



ONR's Determination of the requirement for a Local Authority Off site Emergency Planning Area and the Operator's Prior Information Area as provided for under Regulations 9 and 16 of the Radiation (Emergency Preparedness and Public Information) Regulations 2001 for the Chapelcross Site

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EXECUTIVE SUMMARY

ONR's Determination of the requirement for a Local Authority Off site Emergency Planning Area and the Operator's Prior Information Area as provided for under Regulations 9 and 16 of the Radiation (Emergency Preparedness and Public Information) Regulations 2001 for the Chapelcross Site

This Office for Nuclear Regulation (ONR) project assessment report describes and explains the outcome of ONR's assessment regarding the need for a local authority off-site emergency planning area and operator's prior information area as provided for in regulations 9(1) and 16(1) respectively of the Radiation (Emergency Preparedness and Public Information) Regulations 2001 (REPPIR).

REPPIR requires operators to undertake hazard identifications and risk evaluations (HIREs) in relation to work with ionising radiations. These HIREs must identify all hazards on the site with the potential to cause a radiation accident, and evaluate the nature and magnitude of the risks to employees and other persons (e.g. those who live or work nearby) arising from those hazards. REPPIR also requires operators to assess their HIRE and to send a Report of Assessment (RoA) to ONR following any relevant material change to this work with ionising radiation, or at least within three years of the last assessment.

In cases where it is concluded that there is a potential for a reasonably foreseeable radiation emergency (defined in REPPIR as a reasonably foreseeable event where a person off-site is likely to receive an effective radiation dose in excess of 5 mSv (or other defined dose criteria) in the 12 months following), REPPIR places the legal duty on ONR to define an off-site emergency planning area¹ (i.e. the area within which, in ONR's opinion, any member of the public is likely to be affected by such a radiation emergency as defined in REPPIR). In these cases, there is also a legal duty under REPPIR for ONR to define an area within which prior information is to be distributed to the public.

Previous determinations by ONR for the Chapelcross site have concluded that a radiation emergency is possible and have therefore specified an off-site local authority emergency planning area and prior information area represented by a single circular area around the site with a radius of 2 km.

In its most recent RoA, Magnox Ltd reports a substantial reduction in both the hazard and risk of a radiation emergency at the Chapelcross site because of the defueled status of the reactors and fuel ponds. The RoA concludes that *"It is not reasonably foreseeable that a member of the public could be exposed to a dose in excess of 5 mSv due to the facilities at Chapelcross."*

ONR has made a rigorous assessment of the operator's technical submissions in accordance with its regulatory processes, guidance associated with REPPIR itself, and the relevant ONR technical assessment guide. The ONR assessment agrees with the above Magnox Ltd conclusion.

That being so, some aspects of REPPIR, principally REPPIR regulations 7(1), 9(1) and 16(1), relating to the operator's emergency plan and the identification of off-site planning and prior information areas, no longer apply.

¹ The local authority is subsequently required, in relation to this area, to prepare an adequate off-site emergency plan with the purpose of minimising, so far as is reasonably practicable, radiation exposures to those likely to be affected by such an emergency. Correspondingly, under REPPIR, the operator is required to provide prior information to occupants of this area and to also prepare an operator's on-site emergency plan.

The recommendations of this report are that ONR make the following notifications: That ONR write to

- Dumfries and Galloway Council and Magnox Ltd, to notify them that a REPPIR off-site emergency planning area is no longer specified for the Chapelcross licensed site;
- Dumfries and Galloway Council, to notify them that there is no longer a requirement under REPPIR for the local authority to prepare an off-site emergency plan;
- Magnox Ltd, to notify it that the requirement to ensure the appropriate provision of prior information to the public is no longer required under REPPIR. This notification should be copied to Dumfries and Galloway Council; and
- Magnox Ltd, to notify it that there is no longer a requirement under REPPIR for an operator's emergency plan.

Whilst this review removes the requirement for detailed emergency planning under REPPIR, proportionate emergency arrangements for the protection of the public remain in the form of;

- i. bodies such as local authorities have duties to make adequate emergency arrangements under other legislation such as the Civil Contingencies Act 2004;
- ii. operators have general duties Under the Health and Safety at Work Act 1974 to ensure, so far as is reasonably practicable, the safety and welfare of employees and other persons; and
- iii. operators who hold a nuclear site licence are required to make and implement adequate arrangements for dealing with any accident or emergency (under site licence condition 11 attached to the nuclear site licence); and to prepare necessary contingency plans as required under the Ionising Radiations Regulations 1999.

These other duties are not directly affected by this determination, and, where ONR is the enforcing authority, ONR will continue to seek assurance that the operator remains compliant with these legal obligations, including any such provision and co-ordination of adequate off-site emergency arrangements as these other duties may require.

LIST OF ABBREVIATIONS

CCA	Civil Contingencies Act (2004)
DEPZ	Detailed Emergency Planning Zone (Ref: REPPIR regulation 9(1))
EURATOM	European Atomic Energy Community
HIRE	Hazard Identification and Risk Evaluation
HSE	The Health and Safety Executive
IAEA	The International Atomic Energy Agency
LC	Licence Condition
NEAF	Nuclear Emergency Arrangements Forum
ONR	Office for Nuclear Regulation
PAR	Project Assessment Report
REPPIR	Radiation (Emergency Preparedness and Public Information) Regulations 2001
RoA	Report of Assessment
SAP	(ONR) Safety Assessment Principle(s)
SFAIRP	So far as is reasonably practicable
TAG	(ONR) Technical Assessment Guide

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1 PERMISSION REQUESTED

1. Magnox Ltd submitted a combined and updated Report of Assessment (RoA) / Hazard Identification and Risk Evaluation (HIRE) for the Chapelcross Site (Reference 1) as required by regulation 6 of the Radiation (Emergency Preparedness and Public Information) Regulations 2001 (REPPiR). Magnox Ltd requested (Reference 2) that the Office for Nuclear Regulation (ONR) re-consider the need for a local authority off-site plan. ONR has a legal responsibility under REPPiR regulation 9 to assess and review the requirement for, and where applicable, the size of the REPPiR off-site emergency planning area, referred to as the Detailed Emergency Planning Zone (DEPZ) by Magnox Ltd.
2. This report describes the outcome of ONR's assessment of the Magnox Ltd RoA, provided under REPPiR, for the Chapelcross nuclear licensed site. In particular, on the basis that it determines whether a local authority off-site planning area or the provision of prior information to the public are required under regulations 9(1) and 16(1), this assessment places particular emphasis on the principal conclusion of the Magnox Ltd RoA that:

"It is not reasonably foreseeable that a member of the public could be exposed to a dose in excess of 5 mSv due to the facilities at Chapelcross. The current REPPiR regulation 9 off-site plan and associated 2 km Detailed Emergency Planning Zone are sufficient, but arguably excessive."

2 INTRODUCTION

2.1 BACKGROUND

3. REPPiR came into force in 2001 and the REPPiR off-site emergency planning area around the operating reactors at Chapelcross was determined in 2002 to extend 2 km in all directions from the mid-point of the four reactors. The basis for this off-site emergency planning area was a reference accident involving a burst gas duct and fuel channel fire, resulting in hot gas release, reactor damage and on-site collateral damage.
4. Final shutdown of the Chapelcross reactors took place in February 2004 and their subsequent defueling and the removal of fuel from site was carried out between 2008 and 2013. Any remaining reactor fuel on-site is limited to possible remnants in cooling ponds. This defueling and removal of fuel from the site has resulted in a substantial reduction in the level of radiological hazard and risk presented by the site.
5. In relation to emergency planning, REPPiR requires the operator, in this case Magnox Ltd, to undertake a HIRE of all hazards arising from its work, with the potential to cause a radiation accident. The operator's assessment must be sufficient to demonstrate that all such hazards have been identified and the nature and magnitude of the risks to employees and other persons arising from those hazards have been evaluated. REPPiR also requires that operators submit a RoA of this HIRE to ONR prior to commencement of the work, following any material change (regulation 5(1)), and at least every 3 years (regulation 5(2)). REPPiR also makes provision for ONR to request additional information. In practice, it is usual for the HIRE information itself to be requested to inform ONR's determination. In this case Magnox Ltd submitted a combined RoA and HIRE for the Chapelcross site.
6. Where it is reasonably foreseeable that a radiation emergency (as defined in REPPiR) could arise, REPPiR requires ONR to define the area within which, in its opinion, persons (including any member of the public) are likely to be affected by such

emergencies. This then defines the area for which local authorities are required to prepare an adequate off-site emergency plan (regulation 9(1)), and for which operators are required to provide specified prior information (regulation 16(1)), without it having to be requested.

7. The off-site emergency plan, in cases where one is required, is intended to secure, so far as is reasonable practicable, the restriction of exposure to ionising radiation and the health and safety of persons who may be affected (including consideration of countermeasures and other protection measures that are relevant, reasonably practicable, and proportionate to the radiological risk in the event of a reasonably foreseeable radiation emergency).

NB. ONR has historically used the term detailed emergency planning zone (DEPZ) to refer to the area it defined under REPPIR regulation 9 as requiring an off-site emergency plan. (The term is still used this way in some ONR guidance.) As the term is not used within REPPIR itself (although referred to in the related guidance), and to ensure legal clarity and avoid misunderstanding amongst stakeholders, this report refers to the 'REPPIR off-site emergency planning area' and the 'REPPIR prior information area' under regulations 9 and 16 respectively rather than to 'detailed emergency planning zone' or 'DEPZ'.

8. This report sets out ONR's main considerations in undertaking its independent assessment of the Magnox Ltd RoA for the Chapelcross nuclear licensed site. It takes due account of the findings of the Magnox Ltd RoA and HIRE, additional technical submissions, and the application of ONR's recently revised principles and guidance (Reference 3).

2.2 SCOPE

9. This report sets out the basis for, and conclusions of, the ONR assessment of the REPPIR off-site emergency planning and prior information areas relating to the Chapelcross nuclear licensed site. It has been undertaken in accordance with HSE's guidance on REPPIR (Reference 4) and the supporting relevant technical assessment guide (TAG) (Reference 3).
10. Magnox Ltd submitted the combined HIRE/RoA for Chapelcross to ONR in August 2012, at which point the site was in the latter stages of defueling its four reactors, which was subsequently completed in February 2013. ONR has considered (Reference 5) whether this constitutes a "material change" under REPPIR and would therefore require submission of a new RoA. However, for the purpose of this determination, ONR is satisfied on the basis of the fault scenarios presented in the RoA, that a revised RoA (indicating completion of defueling) is not necessary on the basis that it would not affect the outcome of the determination process. This assessment is therefore based on the original RoA/HIRE (which pessimistically assumes the presence of some reactor fuel on the site). ONR has, however, requested subsequent information to support its technical assessment of the RoA/HIRE and provide further confidence in the assertions it contains. Any future material changes to the nature or magnitude of the hazards presented at this site will require the production of a new HIRE and submission of a revised RoA to ONR.
11. It is noted that, irrespective of REPPIR, bodies such as local authorities have duties to make emergency arrangements under other legislation such as the Civil Contingencies Act 2004 (CCA). In particular, Dumfries and Galloway Council, being identified as a Category 1 responder by the CCA, has a duty to identify risks and maintain plans for the purpose of ensuring, so far as is reasonably practicable, that they are able to

continue their functions in relation to preventing an emergency, to reducing, controlling or mitigating its effects, or taking other action in connection with it.

12. Regardless of this determination, operators have general duties (under the Health and Safety at Work Act 1974) to ensure, so far as is reasonably practicable (SFAIRP), the safety and welfare of employees and other persons.
13. These other duties are not directly affected by this determination and, where ONR is the enforcing authority, it will continue to seek assurance that the operator remains compliant with its other relevant legal obligations, including any such provision and co-ordination of adequate off-site emergency arrangements as these other duties may require.
14. In addition, operators who hold a nuclear site licence are required to continue to make and implement adequate arrangements for dealing with any accident or emergency (under site licence condition 11 attached to the nuclear site licence) and to prepare contingency plans under the Ionising Radiations Regulations 1999 as appropriate.

2.3 METHODOLOGY

15. In order for ONR to define the REPPiR off-site emergency planning and prior information areas, it must first assess the operator's RoA/HIRE and the operator's determination as to whether any radiation emergencies are reasonably foreseeable, and if so, identify the likely extent of their effects.
16. Where (but only where) ONR assesses that a radiation emergency, as defined in REPPiR, is reasonably foreseeable, it must then determine an appropriate REPPiR off-site emergency planning area and prior information area. This is the area within which:
 - the local authority must prepare an off-site emergency plan for the purpose of securing, so far as reasonably practicable, the restriction of exposure to ionising radiation and the health and safety of persons who may be affected by a reasonably foreseeable emergency, and across which;
 - the operator must provide prior information to the public without their having to request it.
17. When determining these areas, ONR considers both technical and local strategic/practical factors.
18. As a consequence, ONR invokes a two stage process as follows:
 - A. Conduct an initial technical assessment of the information provided by Magnox Ltd in the Chapelcross HIRE and RoA; and
 - B. Where the potential for a REPPiR defined reasonably foreseeable radiation emergency exists, establish and consider any other relevant practical and strategic factors relating to the planning and practical implementation of measures to restrict public exposure so far as reasonably practicable (e.g. urgent countermeasures) for those persons who are likely to be affected by a radiation emergency.
19. Stage A requires ONR to assess the operator's assessment of whether there is the potential for a radiation emergency to occur that is reasonably foreseeable. If this potential exists, ONR will assess the operator's identification and characterisation of the likelihood, nature and magnitude of the radiation related risks that may result. ONR will then consider the likely extent of any area within which the dose criteria contained

within Schedule 1 of REPPiR may be met or exceeded. This indicates the minimum distance for further consideration in Stage B, and is usually presented in operator's HIRE reports as a circle with a specified radius centred at the source of the potential release.

20. Stage B applies additional pragmatic, demographic, geographic and practical factors to the ONR determination and requires dialogue with the relevant local authority. The nature of these factors is set out in detail in the relevant ONR technical assessment guide (Reference 3). However, the local authority off-site emergency planning area cannot be smaller than that arising from the technical assessment under Stage A.
21. For most sites the RoA submitted identifies a reference accident, which is the bounding case of a spectrum of reasonably foreseeable accidents that gives rise to the most significant off-site consequences (Reference 4). This is then used as the basis for the determination of the REPPiR off-site emergency planning area. ONR guidance (Reference 3) describes the "reference accident" as an event which is less than likely but realistically possible, such as possible plant and equipment failures, breakdown of administrative arrangements and potential unauthorised behaviour of employees or the public. In the case of Chapelcross, Magnox Ltd has not proposed a specific reference accident. In its place, the RoA presents a number of potential bounding fault scenarios against which ONR's assessment has been made.

3 ASSESSMENT STRATEGY

22. The assessment strategy for the determination of the requirement for and, if required, the extent of the REPPiR off-site emergency planning area is summarised in this section.

3.1 BASIS OF ASSESSMENT

23. This assessment relates to the requirement (or otherwise) for a REPPiR off-site emergency planning area, and a REPPiR prior information area around the Magnox Ltd Chapelcross site. However, in the event that ONR's determination is that the site no longer has the potential to present a reasonably foreseeable radiation emergency, then REPPiR would no longer require such an area to be determined (nor for plans to be established or prior information to be provided (although emergency and contingency considerations are still required under other legislative provisions)).
24. REPPiR only applies to an operator if it holds quantities of radioactive material that exceed the thresholds given in Schedules 2 and 3 of REPPiR. These criteria are set such that, if they are exceeded, there may be the potential for a radiation emergency.
25. REPPiR requires the operator to identify and consider all events and fault sequences that are capable of causing a radiation accident.
26. ONR must determine the local authority off-site emergency planning and operator prior information areas in cases where a person (including members of the public) is likely to be exposed to doses in excess of 5 mSv in the year following a reasonably foreseeable radiation emergency (or other dose criteria defined in REPPiR Schedule 1). In assessing such doses, contributions from all exposure routes must be considered and health protection measures that may be taken during the first 24 hours immediately following the event must be disregarded.
27. In addition, in the event that ONR determines that a radiation emergency is reasonably foreseeable, there is a legal requirement for ONR to determine an off-site planning area and, in relation to this area, for the local authority to prepare an adequate off-site

- emergency plan (regulation 9(1)), and for the operator to provide prior information to the public (regulation 16(1)). In addition, the operator must prepare an operator's emergency plan (regulation 7(1)).
28. The Chapelcross RoA (Reference 1) gives a description of the radioactive inventories of the Chapelcross site in July 2012 (which exceeds the levels specified in Schedule 2 and 3 of REPPiR). These include the following stored materials:
- Reactor fuel (uranium metal encased in a magnesium alloy cladding) – NB. The inventory provided in the RoA for Chapelcross includes a description of the fuel for the 4 reactors, which fully fuelled would total up to 400 tonnes. Reactor defueling and removal of fuel from site began in 2008 and was on-going at the time the RoA was submitted to ONR. Therefore the RoA does not detail the quantity of that fuel that was still on-site but its presence is considered in the assessment. The defueling and removal from site was completed in February 2013, therefore any reactor fuel remaining on-site is limited to possible remnants in cooling ponds.
 - Approximately 252 m³ of intermediate level waste (ILW)
 - Approximately 48,982 m³ of solid and wet low level waste (LLW)
29. In addition, (Reference 1) indicates that radioactivity will also be present in certain structural materials, including:
- Approximately 3,647 m³ of reactor core graphite moderator
 - No more than 883 m³ ILW ingot volume equivalent of reactor internal materials (including; insulation, diagrid, core restraint and support, gas and instrument ducts and nozzles, standpipes and charge pans, control rods, burst can detection pipework and thermocouples)
 - Approximately 5m³ of liquid (oil) waste
30. The operator notes that the activity associated with the structural material (described in the first two bullet points of paragraph 29) is substantially fixed within the structures and would be unlikely to contribute significantly to any release to the environment, even in the case of a severe accident.
31. As a consequence of the residual inventory, some (although not necessarily all) provisions of REPPiR will continue to apply until such a time as the total inventory of radioactive material held on the Chapelcross site falls below the stringent levels specified in Schedule 2 and 3 of REPPiR.
32. Magnox Ltd has submitted a combined hazard identification and risk evaluation (HIRE) and report of assessment (RoA), which forms the basis of 'Stage A' (see section 2.3) of the assessment in this report.

3.2 STANDARDS AND CRITERIA

3.2.1 ACTS, REGULATIONS AND GUIDANCE

33. The relevant standards and criteria considered within this assessment are those contained within REPPiR and its associated guidance (Reference 4). REPPiR is made under the Health and Safety at Work Act 1974 and implements the articles on intervention in cases of radiation emergencies contained in the European Council Directive 96/29/EURATOM - Basic Safety Standards for the Protection of the Health of

Workers and Members of the Public against the Dangers from Ionising Radiation (Reference 6).

3.2.2 SAFETY ASSESSMENT PRINCIPLES & LICENCE CONDITIONS

34. ONR's safety assessment principles (SAPs) (Reference 7) provide inspectors with guidance for making consistent regulatory judgements on nuclear safety cases. Accident management and emergency preparedness are discussed in the SAPs, specifically in paragraphs 639-640, where the applicability of the SAPs in the context of REPIR is given in detail. In addition, cognisance has been taken of SAP: AM.1 - Accident management and emergency preparedness.
35. The SAPs are also directly relevant to the assessment of safety cases, which underpin the HIRE assessment. Therefore many of the SAPs associated with safety cases are relevant.
36. The operator's nuclear site licence conditions place legal requirements on the licensee to make and implement arrangements to ensure that safety is being managed adequately. Key licence conditions relevant to emergency arrangements include LC11 (Emergency arrangements), LC9 (Instructions to persons on site) and LC23 (Operating rules).

3.2.3 TECHNICAL ASSESSMENT GUIDES

37. The SAPs are supported by a suite of internal technical assessment guides, with the following TAG being relevant to this assessment:
 - The technical assessment of REPIR submissions and the determination of detailed emergency planning zones, ONR NS-TAST-GD-082 Revision 2, 2013 (Reference 3). This TAG incorporates ONR's revised principles for determination of REPIR off-site emergency planning areas.

3.2.4 NATIONAL AND INTERNATIONAL STANDARDS AND GUIDANCE

38. The following national guidance has also been considered and, where appropriate, has informed the conduct of this assessment:
 - A guide to the Radiation (Emergency Preparedness and Public Information Regulations 2001 (Reference 4)
39. ONR also notes the relevance of the following International Standards and Guidance:
 - IAEA Safety Standard Series – Preparedness and Response for a Nuclear or Radiological Emergency GS-R-2 (Reference 8)
 - IAEA Safety Standards – Arrangements for Preparedness for a Nuclear or Radiological Emergency GS-G-2.1 (Reference 9)

4 ASSESSMENT OF TECHNICAL SUBMISSIONS

40. Magnox Ltd has submitted a combined RoA and HIRE to ONR (Reference 1). ONR has subjected these submissions and supporting documentation to expert and detailed technical assessment, and the detailed conclusions of this are reported separately in (Reference 10). The key and summary findings of ONR's assessment are given below.

4.1 MAGNOX LTD HIRE/RoA

41. The Chapelcross reactors ceased electricity generation in 2004. Reactor defueling and removal of that fuel from site began in 2008 and Magnox Ltd submitted their latest RoA to ONR in August 2012. Defueling was subsequently completed in February 2013.
42. As a consequence of the shutdown of the reactors, the risk presented by the site that led to the determination, in 2002, of the existing off-site emergency planning area has substantially reduced.
43. The operator describes that a release of activity associated with the reactors is now no longer credible as, following shutdown, they are no longer pressurised or require active cooling. There are no longer any faults associated with the reactor facilities or the fuel route operations as the reactors and fuel route are maintained in a passively safe state that presents no reasonably foreseeable faults leading to a radiation emergency. NB. Since submission of the RoA, the completion of removal of fuel from the site has further reduced its inventory and hazard potential.
44. In order to identify and consider all event and fault sequences that are capable of causing a radiation accident, Magnox Ltd has undertaken a review of the Chapelcross Nuclear Safety Schedules, which list all the items of plant and process which protect against faults to the workforce and the public. Those identified have been assessed using best-estimate data and the public consequences have been assessed using the Nuclear Emergency Arrangements Forum (NEAF) methodology.
45. The RoA describes the five most significant reasonably foreseeable fault sequences that form the basis of the assessment. These faults are described in Table 1.
46. The operator concludes that there is no need to propose a reference accident for the Chapelcross site on the basis that it does not believe that any reasonably foreseeable fault at Chapelcross could lead to a radiation emergency as defined by REPPIR. The Magnox Ltd RoA (Reference 1) concludes:

“Since there is no longer a reasonably foreseeable fault sequence that could lead to a dose to the public of 5 mSv or more beyond the site boundary, the current off-site based plan, based on a DEPZ of 2 km, is sufficient, but arguably excessive.”

Table 1 – Magnox Ltd assessment of Chapelcross fault scenarios

Fault	Description of event	Public dose at site boundary (based on NEAF Methodology)* (mSv)	Fault sequence frequency (per year)
F1	Seismic event leading to a complete loss of pond water containment	0.73	3.0×10^{-4}
F2	Military combat aircraft collision with Low Level Waste storage area leading to a catastrophic fire	4.01	2.0×10^{-6}
F3	Vehicle collision in Intermediate Level Waste storage facility, leading to damage to Temporary Storage Vessels exposing Intermediate Level Waste	1.0	1.0×10^{-3}
F4	Chapelcross Processing Plant Intermediate Level Waste transporter collides with fork lift truck	0.36	1.0×10^{-6}
F5	Military Combat aircraft collision with Temporary Storage Vessels at Intermediate Level Waste storage facility	3.84	2.6×10^{-6}

* Off-site dose consequences for each of the fault scenarios have been assessed by Magnox Ltd for comparison with the threshold defined in REPIR Schedule 1.

4.2 ONR TECHNICAL ASSESSMENT OF THE MAGNOX LTD HIRE/ROA

47. The RoA was submitted in 2012, prior to the completion of defueling activities in February 2013, and therefore relates to a HIRE that assesses the hazards from site at that time (i.e. including residual reactor fuel).
48. However, following the shutdown of the reactors, the legacy fuel has not been the dominant hazard on-site. Further, the RoA concludes that there is no fault associated with the reactor fuel that can lead to a reasonably foreseeable radiation emergency. As previously mentioned in paragraph 10, ONR did consider whether a revised RoA should be submitted to account for the lower hazard following subsequent defueling, and concluded that this was not required on the basis that it would not affect the conclusions of ONR's technical assessment and subsequent REPPiR determination.
49. ONR undertook a detailed technical assessment (Reference 10) of the RoA, during the course of which ONR sought clarification on aspects of the information provided, and also sought further information regarding some elements of dose estimation.
50. Magnox Ltd has presented five fault scenarios (Table 1) within the RoA that have been identified as the most significant reasonably foreseeable events with an off-site public dose consequence. ONR's specialist technical inspector is satisfied that these fault scenarios represent the most significant of those that are both reasonably foreseeable and have the potential to lead to an off-site dose consequence of all those that could occur at Chapelcross.
51. ONR's specialist technical inspector is satisfied that the consequences presented by fault sequences F1, F3 and F4 (which lead to public dose consequences of 1 mSv or less) are sufficiently conservative and below the REPPiR threshold that an exhaustive review of them is not required. The information provided by Magnox Ltd is sufficient to conclude that it is not reasonably foreseeable that these sequences could lead to a radiation emergency as defined by REPPiR.
52. Of the five fault scenarios for Chapelcross described in the RoA, F2 and F5 lead to the most significant potential off-site doses. As a consequence, ONR's specialist technical inspector has conducted a detailed review of these scenarios to establish whether appropriate calculation methods and supporting data have been used such that the result bounds reasonable uncertainty and variation for these fault scenarios. This is to assess whether there is a likelihood that these fault scenarios could exceed the REPPiR threshold for requiring an off-site emergency planning area and prior information area.
53. REPPiR and ONR guidance (References 3 and 7) specifies that best-estimate analysis should be used by operators to calculate off-site dose consequences and that *"evidence should be presented that unwarranted conservatism is not being used"*. Some conservatism may be used in the calculation of off-site dose figures, for example to simplify analysis, but unwarranted conservatism can give rise to a disproportionately extensive emergency plan. Therefore, careful consideration has been given as to whether analysis undertaken by Magnox Ltd for fault sequences F2 and F5 is appropriate to support the conclusions of the RoA/HIRE that these faults are not likely to lead to a reasonably foreseeable radiation emergency as defined in REPPiR.
54. Fault sequence F2 considers a military combat aircraft collision with the low level waste storage area. Magnox Ltd used the NEAF methodology to calculate the off-site dose consequence resulting from fault sequence F2 (4.01 mSv, Table 1). It is ONR's opinion that Magnox Ltd's application of the NEAF methodology did not take sufficient account of doses resulting from ingestion, direct radiation exposure from ground

- deposition of radionuclides, and public occupancy in reaching the calculated off-site dose consequence. In response to this, Magnox Ltd provided a sensitivity study on different occupancy models, added appropriate dose contributions from ingestion doses, and ensured the estimated dose from direct radiation exposure due to ground deposition of radionuclides is assessed over the 12 months period required by REPPiR. When these factors are considered, the sensitivity study shows a potential modified off-site dose consequence for fault F2 of up to 4.55 mSv. This is likely to be an overestimate due to radioactive decay (since the material was stored / the RoA was submitted) and other factors (cf the original estimate in the RoA of 4.01mSv, which omitted the identified additional exposure pathways).
55. ONR's technical specialist inspector has carefully considered whether the key assumptions and modelling used for fault scenario F2 now meet the REPPiR guidance criteria and has concluded that the 4.55 mSv is suitably conservative. In addition, the technical specialist inspector is satisfied that there are no reasonable changes to key assumptions that could lead to significantly worse consequences. On this basis, ONR is satisfied that it is not likely that fault sequence F2 would lead to a reasonably foreseeable radiation emergency as defined in REPPiR.
 56. The remaining fault, fault scenario F5, considers a military combat aircraft collision with temporary storage vessels located in the intermediate level waste store. The off-site dose consequence Magnox Ltd has calculated for this fault sequence results from exposure of a number of fuel pellet bottles following this collision. The stainless steel fuel pellet bottles are stored within temporary storage vessels. Each temporary storage vessel holds 10 pellet bottles in a cast iron crucible, which is set in concrete lined 200 litre mild steel drum. Total weight of each temporary storage vessel is approximately 2 tonnes. There are a total of 187 loaded temporary storage vessels in the intermediate level waste storage facility.
 57. For fault scenario F5, Magnox Ltd has claimed that a total of 40 of the 187 temporary storage vessels will be significantly damaged. It is considered that the pellet bottles will be dislodged and come to rest on the floor, with other debris from the impact providing some shielding. It is assumed that 10% of the exposed pellet bottles (40 in total) will provide direct external radiation exposure to a person at the site fence 30 m away. The resulting off-site dose consequence assessed is 3.84 mSv. This figure is substantially conservative as it is based on a 1 year decay of the radioactive material which is discussed further in paragraphs 60 and 61.
 58. One of the key differences between fault F5 and fault F2 (also an aircraft collision) is that, in the RoA, Magnox Ltd has made no assessment of the consequences of a fire resulting from this crash. ONR's specialist technical inspector requested that Magnox Ltd provide additional information to justify this claim, and to provide an assessment of the additional dose consequence from a fire. Information subsequently provided by Magnox Ltd claimed that the probability of a crash with a fire is a factor of 3 less than that without a fire (2.6×10^{-6} per year, Table 1). Hence the combined crash with fire is no longer considered to be reasonably foreseeable. ONR's specialist technical inspector sought the opinion of a specialist extreme hazards inspector who advised that this frequency reduction was appropriate in this instance.
 59. However, for fault scenario F5, Magnox Ltd nevertheless provided information relating to the assessed doses arising from a fire affecting the temporary storage vessels. It assumes that the pellet bottles contained within the temporary storage vessels are compromised such that their contents are partially spilled. This compromise of the pellet bottles, without fire, would lead to an additional off-site dose consequence, resulting from further dispersal of radioactive material, of approximately 0.4 mSv. With

- a fire, Magnox Ltd has used a more conservative release fraction and the additional off-site dose consequence is assessed to be in the region of 0.5 mSv. These additional dose figures are considered to be realistic as the radioactive decay of the material has been taken into account (see discussion in paragraphs 60 and 61). ONR's specialist technical inspector is satisfied that the additional dose arising from a military combat aircraft collision, even with a fire, does not represent a significant increase over that originally assessed in the RoA.
60. ONR's specialist technical inspector has reviewed and challenged the modelling assumptions used for fault sequence F5 to establish whether they are reasonable and bound the likely consequences. An example is that by simple scaling of the calculated dose consequence it would require 52 temporary storage vessels to be exposed to exceed the REPPIR threshold for a reasonably foreseeable radiation emergency (5 mSv at the site fence). In response Magnox Ltd confirmed that their assumptions of 40 temporary storage vessels being significantly damaged and for the level of debris providing shielding are based on judgement, but highlighted a number of factors that had given them confidence that their assessment is appropriately conservative overall. These are:
- The robust construction of the temporary storage vessels limiting potential exposure to the pellet bottle within.
 - No minimum energy requirement is assumed for temporary storage vessel containment failure during a military aircraft crash.
 - The assessment is based on a 1 year decay of the radioactive material when the actual storage period (and therefore decay period) is between 11 and 35 years.
61. To support the last bullet point argument, Magnox Ltd has also highlighted that since the RoA was written in 2012, this fault has been reassessed as part of the new safety assessment for the intermediate level waste storage facility, but now incorporating a more realistic, but still conservative 10 year decay of the radioactive material (which is actually between 11 and 35 years). This states that most of the radionuclides in the pellet waste were predicted to have decayed to insignificant levels with the exception of tritium, cobalt-60, caesium-134 and europium-152 (with half-lives of 12.32, 5.27, 2.06 and 13.3 years respectively), of which the short lived caesium-134 was the dominant contributor to dose at the start of storage life. This results in a revised off-site dose consequence from this fault being less than 0.7 mSv (previously 3.84 mSv, Table 1). If it is also assumed that the pellet bottles are compromised leading to the partial spilling of their contents and dispersal of radioactive material (paragraph 59), conservative assessment indicates there would be an additional dose of approximately 0.4 mSv from the 40 damaged temporary storage vessels.
62. It can be seen from the additional information provided by Magnox Ltd that, if both doses from gamma shine and other exposure pathways are considered, it would require all the pellet bottles from at least 185 (of the 187) temporary storage vessels to be damaged, with 10% of the exposed bottles providing direct external radiation exposure to a person at the site fence, for the REPPIR threshold to be exceeded. In my opinion the making of this assertion is unreasonably conservative in terms of off-site dose consequence, due to the number of unreasonably conservative assumptions made in its calculation. Furthermore it would be highly unlikely for the REPPIR threshold to be exceeded even if all 187 temporary storage vessels were compromised.
63. Even though some exposure pathways were omitted from the Magnox Ltd RoA the ONR specialist technical inspector is satisfied that the 3.84 mSv calculated for fault

scenario F2 is a conservative estimate because no account is taken of the container integrity or radioactive decay. Therefore he concurs with Magnox Ltds conclusion in the RoA that this fault sequence could not lead to a reasonably foreseeable radiation emergency as defined in REPPIR.

64. Within the technical assessment report, ONR's specialist technical inspector states:

"Based upon the information presented by Magnox, I have satisfied myself that Magnox has undertaken an appropriate review of the safety case to identify potential faults for off-site emergency planning, but that none of these faults could lead to a reasonably foreseeable radiation emergency, as defined by REPPIR"

"I am content to support the conclusion in Ref. 1 (the Magnox Ltd HIRE/RoA (Reference 1)) that it is not reasonably foreseeable that a fault at Chapelcross could lead to a radiation emergency, as defined by REPPIR. Therefore there is no requirement for an off-site planning area."

Conclusion 1: ONR is satisfied that the technical submissions made by Magnox Ltd demonstrate that members of the public are not likely to be exposed to doses in excess of the values of REPPIR Schedule 1. In consequence, a radiation emergency as defined in REPPIR, is no longer judged to be reasonably foreseeable for the Chapelcross site. In this circumstance, the requirements under REPPIR regulation 9, that ONR determines an off-site emergency planning area for the purposes of public protection, no longer applies. Correspondingly, there is no longer a requirement under REPPIR for a local authority off-site plan (regulation 9) nor for the provision of public information by the operator (regulation 16).

5 OFF-SITE EMERGENCY ARRANGEMENTS

65. Although a radiation emergency, as defined in REPPIR, is no longer reasonably foreseeable (and consequently, that a local authority off-site emergency planning area and a prior information area are no longer required by REPPIR), the radioactive inventory of Chapelcross continues to exceed the specified quantities set out in REPPIR Schedule 2. Consequently, under REPPIR regulations 5(1) and 5(2), the licensee continues to be required to review and submit a HIRE every three years, or following a material change in the work with ionising radiation.
66. Whilst no material change in the work with ionising radiation is currently anticipated, Chapelcross is one of the five sites that is being considered by the Ministry of Defence for the storage of nuclear waste from decommissioned nuclear power submarines (Reference 11). The site chosen will be used for interim storage of reactor components until after 2040, when the UK Geological Disposal Facility is planned to come into operation. Public consultation for site selection will run from November 2014 to February 2015. Should Chapelcross be selected, it is expected that it would be some time before Magnox Ltd is in a position where it needs to re-submit an RoA due to submarine related nuclear waste considerations. If such a re-submission indicates any material change in the risk profile of the site, ONR will make a further redetermination to consider whether further measures under REPPIR to protect the public in the event of a reasonably foreseeable radiation emergency would be justified.
67. Notwithstanding that there is no longer a direct requirement under REPPIR for a local authority off-site plan, an operators plan, or for the provision of prior information by the operator in respect of the Magnox Ltd Chapelcross site, both local authority and

operator continue to have relevant legal duties under other legislation that are not directly affected by this determination.

68. Specifically, bodies such as local authorities have duties relating to emergency arrangements under other legislation such as the CCA.
69. Similarly, nuclear licensees have general duties to ensure, so far as is reasonably practicable, the safety and welfare of employees and other persons; to make and implement adequate arrangements for dealing with any accident or emergency (under site licence condition 11 attached to the nuclear site licence); and to prepare contingency plans under the Ionising Radiations Regulations 1999 as appropriate.
70. Whilst ONR is not an enforcing authority for the CCA, ONR, where relevant, will continue to deliver regulatory oversight of the other legal duties as they apply to Magnox Ltd.

6 CONCLUSIONS

71. This report describes ONR's assessment of the operator's RoA/HIRE for the Chapelcross nuclear licensed site and the consequential requirements (or otherwise) for REPPiR off-site emergency planning and prior information areas, which were previously prescribed in 2002 as an area of radius 2 km centred on the mid-point of the four reactors on the Chapelcross nuclear licensed site.
72. The conclusion of this report is that:
 - ONR accepts the conclusion of the Magnox Ltd RoA that there is no longer a fault scenario where a reasonably foreseeable radiation emergency (as defined in REPPiR) might arise at the Chapelcross nuclear site.
 - ONR is satisfied that the Magnox Ltd assessment of hazards at Chapelcross is based on reasonable assumptions and that appropriate methods have been used in the calculation of potential off-site dose consequences.
 - ONR is satisfied that the maximum likely off-site dose consequence for all reasonably foreseeable events at Chapelcross is bounded by 4.55 mSv from fault sequence F2 (although ONR accepts that this is likely to be an overestimate because of radioactive decay and other factors). As a consequence, the criteria requiring the provision of an operator's emergency plan, off-site emergency planning and prior information area under REPPiR regulations 7(1), 9(1) and 16(1) are not met. Therefore, the requirements for the determination of a REPPiR off-site emergency planning area, for an operator's emergency plan, and for prior public information, are no longer required.
 - However, ONR notes that both the local authority and operator have obligations under other legislation relevant to emergency and contingency planning with which they must continue to comply.

7 RECOMMENDATIONS

73. As a result of the conclusions of this report, it is recommended that ONR make the following notifications: That ONR write to

Recommendation 1: Dumfries and Galloway Council and Magnox Ltd, to notify them that a REPPiR off-site emergency planning area is no longer required for the Chapelcross licensed site.

Recommendation 2: Dumfries and Galloway Council, to notify them that there is no longer a requirement under REPPiR for the local authority to prepare an off-site emergency plan.

Recommendation 3: Magnox Ltd, to notify it that the requirement to ensure the appropriate provision of prior information to the public is no longer required under REPPiR. This notification should be copied to Dumfries and Galloway Council.

Recommendation 4: Magnox Ltd, to notify it that there is no longer a requirement under REPPiR for an operator's emergency plan.

Recommendation 5: the Food Standards Agency and the Scottish Environment Protection Agency notifying them of the outcome of this assessment and the removal of the REPPiR off-site planning and prior information areas for the Chapelcross licensed site.

74. ONR will continue to seek assurance that, following the removal of the requirement for an operator's emergency plan and a local authority off-site emergency plan under REPPiR, the operator continues to make adequate provisions and maintains proportionate emergency arrangements for the Chapelcross nuclear licensed site. These include the residual emergency and contingency related legal requirements of the Health and Safety at Work Act, the Nuclear Installations Act and the Ionising Radiations Regulations 1999.

8 REFERENCES

- 1 Chapelcross: REPIIR Regulation 6(4) Hazard Identification and Risk Evaluation: Report of Assessment. NP/SC 5140 Revision 1. O. Lonsdale, June 2012.
- 2 Magnox Ltd letter to ONR – Chapelcross: REPIIR Regulation (6(4) Hazard Identification Risk Evaluation: Report of Assessment. CX50278N, J. Grierson, August 2012.
- 3 The technical assessment of REPIIR submissions and the determination of detailed emergency planning zones, ONR NS-TAST-GD-082 Revision 2 2013.
http://www.onr.org.uk/operational/tech_asst_guides/ns-tast-gd-082.pdf
- 4 A guide to the Radiation (Emergency Preparedness and Public Information) Regulations 2001. L126. 2002. <http://www.hse.gov.uk/pubns/priced/l126.pdf>
- 5 File Note: Evaluation of ONR Technical Assessment of Magnox Chapelcross Report of Assessment in relation to material changes on-site that affect determination of the REPIIR off-site emergency planning area. B. Broadley. December 2014.
- 6 Council Directive 96/29 Euratom of 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation. Official Journal of the European Communities (1996) 39, No L159, 1-114 IBSN 0 11 915263 0
- 7 Safety Assessment Principles for Nuclear Facilities 2006 Edition Revision 1.
<http://www.onr.org.uk/saps/index.htm>
- 8 IAEA Safety Standard Series – Preparedness and Response for a Nuclear or Radiological Emergency GS-R-2
- 9 IAEA Safety Standards – Arrangements for Preparedness for a Nuclear or Radiological Emergency GS-G-2.1
- 10 Technical assessment of Chapelcross REPIIR Hazard Identification and Risk Evaluation (HIRE), ONR-DFW-AR-14-067 Revision 1 October 2014
- 11 Ministry of Defence, Philip Dunne MP, 16th October 2014.
<https://www.gov.uk/government/news/sites-for-submarine-dismantling-consultations-confirmed>