Determination of the Off-site Emergency Planning and Public Information Areas for the Wylfa Nuclear Licensed Site

Radiation (Emergency Preparedness and Public Information) Regulations 2001

Project Assessment Report ONR-COP-PAR-15-015
Revision 0
May 2016
EXECUTIVE SUMMARY

Determination of the Off-site Emergency Planning and Public Information Areas for the Wylfa Nuclear Licensed Site: Radiation (Emergency Preparedness and Public Information) Regulations 2001

The Office for Nuclear Regulation (ONR) is responsible for regulating GB nuclear sites in order to protect the health and safety of employees and the public against risks of harm arising from ionising radiations. ONR’s responsibilities include a legal duty, where it is concluded that there is a potential for a reasonably foreseeable radiation emergency (as defined in the Radiation (Emergency Preparedness and Public Information) Regulations 2001 (REPPiR)), to determine an off-site emergency planning area\(^1\) (i.e. the area within which, in ONR’s opinion, any member of the public is likely to be affected by such an emergency). In these cases, there is also a legal duty, under the same Regulations, for ONR to determine an area\(^2\) within which prior information is to be distributed to the public. A radiation emergency is defined in REPPiR as an event where a person off-site is likely to receive a radiation dose in excess of the thresholds in REPPiR (typically an effective dose in excess of 5 milliSieverts (mSv)) in the 12 months following. It therefore constitutes an important component of the UK’s overall emergency response framework.

This ONR Project Assessment Report describes and explains the basis for the redetermination, in accordance with REPPiR, of the off-site emergency planning area and the area within which prior information is to be distributed to persons around the Magnox Ltd. nuclear licensed site of Wylfa on the Isle of Anglesey.

In relation to the off-site emergency planning area, the responsible local authority, in this case the Isle of Anglesey County Council (IACC), is required to prepare an off-site emergency plan with the purpose of minimising, so far as is reasonably practicable, radiation exposures to those likely to be affected by a reasonably foreseeable radiation emergency. This plan will reflect the potential need to implement appropriate protection measures such as sheltering and evacuation in order to reduce radiation doses to members of the public within all or parts of this area.

REPPiR requires operators who carry out work involving quantities of radioactive materials at or beyond those specified by REPPiR, in this case Magnox Ltd., to undertake a Hazard Identification and Risk Evaluation (HIRE) in relation to their work with ionising radiations. This HIRE 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 that operators must assess their HIRE and to submit a Report of Assessment (RoA) to ONR either prior to commencement of the work with ionising radiation, following any relevant material change in this work, or within three years of the last assessment, whichever is the shorter.

---

\(^1\) 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’ rather than the ‘DEPZ’.

\(^2\) This is sometimes, and has historically been, referred to as the Public Information Zone (PIZ) under regulation 16, but for the same reasons as given above is not used in this report. This report refers to the ‘REPPiR prior information area’.

Office for Nuclear Regulation
Previous determinations for the Wylfa site have concluded that a radiation emergency is reasonably foreseeable and have specified, the off-site local authority emergency planning and prior information areas as a circular area of radius 1.6 km around the Wylfa site.

This re-determination has been undertaken in response to REPPiR submissions to ONR by Magnox Ltd and concludes that, despite power generation ceasing on 31 December 2015, a radiation emergency remains reasonably foreseeable. A modification to the off-site emergency planning and prior information area is required by REPPiR as a result of continuous improvement to Magnox’s assessment and the application of ONR’s recently revised principles for the determination of such areas.

ONR’s re-determination of the REPPiR off-site emergency planning area and the REPPiR prior information area for the Magnox Ltd. nuclear licensed site located at Wylfa on the Isle of Anglesey, has been undertaken in accordance with ONR’s regulatory processes, guidance associated with REPPiR itself, and the relevant ONR Technical Assessment Guide (TAG). In particular, the TAG includes ONR’s determination principles published in 2014 and associated guidance for the determination of such areas. These principles recognise the learning that has emerged from global events such as occurred at Fukushima and the need to review the scope of off-site emergency planning. They also reflect ONR’s commitment to high standards of nuclear safety at nuclear installations, and its continual efforts to seek improvements to measures to secure public safety and to the consistency and transparency of its decision-making.

ONR’s determination process requires that:

(i) Technical assessments be undertaken, by ONR, of Magnox Ltd.’s Hazard Identification and Risk Evaluation (HIRE) and Report of Assessments (RoAs).

(ii) In accordance with the relevant ONR TAG, ONR also gives consideration to practical and strategic factors relating to the planning and potential implementation of a credible off-site emergency plan, and other pragmatic factors appropriate to secure confidence as regards protection of the public. This aspect of the process includes dialogue with the relevant local authorities, in this case the IACC (as the organisation responsible under REPPiR regarding the off-site plan) and considers, amongst other factors, local population (including vulnerable groups), geographical considerations and existing good practice where the local authority emergency plan already extends beyond the minimum required distance. This informs ONR’s determination so as to define more practical emergency planning and prior public information areas than would be the case from purely technical considerations.

ONR’s regulatory principles emphasise the importance of ensuring that an appropriate balance is achieved between the assessment of technical submissions provided by the operator and other practical and strategic considerations judged to be appropriate in the interests of public safety. As a consequence, the ultimate determination of the REPPiR off-site emergency planning area represents ONR’s regulatory judgement, and is not formed solely on the basis of technical considerations or criteria.

The outcome of ONR’s review, taking into account the latest review of hazards on the site and relevant practical and strategic considerations relating specifically to Wylfa, is that both the REPPiR off-site emergency planning area and the REPPiR prior information area for the Wylfa site have been re-defined. The off-site emergency planning and prior information area for Wylfa is shown in Appendix D, Map 3. It may be generally described as a land area which is defined by geographical features located approximately 1-2.5 km from the centre of the Wylfa site including the villages of Tregele and Cemaes, and an approximately rectangular seaward area that commences at the points where the land area reaches the coast, and extends north for approximately 1 km out to sea.

Changes to the shape of the off-site emergency planning area from a circle to the shape indicated in Appendix D, Map 3 reflect factors which ONR judges to be relevant in securing confidence as regards to protection of the public during a reasonably foreseeable radiation
emergency, the learning that has emerged from global events such as occurred at Fukushima, and the need to review the scope of off-site emergency planning.

The recommendations of this report are that ONR write to:

1. IACC and Magnox Ltd. to advise that the REPPIR off-site emergency planning areas have been determined as the area within the green line shown in Appendix D, Map 3.
2. IACC confirming the need to update, as required, its detailed emergency plan to adequately cover the area defined in the first recommendation.
3. Magnox Ltd. confirming the requirement to ensure the appropriate provision of prior information to the public within the area referred to in the first recommendation. This information should also be copied to IACC.
4. Nuclear Decommissioning Authority (NDA), Natural Resources Wales (NRW), Environment Agency (EA), Food Standards Agency (FSA), Department of Energy & Climate Change (DECC), and Maritime and Coastguard Agency (MCA) to advise it of the revised REPPIR off-site emergency planning and information areas.
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>BNG</td>
<td>British National Grid (referencing eastings and northings)</td>
</tr>
<tr>
<td>CCA</td>
<td>Civil Contingencies Act (2004)</td>
</tr>
<tr>
<td>DEPZ</td>
<td>Detailed Emergency Planning Zone (Ref: REPPiR regulation 9(1))</td>
</tr>
<tr>
<td>EA</td>
<td>Environment Agency</td>
</tr>
<tr>
<td>EURATOM</td>
<td>European Atomic Energy Committee</td>
</tr>
<tr>
<td>FSA</td>
<td>Food Standards Agency</td>
</tr>
<tr>
<td>GB</td>
<td>Great Britain</td>
</tr>
<tr>
<td>HIRE</td>
<td>Hazard Identification and Risk Evaluation</td>
</tr>
<tr>
<td>HSE</td>
<td>Health and Safety Executive</td>
</tr>
<tr>
<td>IACC</td>
<td>Isle of Anglesey County Council</td>
</tr>
<tr>
<td>IAEA</td>
<td>The International Atomic Energy Agency</td>
</tr>
<tr>
<td>MCA</td>
<td>Maritime and Coastguard Agency</td>
</tr>
<tr>
<td>NDA</td>
<td>Nuclear Decommissioning Authority</td>
</tr>
<tr>
<td>NRW</td>
<td>Natural Resources Wales</td>
</tr>
<tr>
<td>ONR</td>
<td>Office for Nuclear Regulation</td>
</tr>
<tr>
<td>PAR</td>
<td>Project Assessment Report</td>
</tr>
<tr>
<td>PAZ</td>
<td>Precautionary Action Zone (IAEA terminology)</td>
</tr>
<tr>
<td>PIZ</td>
<td>Public Information Zone (Ref: REPPiR regulation 16(1))</td>
</tr>
<tr>
<td>PHE</td>
<td>Public Health England</td>
</tr>
<tr>
<td>REPPiR</td>
<td>Radiation (Emergency Preparedness and Public Information) Regulations 2001</td>
</tr>
<tr>
<td>RoA</td>
<td>Report of Assessment</td>
</tr>
<tr>
<td>SAPs</td>
<td>(ONR) Safety Assessment Principles</td>
</tr>
<tr>
<td>TAG</td>
<td>(ONR) Technical Assessment Guide</td>
</tr>
<tr>
<td>UPZ</td>
<td>Urgent (protective action) Planning Zone (IAEA terminology)</td>
</tr>
</tbody>
</table>
TABLE OF CONTENTS

EXECUTIVE SUMMARY ........................................................................................................... i
GLOSSARY ............................................................................................................................. iv
TABLE OF CONTENTS ............................................................................................................ v
1 REGULATORY CONTEXT .............................................................................................. 1
2 BACKGROUND ............................................................................................................. 1
3 SCOPE ............................................................................................................................ 2
4 METHODOLOGY ............................................................................................................ 3
  4.1 ONR’s process for determining a REPPIR off-site emergency planning area ............ 3
  4.2 Basis of assessment ........................................................................................................ 4
  4.3 Standards and Criteria ..................................................................................................... 5
5 ASSESSMENT OF TECHNICAL SUBMISSIONS ................................................................ 6
  5.1 Magnox Limited RoA ....................................................................................................... 6
  5.2 ONR Technical Assessment of the Magnox RoA ............................................................ 7
  5.3 Conclusions of Technical Assessments ........................................................................... 8
6 ASSESSMENT OF PRACTICAL AND STRATEGIC CONSIDERATIONS FOR
   THE DETERMINATION OF the REPPIR OFF-SITE EMERGENCY PLANNING
   AREAS AND THE REPPIR PRIOR INFORMATION AREAS ......................................... 8
  6.1 Local Geographic, Population and Practical Implementation Factors .......................... 9
  6.2 Credibility and Confidence in the Extent of the REPPIR Off-site Emergency
      Planning Area ................................................................................................................... 10
  6.3 Avoidance of Bisect of Local Communities ................................................................. 11
  6.4 Inclusion of Immediately Adjacent Vulnerable Groups ............................................. 12
  6.5 International Good Practice .......................................................................................... 13
  6.6 Consideration of Benefits and Dis-benefits of Dose Reduction Measures (including
      Countermeasures) ........................................................................................................... 14
  6.7 Other site specific factors of which ONR is aware ....................................................... 15
7 CONCLUSIONS ............................................................................................................. 16
8 RECOMMENDATIONS .................................................................................................... 17
9 REFERENCES ............................................................................................................... 18
10 APPENDICES .............................................................................................................. 20
Appendix A ............................................................................................................................. 20
  Map 1: Map of Wylfa 2002-2016 REPPIR off-site emergency planning area ..................... 20
  Map 2: Map of populations adjacent to Wylfa ..................................................................... 21
Appendix B ............................................................................................................................. 22
  Significant Infrastructure ..................................................................................................... 22
  Transport issues .................................................................................................................. 22
  Hospitals ............................................................................................................................. 22
  Strategic Control Centres ................................................................................................... 22
Appendix C ............................................................................................................................. 23
  Vulnerable groups .............................................................................................................. 23
Appendix D ............................................................................................................................. 24
  Map 3: ONR determination of the REPPIR off-site emergency planning area and the
         REPPIR prior information area around the Magnox Ltd. nuclear licensed site of
         Wylfa .............................................................................................................................. 24
1 REGULATORY CONTEXT

The UK Energy Act (reference 1) requires the Office for Nuclear Regulation (ONR) to do whatever it considers appropriate for the purposes of protecting persons against risks of harm arising from ionising radiations from GB nuclear sites, including through:

   a. securing the health, safety and welfare of persons at work on GB nuclear sites; and

   b. protecting persons, other than persons at work on GB nuclear sites, against risks to health or safety arising out of or in connection with the activities of persons at work on GB nuclear sites.

ONR does this by providing efficient and effective regulation of the nuclear industry, holding it to account on behalf of the public, and, in particular, ensuring that appropriate arrangements are put in place to deal with a nuclear emergency.

ONR’s responsibilities include a legal duty, where it is concluded that there is a potential for a reasonably foreseeable radiation emergency (as defined in the Radiation (Emergency Preparedness and Public Information) Regulations 2001 (REPPiR)), to determine an off-site emergency planning area. This is the area within which, in ONR’s opinion, any member of the public is likely to be affected by such an emergency\footnote{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’ under regulation 9 rather than to ‘detailed emergency planning zone’ or DEPZ.}. In these cases, there is also a legal duty under the same regulations, for ONR to determine an area within which prior information is to be distributed to the public\footnote{This is sometimes, and has historically been, referred to as the Public Information Zone (PIZ) under regulation 16, but for the same reason as given above is not used in this report. This report refers to the ‘REPPiR prior information area’.}. A radiation emergency is defined in REPPiR as a reasonably foreseeable event where a person off-site is likely to receive a radiation dose in excess of the thresholds in REPPiR (typically an effective dose in excess of 5 milliSieverts (mSv)) in the 12 months following it. It therefore constitutes an important component of the UK’s overall emergency response framework.

This report sets out the outcome and justification for the determination of the revised off-site emergency planning and prior information areas for the Magnox Ltd. nuclear licensed site of Wylfa, in accordance with the requirements of REPPiR regulations 9(1) and 16(1) respectively (reference 2).

ONR is of the opinion that the extent of areas for local authority off-site planning and for the provision of prior information by the operator should be the same. This is a reflection of the fact that the factors considered by ONR for determination of these areas are the same. As a consequence, and for simplicity, where the term ‘REPPiR off-site emergency planning area’ is used in this report, it should be assumed to refer equally to the off-site emergency planning and prior information areas.

2 BACKGROUND

The UK nuclear regulatory system requires that every licensee (i.e. nuclear site license holder) demonstrate to the regulator that it fully understands the hazards and risks associated with its operations and controls them appropriately. The regulator assesses the safety and security of the design and operation of nuclear plant to ensure that licensees’ provisions are robust, and that any risks are reduced so far as is reasonably practicable.

Magnox Ltd. is the company responsible for operations at the Wylfa nuclear licensed site on behalf of the Nuclear Decommissioning Authority (NDA), a non-departmental public body in the UK which is responsible for managing the effective and efficient clean-up of the UK nuclear legacy.
REPPIR came into force in 2001, and the REPPIR off-site emergency planning area around the operating reactors at the Magnox Ltd. Wylfa site was determined at the time to be a circle of radius 1.6 km centred on the reactor building.

Wylfa power station is on the coast of the Irish Sea on the northern side of the Isle of Anglesey and began generating electricity in 1971. It has two Magnox reactors. Reactor 2 ceased electricity generation in April 2012 and Reactor 1 ceased generation in December 2015. Both reactors had a generating capacity of 480 MW during operation. Today the Wylfa site is in the defueling phase, following which work will be undertaken to take the site into care and maintenance.

In relation to emergency planning, REPPIR requires operators, in this case Magnox Ltd., to undertake a Hazard Identification and Risk Evaluation (HIRE) of hazards arising from their work with the potential to cause a radiation accident on their site. These assessments 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 Report of the Assessment (RoA) of their HIRE to the ONR prior to commencement of the work, following any material change, and at least every three years, whichever is the shorter.

Where it is reasonably foreseeable that a radiation emergency (as defined in REPPIR) could arise, REPPIR requires ONR to determine areas 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)) to members of the public without them having to request it and also make that information publicly available.

The off-site emergency plan, in cases where one is required, should include countermeasures in order to reduce radiation doses to members of the public, such as sheltering, evacuation, administering stable iodine tablets (in the case of operating nuclear reactors), and other protection measures that are relevant, reasonably practicable, and proportionate to the radiological risk.

Following the determination by ONR, the local authority, in this case Isle of Anglesey County Council (IACC), is required to prepare an adequate off-site emergency plan. In so doing, the local authority has a legal obligation to consult a range of persons (including the operator, the emergency services, the relevant health authority, and such other persons, bodies and authorities and members of the public as it considers appropriate). This plan must then be reviewed, revised where necessary, and tested at least every three years.

From 2002 to 2016, there was a circular REPPIR off-site emergency planning areas around the Wylfa site with a radius of 1.6 km around the centre of the reactor building (grid reference SH 35066 94009). This area is shown in Appendix A, Map 1: Map of Wylfa 2002-2016 REPPIR off-site emergency planning area. The corresponding IACC emergency plan for this area is entitled “Wylfa Nuclear Power Station Off-Site Emergency Plan” (reference 3).

This report sets out the main considerations that ONR has given to determining revised REPPIR off-site emergency planning areas for the Wylfa site. It takes due account of the findings of the RoAs, HIREs and of ONR’s principles and guidance for making such determinations.

3 SCOPE

The assessment described in this report sets out the basis for, and conclusions of, the re-determination of the REPPIR off-site emergency planning and prior information area relating to the Wylfa site. It has been undertaken in accordance with the guidance on REPPIR (reference 4) and the relevant ONR supporting Technical Assessment Guide (TAG) (reference
5), which incorporates ONR’s principles for determination of REPPIR areas and related
guidance as published in 2014.

ONR’s principles recognise the learning that has emerged from global events such as
occurred at Fukushima, and the subsequent need to review the scope of off-site emergency
planning. They also reflect ONR’s commitment to high standards of nuclear safety at nuclear
installations, and its continual efforts to seek improvements to standards and to the
consistency and transparency of its decision-making.

Provisions for the implementation of food restrictions are not relevant to the process of
determining the REPPIR off-site emergency planning area on the basis that they are provided
separately (Food and Environment Protection Act 1985 (FEPA)) and are under the legal
jurisdiction of the Food Standards Agency (FSA). These provisions are therefore addressed
by separate legislation other than REPPIR, may be exercised in a broader range of
circumstances (i.e. not restricted to a radiological event), and are subject to existing planned
implementation arrangements made by the FSA. They are therefore outside the scope of this
report.

4 METHODOLOGY

4.1 ONR’s process for determining a REPPIR off-site emergency planning area

This process requires that ONR:

A. Conduct an initial independent technical assessment of the information provided
   by the licensee in their HIRE and RoA seeking and using additional information as
   appropriate; 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.

Step A requires ONR to assess the operator’s identification and characterisation of the
likelihood, nature and magnitude of the radiation related risks that may result for a radiation
accident. ONR also 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
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 Step B, and is usually presented in the operator’s HIRE reports as a
circle with a specified radius centred at the source of the potential accident.

Step B applies additional pragmatic, population (including vulnerable groups), 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 TAG
(reference 5). Whilst the determined REPPIR off-site emergency planning area, as a result of
considering these additional factors, need not be circular, it cannot be smaller than that arising
from the technical assessment under Step A.

ONR’s principles relating to practical and strategic considerations (reference 5) emphasise
that, in the undertaking of the determination, it is important to ensure that a balance is
achieved between the assessment of the technical report provided by the licensee, and such
additional practical and strategic considerations that, in ONR’s opinion, are judged necessary
in the interests of confidence in public safety. As a consequence, the extent of the REPPIR
off-site emergency planning area represents a regulatory judgement of the significance of all
of these factors, and is made on a case-by-case basis.

The factors that ONR’s principles and associated guidance indicate should be considered are
summarised as follows:

- local geographic, population and practical implementation factors;
• avoidance of bisection of local communities where sensible to do so;
• inclusion of immediately adjacent groups of vulnerable people;
• the need for the REPPPIR off-site emergency planning area to provide for a credible emergency plan, for the purposes of public protection, in which the public will be confident;
• consideration of the implications of the extent of the REPPPIR off-site emergency planning area in the context of an effective emergency response (e.g. dilution of resources (i.e. police, fire and ambulance) and potential dis-benefits associated with immediate/urgent countermeasures);
• relevant international good practices; and
• other relevant site specific factors of which ONR are aware.

The starting point for the off-site emergency planning area is based on the most significant reasonably foreseeable event (referred to in ONR’s Technical Assessment Guide (TAG) reference 5 as the ‘reference accident’, and described in guidance as an event which is less than likely but realistically possible). Such an accident could be caused, for example, by possible plant and equipment failures, breakdown of administrative arrangements, and potential unauthorised behaviour of employees or the public.

For events that are judged not to be reasonably foreseeable (e.g. extremely low frequency but potentially higher consequence events), the guidance associated with REPPIR recommends, as a good practice, that local authorities should be capable of extending their emergency response beyond the REPPPIR off-site emergency planning area should it be necessary to do so. However, extendibility arrangements are not considered further in this determination.

Although the local authority off-site emergency plans include many protection measures to reduce radiation doses to members of the public, the most commonly referenced off-site urgent countermeasures available in the early stages of a nuclear emergency are sheltering, evacuation and, in the case of operating nuclear power reactors, the administration of stable iodine tablets.

In determining a REPPPIR off-site emergency planning area, ONR acknowledges that the implementation of urgent countermeasures, for example rapid evacuation, can, in some circumstances, convey a risk of harm to individuals to whom they are applied. For example, following the Fukushima accident in Japan in March 2011, Koichi Tanigawa et al. report in the Lancet journal on the loss of life that occurred as a result of the implementation of evacuation (reference 6). Within a REPPPIR off-site emergency planning area, the local authority may expect some countermeasures to be applied immediately or urgently across at least a part of the area (normally that closest to the potential source of radiation). It is important that the area within which they may be applied, in the event of an emergency, is targeted and proportionate in order to ensure that overall risks to those affected are reduced so far as is reasonably practicable.

4.2 Basis of assessment

The REPPPIR off-site emergency planning area must, as a minimum, include all of the area around the site within which a person (including members of the public) could receive an effective dose in excess of 5 mSv in the year following a reasonably foreseeable radiation emergency (or other dose criteria defined in REPPIR Schedule 1). When assessing the extent of exposure, REPPPIR requires that operators assess the potential doses to members of the public from all exposure routes and, for this purpose, must disregard any health protection countermeasures that may have been taken by the local authority, emergency services or the exposed persons themselves, during the first 24 hours immediately following the event.

The Wylfa RoA (reference 7) provides a detailed description of the remaining plant containing radioactive substances on the site, (which exceed the levels specified in Schedule 2 of REPPPIR). The majority of the radioactivity present on the site is contained in the remaining irradiated fuel and other radioactive material in the form of both Low Level Waste (LLW) and Intermediate Level Waste (ILW). In addition to the fuel, the remaining potentially important inventories include:
- Sludges (approximately 28 m$^3$)
- Mild steel plant items (approximately 325 m$^3$)
- Miscellaneous activated components (approximately 835 m$^3$)

In addition, radioactivity will also be present as a result of the activation of structural materials, including:

- Graphite moderator (approximately 6000 m$^3$)
- Reactor internals including control rods, thermocouples, charge chutes and activated mild and stainless steel items (approximately 4400 m$^3$ total)
- Concrete (approximately 57200 m$^3$)

Magnox Ltd. notes that the activity associated with the structural material 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.

The provisions of REPPiR will continue to apply until such a time as the total inventory of radioactive material held on the Wylfa site falls below the stringent levels specified in Schedules 2 and 3 of REPPiR.

4.3 Standards and Criteria

4.3.1 Acts, regulations and guidance

The relevant standards and criteria considered within this assessment are those contained within the REPPiR (reference 2) and its associated guidance (reference 4). REPPiR are regulations created 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 (European Atomic Energy Committee (EURATOM)) - Basic Safety Standards for the Protection of the Health of Workers and Members of the Public against the Dangers from Ionising Radiation (reference 8).

4.3.2 Safety Assessment Principles

ONR’s Safety Assessment Principles (SAPs) provide inspectors with a guiding framework for making consistent regulatory judgements on nuclear safety cases. Although the SAPs are not directly relevant to the assessment of REPPiR submissions, the guidance within SAP: AM.1 - Accident management and emergency preparedness (reference 9) has been taken into account.

4.3.3 Technical Assessment Guides

The SAPs are supported by a suite of internal TAGs, with the following TAG being applied in this assessment:

- The technical assessment of REPPiR submissions and the determination of detailed emergency planning zones, ONR NS-TAST-GD-082 Revision 2 2013 (reference 5). This TAG incorporates ONR’s revised principles for determination of REPPiR off-site emergency planning areas.

4.3.4 National and International Standards and Guidance

The following national guidance has also been considered and, where appropriate, has informed the conduct of this assessment:


ONR also notes the relevance of the following International Standards and Guidance:

5 ASSESSMENT OF TECHNICAL SUBMISSIONS

In accordance with REPPIR regulation 5, Magnox Ltd. undertook a review of their HIRE in 2013 and identified and assessed all hazards on site with the potential to cause a radiation accident. It contains information about the Wylfa site, the current and planned operations, and their associated radiological hazards (reference 7). A further review was undertaken to address the changes in operations presented by the cessation of generation and the beginning of defueling in November 2015 (reference 12).

ONR has subjected Magnox Ltd.’s RoAs (references 7 and 12) and supporting documentation to expert and detailed technical assessment. A summary of Magnox Ltd.’s submissions and ONR’s technical assessment of them (references 13 and 14) are detailed in sections 5.1 and 5.2 respectively.

5.1 Magnox Limited RoA

Power generation at Wylfa ceased in 2015 and the site is now in the defueling phase. This period will see the reactors vessels depressurised along with a reduced demand on core cooling requirements. Operational activities will include the removal of irradiated fuel from the two reactors to on-site dry storage followed by despatch from the site with these operations expecting to take approximately 3 years. Following the removal of fuel from the site, the site will enter a care and maintenance preparation phase where the focus will be on radioactive waste management and decommissioning activities, including the retrieval, processing and packaging of intermediate level waste.

To identify candidate reasonably foreseeable faults which could lead to a radiation emergency as defined by REPPIR, Magnox Ltd. has developed screening criteria based upon the calculated frequency and potential consequences of fault sequences. The criteria include identifying the potential for “cliff-edge” effects, where faults not usually considered reasonably foreseeable could lead to significant radiological consequences.

The dose consequences have been calculated by Magnox Ltd. on an unmitigated conservative basis, using the Inter-Utilities Working Group (IUWG) methodology. Magnox Ltd. recalculated the likely doses to a member of the public on a best-estimate basis using the Nuclear Emergency Arrangements Forum (NEAF) methodology to estimate doses that could be averted through the application of early countermeasures.

The licensee’s dose estimates are based on the exposed person remaining outdoors in the path of the plume receiving the maximum dose from all pathways throughout the first 24 hours following the fault. The person is then assumed to remain for the rest of the year at a nominal critical habitation downwind of the activity release point. For each fault, the dose for an adult, child and infant were evaluated and the maximum used.

The exposure pathways considered include:

- Inhalation of contaminated air;
- Ingestion of contaminated food in the first 24 hours following release;
- Exposure to external radiation emitted by the contaminated air; and
- Exposure to external radiation emitted by radioactive material that has settled on the ground.

The Magnox Ltd. 2015 RoA (reference 12) identifies the worst reasonably foreseeable accident as a reactor temperature transient with core and fuel temperatures significantly exceeding 250°C and with a damaged fuel element present in the core, undergoing breakaway uranium oxidation.
Table 1: Summary of fault sequences and off-site doses

<table>
<thead>
<tr>
<th>Fault Description</th>
<th>Public dose at site boundary (mSv)*,**</th>
<th>Fault sequence frequency (per year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reactor temperature transient with core and fuel temperatures significantly exceeding 250°C and with a damaged fuel element present in the core, undergoing breakaway uranium oxidation</td>
<td>170</td>
<td>&lt;4 x 10^-6</td>
</tr>
<tr>
<td>Reactor temperature transient with core and fuel temperatures not exceeding 250°C and with a damaged fuel element present in the core</td>
<td>1.8</td>
<td>~4 x 10^-6</td>
</tr>
<tr>
<td>Fire in Radioactive Waste Management Facilities</td>
<td>1.06</td>
<td>~4 x 10^-4</td>
</tr>
</tbody>
</table>

* Public dose – whole body effective dose received in the 12 months following the event.
** Off-site dose consequence for each of the fault groups have been assessed by Magnox Ltd. for comparison with the whole body dose threshold defined in REPPIR Schedule 1 as 5 mSv.

All accidents that could lead to a reasonably foreseeable radiation emergency result in the release of radioactivity from spent fuel. This would include fission products with significant contributions to dose uptake from strontium, caesium and ruthenium. Radioactive iodine would contribute significantly to releases during reactor operations and shortly after reactor shut-down, however, the release of radioactive iodine is no longer significant at Wylfa as both reactors are now shut-down.

Magnox Ltd. have used the NEAF radiological dose methodology in order to calculate the 5 mSv dose contour (reference 15). This assumes Category D weather conditions and a wind speed of 5 m/s. The exposure pathways considered are ingestion, inhalation, cloud gamma and ground gamma (1 day). The dose to the lens of the eye has not been calculated in this assessment as it was not considered possible that it would be the limiting dose. This is in accordance with REPPIR guidance (reference 4) which states that it is not anticipated that this dose will be the reason for a radiation emergency being identified.

High consequence, low frequency external events such as aircraft impact, extreme weather, flooding and seismic events are considered in the safety case and no faults are identified that give rise to a significant off-site release of radiation (reference 16). A security review has also been undertaken concluding that it is not reasonably foreseeable for any security related event to lead to public dose consequences beyond the reference accident (reference 17).

The licensee’s RoA concludes that the 5 mSv contour, corresponding to the dose that defines a radiation emergency, lies within 900 m of the point of the radioactive release. This distance is a reduction from the circular area of at least 1.6 km from the centre of the site (reference 3). This distance equates to a mile and was the distance which was in place around Wylfa prior to the introduction of REPPIR. When REPPIR was introduced, it was considered unlikely that any person beyond this area would be exposed to a dose high enough to require prompt countermeasures to be applied and therefore was sufficient (reference 18).

5.2 ONR Technical Assessment of the Magnox RoA

REPPIR and ONR guidance (references 2 and 4) specify 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
ONR’s technical assessment (reference 14) considered the adequacy of the operator’s HIRE and RoA submissions against the issues listed below. Based on this, ONR’s specialist inspectors recommend a minimum size for the off-site emergency planning area. This is based on a dose contour within which the radiation dose to a member of the public from a reasonably foreseeable event could exceed 5 mSv.

ONR’s assessment addressed the following issues, with a view to commenting on the adequacy of different aspects of Magnox Ltd.’s submission:

- Whether the radionuclide inventory on the site exceeds the REPPiR Schedule 2 or 3 threshold values for REPPiR to apply;
- The definition and selection of appropriate reasonably foreseeable reference accidents;
- Whether a radiation emergency is reasonably foreseeable;
- The adequacy of the HIRE in determining the magnitude of off-site radiological releases resulting from a reasonably foreseeable accident; and
- The size of the 5 mSv dose contour to be used to inform the setting of the REPPiR off-site emergency planning area.

The RoA identifies the worst reasonably foreseeable accident as a reactor temperature transient with core and fuel temperatures significantly exceeding 250°C and with a damaged fuel element present in the core undergoing breakaway uranium oxidation.

5.3 Conclusions of Technical Assessments

ONR’s technical assessment (reference 14) concludes that Magnox Ltd.’s submission adequately meets the requirements of REPPiR with respect to the representation of a reasonably foreseeable radiation emergency.

The ONR technical assessment concludes that the radiation emergency dose contour distance (5 mSv) is appropriately estimated at 900 m from the point of occurrence of the reference accident. The reference accident is the only reasonably foreseeable radiation emergency and therefore is the bounding distance of the 5 mSv contour. However, these distances are informed solely by the technical assessment and do not consider the application of strategic and practical factors (as described in section 6 below).

Conclusion 1: ONR is satisfied that the technical submissions made by Magnox Ltd. demonstrate that members of the public would not be likely (the legal test provided by REPPiR) to be exposed to effective doses in excess of 5 mSv (or other dose criteria defined in REPPiR Schedule 1), in the year following a reasonably foreseeable radiation emergency, beyond a radial distance of 900 m from the centre of the reactor building on the Wylfa site.

6 ASSESSMENT OF PRACTICAL AND STRATEGIC CONSIDERATIONS FOR THE DETERMINATION OF THE REPPiR OFF-SITE EMERGENCY PLANNING AREAS AND THE REPPiR PRIOR INFORMATION AREAS

The purpose of the REPPiR off-site emergency planning area is to define the area for which the local authority must prepare an off-site emergency plan which is adequate to restrict exposures to the public, so far as is reasonably practicable, in the event of a reasonably foreseeable radiation emergency.

In accordance with ONR’s TAG (reference 5) and the principles incorporated within it, ONR must also give consideration to the practicality (in an emergency planning sense) of the REPPiR off-site emergency planning area, by considering a number of pragmatic factors considered to be relevant to securing its confidence regarding the effectiveness and credibility of the plans to deliver protection of the public.
In the course of considering these factors, ONR has consulted with IACC (as the organisation responsible under REPPiR for preparation of the off-site emergency plans for Wylfa) and considered data in the 2013 and 2016 RoAs (references 7 and 12) and data from the Health and Safety Executive (HSE) National Population Database (reference 19).

The application of these practical and strategic factors is discussed in sections 6.1 to 6.7 below.

6.1 Local Geographic, Population and Practical Implementation Factors

ONR TAG (reference 5) states that:

“The relevant local authority is consulted on the basis that it has significant ‘local’ knowledge and has the responsibility for development and, in the highly unlikely event that it is ever necessary, implementation of the off-site emergency plan. (Note: The local authority also has the legal duty to undertake consultation in relation to the off-site emergency plan as provided for under REPPiR regulation 9(12)).”

Wylfa is on the coast of the Irish Sea about 15 km north-east of Holyhead on the northern side of the Isle of Anglesey. The area around Wylfa is rural with an undulating landscape. The village of Cemaes and the coastal town of Amlwch lie 2 km and 9 km to the east respectively, while the village of Tregele lies about 1 km to the south.

IACC has been consulted on a number of local geographic, demographic and practical implementation factors which are taken into account throughout this report. Appendix B provides further details of local factors. IACC has advised that in this locality, there is no apparent benefit for using parish or postcode boundaries. However, the use of practical geographic features was identified as beneficial for ease of implementing the emergency plan. Therefore, as far as is sensible, the REPPiR planning area for Wylfa should be defined using physical features such as roads, rivers or footpaths.

**Conclusion 2:** To assist IACC in the preparation and implementation of the off-site emergency plan, the REPPiR off-site emergency planning area boundary should be defined, so far as is sensible, using physical features such as roads, rivers, footpaths or other established boundaries.

Whilst the land component of this area can be defined by the use of geographical features, this option does not exist for the seaward component. Whilst the seaward component could continue to be defined as a broadly semi-circular area, it is ONR’s opinion that the land and marine components should meet at the same points on the coast, thereby avoiding discontinuities.

As part of IACC’s off-site emergency plan, the Maritime and Coastguard Agency (MCA) (which is responsible for coordinating the exclusion of maritime traffic during a radiation emergency) was consulted. The MCA has recommended (reference 14) that, in terms of being able to notify vessels (unambiguously and simply) of an exclusion zone in the event of an emergency, the most effective options for the marine component of the area would be either a semi-circle (of defined centre coordinate and radius) or a rectangle (with defined corner coordinates). Since using geographical features to define the land component of the REPPiR off-site emergency planning area would not meet the coast at equal distances from the Wylfa site, it was decided to discount the semi-circle option on pragmatic grounds. Consequently, the extent of the marine area should be defined as a rectangle that commences at the points where the land area meets the coastline. MCA advice indicates that the simplest description of the marine area would be the area bounded by two latitudinal coordinates at a single longitudinal or fixed integer distance from the coast. This would readily allow MCA to advise vessels to take appropriate countermeasures within a clearly defined area.

In accepting this advice, it has been determined that the extent of the marine area should be defined as a rectangle that commences at the points where the land area meets the coastline, extending out to sea to the convenient British National Grid Northing 395000 (994 m north of the Wylfa reactor building) and between the Eastings 233560 and 237063.
Conclusion 3: The extent of the marine area should be defined as a rectangle that commences at the points where the land area meets the coastline, extending out to sea to the British National Grid Northing 395000 (approximately 1 km) and between the Eastings 233560 and 237063.

6.2 Credibility and Confidence in the Extent of the REPPPIR Off-site Emergency Planning Area

ONR TAG (reference 5) states that:

“Although REPPPIR places the duty on the independent regulator to make an objective and unbiased regulatory determination of the extent of the REPPPIR off-site emergency planning area (formerly Detailed Emergency Planning Zone (DEPZ)), ONR considers that, in the interests of confidence in public safety (noting the assumptions and estimations used to determine the 5 mSv contour), the DEPZ should be of sufficient extent so as to provide for a meaningful off-site emergency plan. It should, therefore, incorporate an appropriate degree of conservatism and pragmatism, and provide for a credible and effective response in the event of a reasonably foreseeable radiation emergency.”

The result of ONR’s technical assessment of the RoA submitted by Magnox Ltd. confirms that the limit of the extent to which members of the public are likely to be exposed to 5 mSv in the year following a reasonably foreseeable radiation emergency is a distance of approximately 900 m from the Wylfa site.

However, REPPPIR states that the safety objective of the planning undertaken by local authorities with the REPPPIR offsite emergency planning area is to “…secure, so far as is reasonably practicable, the restriction of exposure…” to “…persons who may be affected…” by a reasonably foreseeable radiation emergency, rather than simply to restrict public exposures in such an event to 5 mSv over the following year.

Hence, a REPPPIR off-site emergency planning area based on a contour equating to the limit of the extent of public exposures of ‘5 mSv over the year after such an emergency’ must also provide a sufficient off-site planning area for the purposes of satisfying this broader REPPPIR dose restriction intention, noting the proximity of any significant conurbations to the site.

ONR is mindful that, whilst UK licensees are typically conservative in their approach to nuclear safety, complex technical assessments of potential emergency situations must inevitably rely on a range of assumptions, judgements and estimates.

Whilst ONR is satisfied that the REPPPIR submission made by the licensees demonstrates the overall risk from the site has been conservatively estimated, ONR is of the opinion that it is appropriate, where public safety is at stake, that it acts with reasonable conservatism in its own right, in the interests of confidence in securing the public safety objective of REPPPIR.

As a consequence, ONR’s principles recognise that should an off-site emergency planning area demand very little by way of an emergency plan in practice (e.g. it contains a very small population), it may not be capable of providing sufficient flexibility in the (albeit extremely unlikely) event that the technical assumptions, judgements or estimates made by licensees are challenged in practice.

This is a relevant consideration in the case of Wylfa due to the relatively close proximity of the populations of Tregel and Cemaes. As a consequence, the extent of the plan should be such that it necessarily provides for a maximum credible and effective off-site emergency response plan.

To examine the extent of the area necessary to provide for such off-site planning, the populations adjacent to the site were considered. The following table identifies the populations in bands out to 3 km from the site.
Table 2: Populations adjacent to the Wylfa nuclear licensed site (reference 19, 20).

<table>
<thead>
<tr>
<th>Distance</th>
<th>Population*</th>
<th>Vulnerable Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 -1000 m</td>
<td>14</td>
<td>0</td>
</tr>
<tr>
<td>1000 -1500 m</td>
<td>97</td>
<td>0</td>
</tr>
<tr>
<td>1500 – 2000 m</td>
<td>678</td>
<td>0</td>
</tr>
<tr>
<td>2000 – 2500 m</td>
<td>874</td>
<td>84 + 16</td>
</tr>
<tr>
<td>2500 – 3000 m</td>
<td>104</td>
<td>0</td>
</tr>
</tbody>
</table>

*Data reflects night time population figures.

The estimated residential population within 1 km of the site represents a small area of very low population density. Having consulted IAAC, in my opinion this would not be sufficient in nature to provide for a credible and effective off-site emergency plan to secure protection of the public in the event of a reasonably foreseeable radiation emergency at Wylfa, noting the close proximity of the populations of Tregele and Cemaes.

An area extending to include the village of Tregele (without including any part of the town of Cemaes) was also considered. This area also has a low population density with approximately 290 residents (reference 19). Therefore, and for the same reason as above, in my opinion this would also not be sufficient to provide for a maximum credible and effective off-site emergency plan to secure protection of the public in the event of a reasonably foreseeable radiation emergency at Wylfa, again noting the close proximity of the population centre of Cemaes.

In conclusion, due to the small populations within the immediate vicinity of the site, and the comparatively large adjacent population of Cemaes, the REPPIR off-site emergency planning area for Wylfa should extend to include at least part of the village of Cemaes.

**Conclusion 4: To provide for a maximum credible and effective plan to secure the protection of the public and restriction of exposures so far as is reasonably practicable, the REPPIR off-site emergency planning area should extend to include the village of Tregele and at least part of the village of Cemaes.**

6.3 Avoidance of Bisection of Local Communities

ONR TAG (reference 5) states that:

"Whilst accepting that it may sometimes be unavoidable, ONR’s preference is to avoid the bisection of small settlements or communities, on the basis that any REPPIR off-site emergency planning area (formerly DEPZ) determination is based on some unavoidable assumptions and estimates, and is therefore not precise. Bisection of small communities has raised concerns in terms of public perception, and also has the potential to affect the effectiveness of implementation of countermeasures."

Bisection or division of communities has the effect that neighbours may find themselves inside and outside of the area respectively. ONR is aware that this may result in expressions of concern from members of the community, may confuse the community, and may result in practical differences in the levels of emergency planning provided to immediate neighbours. These practical differences in levels of planned protection could also present practical challenges for the local authority and emergency services.

Clearly, whilst the avoidance of the bisection of these communities presents the benefits described, these need to be weighed against potential drawbacks in terms of the size of the protection challenge and impact on the effectiveness of the off-site emergency plan. For example, the risks presented to the additional population associated with implementation of
protection countermeasures (e.g. stress, traffic accidents etc) should not be overlooked. This is considered further in section 6.6.

In my opinion, in this specific case, it would be neither sensible, justifiable, nor appropriate, from the perspective of emergency planning or of public confidence in its own safety, for the REPPIR off-site emergency planning area and prior information area to continue to bisect the village of Tregele.

Noting ‘Conclusion 4’ above (to the effect that REPPIR off-site emergency planning area should include Tregele and at least part of Cemaes), in my opinion the provision of emergency planning and of prior public information should also extend to encompass the population of Cemaes. This would act in the best interests of securing confidence in public safety and require the local authority to consider all reasonably practicable planning measures to restrict exposure in the event of such a reasonably foreseeable radiation emergency from Wylfa.

It is also considered that the avoidance of bisection of Tregele and Cemaes would limit confusion as regards to the action to be taken in the event of a reasonably foreseeable radiation emergency.

In addition, the associated dis-benefits of including the entirety of these communities would not be grossly disproportionate to the benefits in this particular case.

Considering all of these arguments, all of the villages of Tregele and Cemaes should be included within the revised REPPIR off-site emergency planning area.

**Conclusion 5:** It would be appropriate and reasonably practicable to include the villages of Tregele and Cemaes within the determination of a revised REPPIR off-site emergency planning area for Wylfa.

### 6.4 Inclusion of Immediately Adjacent Vulnerable Groups

ONR TAG (reference 5) states that:

“ONR recognises that groups of vulnerable people (e.g. care homes, schools, camping and caravan sites, itinerant populations, etc) located close to the REPPIR off-site emergency planning area (formerly DEPZ) should be provided for in the same manner as those located within the zone.” (The definition of ‘vulnerable’ groups must be the definition adopted by the relevant local authority.)

To support determination of the required emergency planning area, additional information on vulnerable groups was provided by IACC (reference 3). There had been discussion with the local authority over what constitutes a vulnerable group. When considering this factor, ONRs intent is to be consistent with other aspects of council arrangements for vulnerable groups, therefore, as a default, it will use the relevant local authorities’ definition of what constitutes a vulnerable group when considering the extent of the planning area. It should be noted that there is Cabinet Office guidance on this subject with a general definition of “vulnerability” to mean; “those that are less able to help themselves in the circumstances of the emergency” and include people with mobility difficulties, mental health issues, children/elderly, hearing and visual impaired.

For consistency with other determinations I have also considered the inclusion of groups who would be at risk of greater exposure (so in a sense could be considered as “vulnerable”) to the effects of any radiation emergency – examples include pleasure craft on the water, residents of tents, caravans and beach huts, or sites where members of the public may have restricted access to information, shelter or egress.

Information provided by IACC (reference 3, 20) relating to vulnerable communities in the area 1 km outside the Wylfa site 5 mSv contour has been considered (Appendix C). This information identifies a school and an associated childcare as a vulnerable population. There is also a campsite located between Cemaes and Tregele.

---

Noting ‘Conclusion 5’ (that the entirety of Cemaes should be included within the re-defined REPPIR off-site emergency planning area), there are no additional vulnerable groups within a 100 m wide zone of the area determined by this report in Section 6.1, and only 3 such properties of any description within this distance.

**Conclusion 6:** I conclude that the adoption of a REPPIR off-site emergency planning area that includes the whole of the villages of Tregele and Cemaes would not need further modification to incorporate adjacent vulnerable groups.

## 6.5 International Good Practice

ONR TAG (reference 5) states that:

> “ONR is of the view that its decisions should be informed by accepted international good practice.”

Relevant international good practice relating to nuclear emergency planning, is contained in International Atomic Energy Agency (IAEA) publications GSR Part 7 and GS-G-2.1 (references 10 & 11). The guidance document (GS-G-2.1) is non-binding, and provides one of many potential benchmarks for comparison.

In these documents, the IAEA identifies categories of reactor power output and potential ‘threat’, and advocates the adoption of two types of emergency planning zones: a Precautionary Action Zone (PAZ) and an Urgent Protective Action Planning Zone (UPZ). However, due to differences in the UK legal framework, and the assessment of reasonably foreseeable radiation emergencies on a case-by-case basis, neither of these zones are directly comparable with ONR’s determination of a REPPIR off-site emergency planning area.

In the UK, the legal framework for local off-site emergency planning is set out in REPPIR and, although ONR’s principles broadly align with (and meet the spirit of IAEA guidance), the IAEA guidance specifically allows for an approach based on case-by-case assessment (as happens in the UK). In addition, there are a number of similarities, but also important differences, between the UK legislative and IAEA regimes, which are summarised as follows:

a) IAEA guidance document (GS-G-2.1) provides generic indicative radial distances around different categories of nuclear installations, but also states that ‘a different distance should be used when this is substantiated by a detailed safety analysis’. UK legislation, REPPIR, requires the off-site emergency planning area to be based on a robust site specific technical identification and evaluation of the hazards and risks presented by each individual site and, as such, these indicative generic distances are not applied in the UK (although they do provide a comparator, albeit of limited value).

b) IAEA guidance is based on consideration of extreme accidents, whereas the UK legal framework, as set out in REPPIR, requires detailed planning areas to be based on reasonably foreseeable events (more frequent but less severe events).

c) IAEA guidance is based on restricting severe deterministic doses (i.e. relatively high doses accrued over a shorter period), whereas REPPIR is based on restricting doses, so far as is reasonably practicable, to everyone who may be affected by a radiation emergency, where a radiation emergency is defined in the UK as an emergency with the potential for an accrued dose of 5 mSv or more in the year following the emergency (or other relatively low dose criteria). This is a far lower dose threshold in the range of stochastic (random or chance) effects only.

d) The ‘5 mSv in the year following the emergency’ criteria, relating to the definition of a ‘…reasonably foreseeable radiation emergency’ in UK legislation (REPPIR), is based on European EURATOM Basic Safety Standards (reference 8) and is broadly supported (of the same order of magnitude) by Public Health England (PHE) (reference 21), which recommends that significant countermeasures ‘…should be offset by a correspondingly significant level of anticipated dose averted (i.e. at least 10 mSv in the first year). Less disruptive or resource intensive measures could be considered for averting lower levels of dose.’

e) Both the IAEA guidance and ONR’s revised Principles for Determination of the REPPIR off-site emergency planning area (and related guidance) (references 10 & 5)
indicate that areas should take account of a range of factors (e.g. geographical factors and electoral boundaries etc.) This aspect of international guidance is reflected in ONR's principles for the determination of REPPIR off-site emergency planning areas.

f) UK radiological emergency planning arrangements are complemented by arrangements available under the Civil Contingencies Act (2004) (CCA) (reference 22), and the developing concept of extendibility (i.e. the concept of planning for emergencies beyond those that are reasonably foreseeable, with the possibility of outline planning to implement dose reduction measures beyond the REPPIR off-site emergency planning area in the highly improbable event of a more severe emergency). UK regulatory guidance states that off-site plans prepared under REPPIR should include a framework for such scalability.

Section 9 of the existing IACC Off-site Emergency Plan (reference 3) contains voluntary arrangements that are supplementary to the REPPIR off-site emergency planning areas, and which reflect a tiered approach to off-site emergency planning that has analogies with the IAEA concepts and principle of extendibility as described above. ONR is not the enforcing authority for CCA.

In summary, whilst UK legislation (in the form of REPPIR) does not seek to adopt the prescriptive aspects of GS-G-2.1, and noting its limited relevance given the legislative approach taken in the UK, it is of interest that the areas determined within this report falls within the international good practice ranges.

6.6 Consideration of Benefits and Dis-benefits of Dose Reduction Measures (including Countermeasures)

ONR TAG (reference 5) states that:

“Countermeasures can, in some circumstances, convey risks as well as benefits to the individuals to whom they may be applied. ONR considers that the REPPIR off-site emergency planning area (formerly DEPZ) should consider an appropriate balance between the benefits of dose averse and the potential dis-benefits associated with implementing immediate countermeasures in a radiation emergency across too wide an area.”

ONR acknowledges that there are benefits and dis-benefits associated with an increase or decrease in the size of the REPPIR off-site emergency planning area. These were identified and considered as follows.

Noting that REPPIR requires that the off-site emergency planning area must, as a minimum, include all of the area around the sites within which a person (including members of the public) could receive an effective dose in excess of 5 mSv in the year following a reasonably foreseeable radiation emergency (or other dose criteria defined in REPPIR Schedule 1):

- an area of the minimum size might be beneficial as emergency responders would be able to focus their efforts on delivering dose reduction measures (including urgent countermeasures) in a concentrated manner across a smaller population and geographical area;
- a larger area (e.g. that, for instance, extended to avoid bisection of local communities or to include a vulnerable group) might be perceived as providing safety benefits to a larger population;
- however, a larger area would be judged to have the potential to compromise the effectiveness and timeliness of some of the emergency arrangements; and
- a larger area might be perceived as requiring the application of protection measures (e.g. sheltering, evacuation) across more people than may be necessary (with any risks that could be presented by such measures). This notwithstanding, REPPIR provides the local authority with the flexibility to determine (in consultation with others) exactly what protection measures and dose restriction measures should be planned for in a proportionate and targeted manner. REPPIR does not require that identical measures be applied to everyone within the REPPIR off-site emergency planning area, and allows the targeting of specific dose reduction measures to specific sub-populations within the area.
As described in paragraph 6.3 and Conclusion 5, the inclusion of the villages of Tregele and Cemaes is considered to be appropriately conservative in the interests of public safety (and in restricting exposures so far as is reasonably practicable). Their inclusion would require the establishment of sufficient capability for the plan to be credible (i.e. to provide sufficient flexibility to take all reasonably practicable measures to restrict exposure, and in the highly unlikely event that the effects of reasonably foreseeable radiation emergencies had been underestimated, or that any assumptions and judgements in the licensee submissions were challenged in practice).

Whilst some may argue that an extension to the REPPIR off-site emergency planning area might have unwarranted cost implications, REPPIR provides sufficient flexibility such that a targeted and proportionate plan can be produced. Whilst ONR notes the potential for cost implications, this is not a material factor in determining off-site planning areas.

As a consequence, it is my judgement that the determination of a larger area neither necessarily implies any detrimental dilution of the arrangements that IACC may put in place as regards the REPPIR off-site emergency planning area, nor the need to apply unnecessary (dis-beneficial) countermeasures.

Taking these considerations into account, and on balance, the safety benefits associated with increasing the REPPIR off-site emergency planning area (for reasonably foreseeable radiation emergencies) to include Cemaes and Tregele, outweighs the benefits of excluding or bisecting these villages.

**Conclusion 7:** Taking into account the benefits and dis-benefits of the application of emergency dose reduction measures (and noting the flexibility offered by REPPIR to the local authority to target such measures to specific sub-populations or areas), it is judged on balance that the benefits of including Cemaes and Tregele outweigh the benefits of exclusion.

### 6.7 Other site specific factors of which ONR is aware

ONR TAG (reference 5) states that:

> “ONR will also consider, in determining REPPIR off-site emergency planning areas (formerly DEPZs), any additional site-specific factors that it considers relevant on a case-by-case basis.”

REPPIR requires operators to review their HIRE before the commencement of operation of any new work or relevant material change to existing work with ionising radiation. A material change could include, for example:

a) use of different radioactive substances;
b) use of different quantities of the same radioactive substances;
c) changes in the physical form of the radioactive substances in use;
d) use of new or different technologies;
e) modifications to existing technologies; or
f) changes in safety management or safety-critical administrative procedures.

Further to this, REPPIR places a legal duty on the operator to submit a RoA to ONR at least 12 months before the commencement of any such material changes to operations that could affect the validity of the off-site planning area, or new work with ionising radiation.

The radiological hazards and risks associated with any new work, or relevant material change to existing work, at the Magnox Ltd. site would need to be considered by ONR, and emergency planning arrangements put in place by IACC to ensure adequate protection of the workforce and public as intended by REPPIR.

A site specific factor that may be considered relevant to the extent of the REPPIR off-site emergency planning areas for Wylfa relates to the potential for the construction of one or more new nuclear power stations at Wylfa. This might affect the extent of the Wylfa REPPIR off-site emergency planning area, however, in the absence of a RoA for such a development, ONR is unable to take account of any proposed development of additional reactors at this location.
REPPIR neither requires that a RoA exist for a potential new reactor at this stage, nor allows for it to be taken into account in a speculative manner,

However, REPPIR does require that a review (and re-determination if appropriate) of the REPPIR off-site emergency planning area be undertaken before the commencement of operation of any such new reactor(s). Further, REPPIR places a legal obligation on the operator to submit a RoA to ONR at least 12 months before the commencement of work with ionising radiation.

ONR notes that, in addition to the radiological considerations relating to any proposed new reactor development, that emergency planning arrangements put in place by IACC would need to consider (at an appropriate time) the ability of the plan to protect the potentially large construction workforce which would be working, and possibly living, in the vicinity of the existing site.

These issues have been identified to IACC, which is the duty holder for the off-site emergency plan (and is also involved in planning processes relating to some aspects of construction and related developments).

**Conclusion 8:** Whilst REPPIR would require a review and re-determination (if appropriate) of the REPPIR off-site emergency planning area prior to operation of any new nuclear reactors at Wylfa, it does not permit this to be taken into account at the time of this determination (i.e. speculatively).

7 CONCLUSIONS

This report sets out the main considerations that ONR has given to determining a revised REPPIR off-site emergency planning and prior information area for the Wylfa nuclear licensed site. It takes due account of the findings of Magnox Ltd.’s RoA, ONR’s detailed technical assessment of it, ONR’s determination principles and guidance, international best practice and local geographic and population information.

The process of determination of a REPPIR off-site emergency planning area requires regulatory judgement to balance a broad range of technical, practical, and strategic factors (which may, of themselves, require that judgements, estimations, and assumptions be made).

In summary, the conclusions of this report are that:

**Conclusion 1:** ONR is satisfied that the technical submissions made by Magnox Ltd. demonstrate that members of the public would not be likely (the legal test provided by REPPIR) to be exposed to effective doses in excess of 5 mSv (or other dose criteria defined in REPPIR Schedule 1), in the year following a reasonably foreseeable radiation emergency, beyond a radial distance of 900 m from the centre of the reactor building on the Wylfa site.

**Conclusion 2:** To assist IACC in the preparation and implementation of the off-site emergency plan, the REPPIR off-site emergency planning area boundary should be defined, so far as is sensible, using physical features such as roads, rivers, footpaths or other established boundaries.

**Conclusion 3:** The extent of the marine area should be defined as a rectangle that commences at the points where the land area meets the coastline, extending out to sea to the British National Grid Northing 395000 (approximately 1 km) and between the Eastings 233560 and 237063.

**Conclusion 4:** To provide for a maximum credible and effective plan to secure the protection of the public and restriction of exposures so far as is reasonably practicable, the REPPIR off-site emergency planning area should extend to include the village of Tregele and at least part of the village of Cemaes.

**Conclusion 5:** It would be appropriate and reasonably practicable to include the villages of Tregele and Cemaes within the determination of a revised REPPIR off-site emergency planning area for Wylfa.
Conclusion 6: I conclude that the adoption of a REPPIR off-site emergency planning area that includes the whole of the villages of Tregele and Cemaes would not need further modification to incorporate adjacent vulnerable groups.

Conclusion 7: Taking into account the benefits and dis-benefits of the application of emergency dose reduction measures (and noting the flexibility offered by REPPIR to the local authority to target such measures to specific sub-populations or areas), it is judged on balance that the benefits of including Cemaes and Tregele outweigh the benefits of exclusion.

Conclusion 8: Whilst REPPIR would require a review and re-determination (if appropriate) of the REPPIR off-site emergency planning area prior to operation of any new nuclear reactors at Wylfa, it does not permit this to be taken into account at the time of this determination (i.e. speculatively).

Consequently, for emergency planning purposes and in order to ensure appropriate conservatism as regards the protection of the public in the unlikely event of a reasonably foreseeable radiation emergency, the REPPIR off-site emergency planning area (and the area within which prior information must be distributed in accordance with REPPIR regulation 16(1)) is defined as the area around the nuclear licensed site bounded by the green line on Appendix D, Map 3: ONR determination of the REPPIR off-site emergency planning area and the REPPIR prior information area around the Magnox Ltd. nuclear licensed site of .

The area defined may generally be described as:

A land area which is defined by geographical features located within a circular radius of approximately 1 - 2.5 km from the centre of the Wylfa nuclear licensed site including the villages of Tregele and Cemaes, and an approximately rectangular seaward area that commences at the points where the land area reaches the coast, and extends north for approximately 1 km out to sea.

This re-determination has been undertaken in response to REPPIR submissions to ONR by Magnox Ltd. In these submissions, Magnox Ltd. estimates the maximum radiological hazard in the event of a reasonably foreseeable radiation emergency to be smaller than the 1.6 km planning area which was a bounding area defined prior to the introduction of REPPIR. ONR has considered these submissions, applied its principles for the determination of such areas, which recognise the learning that has emerged from global events such as occurred at Fukushima and the resultant need to review the scope of off-site emergency planning and defined the area shown in Map 3.

This is consistent with ONR's insistence that high standards of nuclear safety at nuclear installations are maintained at all times, and reflects our commitment to implementing improvements where appropriate and proportionate to do so.

8 RECOMMENDATIONS

As a result of the conclusions of this report, the recommendations are that ONR write to:

1. IACC and Magnox Ltd. to advise that the REPPIR off-site emergency planning areas have been determined as the area within the green line on Map 3 within Appendix D.
2. IACC confirming the need to update, as required, its detailed emergency plan to adequately cover the area defined in the first recommendation.
3. Magnox Ltd. confirming the requirement to ensure the appropriate provision of prior information to the public within the area referred to in the first recommendation. This information should also be copied to IACC.
4. Nuclear Decommissioning Authority (NDA), Natural Resources Wales (NRW), Environment Agency (EA), Food Standards Agency (FSA) and Maritime and Coastguard Agency (MCA) to advise it of the revised REPPIR off-site emergency planning and information areas.
9 REFERENCES


15 Nuclear Emergency Arrangement Forum (NEAF)1989 Paper 1 Rev. 2 (November 2005), Preferred Assessment Methodology for Deriving the Radiological Consequences of Accidents for Emergency Planning Purposes


19 Data derived from the HSE National Population Database. Crown Copyright and Database Rights 2015.

20 Email from North Wales Councils to ONR re: Comments on the Wylfa determination PAR. 11 May 2016.


22 Civil Contingencies Act 2004.
10 APPENDICES

APPENDIX A

Map 1: Map of Wylfa 2002-2016 REPPIR off-site emergency planning area
Map 2: Map of populations adjacent to Wylfa
APPENDIX B

Significant Infrastructure

The basic definition of national infrastructure means “those facilities, systems, sites and networks necessary for the functioning of the country and the delivery of the essential services upon which daily life in the UK depends”.

In terms of critical national infrastructure this definition is developed (or restricted) to those “critical” elements of infrastructure, the loss or compromise of which would have a major detrimental impact on the availability or integrity of essential services, leading to severe economic or social consequences or to loss of life.

IACC have advised ONR that there are no critical or national infrastructure assets within 0-10 km of the Wylfa. (It should be noted that information relating to critical national infrastructure is marked restricted).

However, there are a number of local infrastructure assets e.g. relating to the provision of utilities within the 0-10 km zone for each site. These include reservoirs’, pumping stations and water treatment works and a few of private water supplies. There are electricity substations throughout the 0-10 km zones.

Transport issues

- Access to Wylfa is via the A5025 from the east or west. There are a number of minor roads around the site but no other A or B roads.
- The closest railway station to the site is Valley which is 12 miles away. The closest main railway station is Holyhead at approximately 16 miles.
- A number of footpaths and other rights of ways exist within the immediate area of the site including the Isle of Anglesey Coastal Path as well as National Cycle Route 566.

Hospitals

Ysbyty Gwynedd, Bangor and the Royal Liverpool Hospital are designed receiving hospitals in the event of an off-site nuclear emergency.

The Medical Physics Unit is located at Glan Clwyd, Bodelwydden.

Rest Centre

There is a rest centre located at Amlwch Leisure Centre, Amlwch.

Strategic Control Centres

The Strategic Control Centre located at North Wales Police HQ, Colwyn Bay. The media briefing centre is also located there.
APPENDIX C
Vulnerable groups

In relation to “vulnerable groups” it should be noted that there is Cabinet Office guidance on this subject with a general definition of “vulnerability” to mean; “those that are less able to help themselves in the circumstances of the emergency” and include people with mobility difficulties, mental health issues, children/elderly, hearing and visual impaired. (https://www.gov.uk/government/publications/emergency-preparedness chapter 5 & 7)

ONR’s principles for determinations (reference 5) require consideration of vulnerable groups, identifiable premises providing facilities for vulnerable people e.g. schools, sheltered accommodation etc.

The vulnerable groups include a primary school Ysgol Cemaes, Cemaes Bay LL 67 0LB and a child care Cylch Meithrin Cemaes with the same address.

There is also a Campsite Dolydd, Ffordd-Y-Felin, Cemaes Bay, Isle of Anglesey, LL67 0DS which can accommodate up to 5 caravans or motorhomes and up to 10 trailer tents or tents.
APPENDIX D

Map 3: ONR determination of the REPPIR off-site emergency planning area and the REPPIR prior information area around the Magnox Ltd. nuclear licensed site of Wylfa

The area defined by this map may be generally described as:

A land area which is defined by geographical features located within a circular radius of approximately 1-2.5 km from the centre of the Wylfa nuclear licensed site including the villages of Tregele and Cemaes, and an approximately rectangular seaward area that commences at the points where the land area reaches the coast, and extends north for approximately 1 km out to sea.