), updating this information where appropriate and presenting it in the order and manner requested by ENSREG. The NAcP report production has followed standard ONR processes for production and approval, as well as the established processes for the underlying technical assessment of licensee activities, and has been approved at the highest level by the Chief Inspector.

**The National Approach to Monitoring Compliance.** The national approach to monitoring compliance is described in the recent Implementation Report (Ref 5) and involves embedding the Fukushima related activities within ONR's operational programmes. This means that the required follow up work in monitoring compliance and ensuring on-site implementation effectively becomes part of normal business and dealings with the licensees. All ongoing activity will be tracked and record until ONR is satisfied that that adequate implementation has been achieved. ONR is a goal setting, largely non-prescriptive regulator. This means that we expect the licensees to make proposals on how they intend to meet the required safety outcomes, and to justify why their proposal represents the safest reasonably practicable option for improvement. ONR may then challenge the basis for these proposals, and the associated timescales, to see if any more can be done that is reasonably practicable to reduce risks further. If we are not satisfied, ONR will require licensees to revisit the issue, undertake further work as appropriate, and provide further evidence to justify their proposals. In the event that ONR remains dissatisfied enforcement action will be taken to ensure an appropriate outcome.

**Openness and Transparency** The UK nuclear regulator has been developing its openness and transparency agenda for nearly a decade. ONR has stated that openness and transparency mean adopting a presumption of disclosure, and a specific work stream is in place to ensure more work is made publicly available. This report will be made publically available in addition to the Project Assessment Reports relating to this work that are available on the ONR website (<http://www.hse.gov.uk/nuclear>). The website is a key channel for ONR with regards to its commitment to being open and transparent. Quarterly news, an online publication, gives an overview of ONR's work during the previous three months and every month an external eBulletin is sent to over 12,000 subscribers. This report will form a part of these updates. Whilst ONR does not intend to produce further discrete Fukushima Implementations reports or Action Plans, it is committed to continuing to monitor and assess progress through normal business, to publish summary updates for stakeholders on our website and site stakeholder reports and to continue to advise government on the adequacy of progress made by the industry. There will be a published auditable trail on the resolution of all of the outstanding work items related to Fukushima lessons.

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