



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

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EXECUTIVE SUMMARY

Determination of the Requirement for Off-site Emergency Planning and Prior Information Areas for the Winfrith 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 area¹ (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 area² 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 determination, in accordance with REPPIR, of the requirement for an off-site emergency planning area and the area within which prior information is to be distributed to persons around Magnox Ltd. nuclear licensed site at Winfrith.

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 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.

This determination has been undertaken in response to the latest REPPIR submission to ONR by Magnox Ltd. The submission is a formal declaration that since the last HIRE report was submitted for the Winfrith site there has been no detrimental material change in the work with ionising radiations and the conclusion of the 2012 RoA is still valid, i.e.

'...there are no reasonably foreseeable radiation accidents on the Winfrith site that would result in a radiation emergency.'

ONR has made an assessment of the Magnox Ltd.'s technical submissions in accordance with its regulatory processes, guidance associated with REPPIR itself, and the relevant ONR technical assessment guide. ONR's assessment agrees with the Magnox Ltd. conclusion that a radiation emergency at the Winfrith nuclear licensed is not reasonably foreseeable.

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' under regulation 9 rather than to 'detailed emergency planning zone' or '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'

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, do not apply.

The recommendation of this report is that ONR write to:

- Magnox Ltd. and Dorset County Council to notify them that, as a result of ONR's recent assessment, there is no requirement for a REPPiR off-site emergency planning area or a prior information area for the Winfrith nuclear licensed site.

LIST OF ABBREVIATIONS

DEPZ	Detailed Emergency Planning Zone (Ref: REPPIR regulation 9(1))
EURATOM	European Atomic Energy Community
FEPA	Food and Environment Protection Act 1985
FSA	Food Standards Agency
GB	Great Britain
HIRE	Hazard Identification and Risk Evaluation
IAEA	The International Atomic Energy Agency
NDA	Nuclear Decommissioning Authority
ONR	Office for Nuclear Regulation
PIZ	Public Information Zone
REPPIR	Radiation (Emergency Preparedness and Public Information) Regulations 2001
RoA	Report of Assessment
RSRL	Research Sites Restoration Limited
SAP	Safety Assessment Principle(s)
SGHWR	Steam Generating Heavy Water Reactor
TAG	Technical Assessment Guide (ONR)
UKAEA	United Kingdom Atomic Energy Authority

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1 REGULATORY CONTEXT

The 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 (Great Britain) nuclear sites, including:

- 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 appropriate arrangements are 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 (REPPPIR) (reference 2)), 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 emergency³. 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 public⁴. A radiation emergency is defined in REPPPIR as an event where a person off-site is likely to receive a radiation dose in excess of the thresholds in REPPPIR (typically an effective dose in excess of 5 milliSieverts) in the 12 months following the event. 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 requirement for off-site emergency planning and prior information areas for the Magnox Ltd. nuclear licensed site at Winfrith, in accordance with the requirements of REPPPIR regulations 9(1) and 16(1) respectively (reference 2).

ONR is of the opinion that the extent of the 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 the determination of these areas are the same. As a consequence, and for simplicity, where the term 'REPPPIR off-site emergency planning area' is used in this report, it refers 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 licence 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 risks are reduced so far as is reasonably practicable.

³ ONR has historically used the term detailed emergency planning zone (DEPZ) to refer to the area it defined under REPPPIR 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 REPPPIR itself (although referred to in the related guidance), to ensure legal clarity and avoid misunderstanding amongst stakeholders, this report refers to the 'REPPPIR off-site emergency planning area' under regulation 9 rather than to 'detailed emergency planning zone' or 'DEPZ'

⁴ 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 'REPPPIR prior information area'.

Magnox Ltd. is currently the company responsible for operations at the Winfrith site on behalf of the Nuclear Decommissioning Agency (NDA), a non-departmental public body in the UK which is responsible for managing the effective and efficient clean-up of the UK's nuclear legacy.

The Winfrith nuclear licensed site is located on Winfrith Heath in south Dorset. Construction of the site began in 1957 to provide additional capacity for the UK's rapidly expanding civil nuclear research programme under the management of the United Kingdom Atomic Energy Authority (UKAEA). The site operated nine reactors between the 1960's and 1990's, ranging from zero energy reactors to the Steam Generating Heavy Water Reactor (SGHWR) which supplied electricity to the national grid. In 2005 the site began operating as a contractor to the newly created Nuclear Decommissioning Authority (NDA). In 2009 Research Sites Restoration Limited (RSRL), a subsidiary of the UKAEA was founded and became the site licence company responsible for the closure programme at Winfrith under contract to the NDA. In 2015 the site was re-licensed to the current licence holder Magnox Ltd.

In relation to emergency planning, REPPiR requires the operator, in this case Magnox Limited, to undertake a Hazard Identification and Risk Evaluation (HIRE) of all 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 ONR prior to the commencement of the work with ionising radiation, following any relevant material change in the work, or within three years of the last assessment, whichever is 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.

This report sets out the main considerations that ONR has given to reviewing the requirement for REPPiR off-site emergency planning areas for the Winfrith site. It takes due account of the findings of the RoA, HIRE and 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 determination of the requirement for REPPiR off-site emergency planning areas relating to the Winfrith site. It has been undertaken in accordance with the guidance on REPPiR (reference 3) and the supporting relevant ONR Technical Assessment Guide (TAG) (reference 4) 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 and 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 RoA 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 4). 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.

4.2 BASIS OF ASSESSMENT

The REPPiR 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, REPPiR 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 Winfrith RoA (reference 5) provides details of the radioactive inventories on the site which exceed the levels specified in schedules 2 and 3 of REPIR. The majority of the radioactivity present on the site is in the form of solid waste. The most significant inventories are summarised below:

- Tritium in the form of tritium gas in high integrity containments (e.g. gas cylinders), tritium gas in glass ampules, tritiated solids, metal hydrides (tritides), tritiated water, tritiated heavy water or tritiated organic liquids (including oil and solvents).
- Natural and depleted uranium stock.
- Thorium stock.
- Immobilised intermediate level solid waste.
- Residual radioactivity in shut-down, de-fuelled reactors, Dragon and SGHWR.
- Gamma calibration sources.

The provisions of REPIR will continue to apply, until such time as the total inventory of radioactive material held on the Winfrith site falls below the stringent levels specified in schedules 2 and 3 of REPIR.

4.3 STANDARDS AND CRITERIA

4.3.1 ACTS, REGULATIONS AND GUIDANCE

The relevant standards and criteria considered in this assessment are those contained in within REPIR (reference 2) and its associated guidance (reference 3). REPIR are regulations created under the Health and Safety at Work Act etc. 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 6).

4.3.2 SAFETY ASSESSMENT PRINCIPLES AND LICENCE CONDITIONS

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 REPIR submissions, the guidance within SAP: AM.1 - Accident management and emergency preparedness (reference 7) has been taken into account.

4.3.3 TECHNICAL ASSESSMENT GUIDES

The SAP principles are supported by a suite of internal Technical Assessment Guides (TAG), with the following TAG being applied to this assessment:

- The technical assessment of REPIR submissions and the determination of detailed emergency planning zones, ONR-NS-TAST-GD-082 (reference 4). This incorporates ONR's revised principles for the determination of REPIR 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:

- A guide to the Radiation (Emergency Preparedness and Public Information) Regulations 2001 (reference 3).

ONR also notes the relevance of the following international standards and guidance:

- The International Atomic Energy Agency (IAEA) Safety Standard Series-Preparedness and Response for a Nuclear or Radiological Emergency GSR Part 7 (reference 8).
- IAEA Safety Standards-Arrangements for Preparedness for a Nuclear or Radiological Emergency GS-G-2.1 (reference 9).

5 ASSESSMENT OF TECHNICAL SUBMISSIONS

In accordance with REPIIR regulation 5, RSRL undertook a review of the HIRE for the Winfrith site in 2012 which identified and assessed all of the hazards on the site with the potential to cause a radiation accident. It contains information about the Winfrith site, the current and planned operations and their associated radiological hazards. A further review was performed by Magnox Ltd. in 2015 and a declaration made that there had been no changes which affect the conclusion of the 2012 RoA.

ONR has subjected the RoA (reference 5), declaration of no change (reference 10) and supporting documentation to expert and detailed technical assessment. A summary of the submissions and ONR's technical assessment (reference 11, 12) of them are detailed in sections 5.1 and 5.2 respectively.

5.1 MAGNOX LIMITED ROA

During the 1990s the UK Government announced an end to civil nuclear research, the Winfrith reactors were shut-down and decommissioning of the site began. To-date, almost a third of the original site's clean-up programme has been completed and in 2002 ONR approved the de-licensing of part of the site. Of the nine reactors built on the site, only the Dragon and SGHWR remain, both of which have been de-fuelled and placed into care and maintenance. Many of the ancillary buildings have already been demolished under the Nuclear Decommissioning Authority (NDA) decommissioning programme.

To identify candidate radiation accidents which could lead to a radiation emergency as defined by REPIIR, Magnox Ltd. reviewed the hazard assessments from the all of the Winfrith facility safety cases. To determine if it was reasonably foreseeable for a radiation emergency to occur Magnox Ltd. applied screening criteria based upon calculated initiating frequency and accident consequences. The assessment excluded radiation accidents with low initiating event frequencies (10^{-5} y^{-1} for faults in a facility and 10^{-4} y^{-1} for natural hazards); however, a sensitivity analysis was performed to identify the potential for "cliff-edge" effects to determine if faults with lower initiating event frequencies not considered reasonably foreseeable could lead to significant radiological consequences.

High consequence, low frequency external events such as aircraft impact and seismic events are considered but no faults are identified which can give rise to a significant off-site release of radiation. 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 13).

The public consequences used in the RoA were drawn from the dose estimates used in the existing safety cases, which were calculated on a conservative basis using UKAEA methodology. Magnox were aware that these dose estimates did not explicitly comply with the requirements of REPIIR, particularly with respect to the degree of conservatism and assumptions regarding occupancy.

Magnox Ltd. revised the dose assessments to remove unwarranted conservatism however, these still were not dose assessments for a 1 year period following the emergency as required by REPIIR. To compensate Magnox Ltd. applied a surrogate public dose threshold of 0.5 mSv, and provided a demonstration that a predicted safety case dose of 0.5 mSv to a member

of the public could not reasonably result in an equivalent public dose exceeding 5 mSv based on REPPiR criteria. All of the assessed faults resulted dose estimates below 0.5 mSv.

The Magnox Ltd. assessment identifies the worst reasonably foreseeable accident as the collapse of the SGHWR building due to an aircraft impact. Magnox recalculated the safety case derived dose estimates to comply with REPPiR requirements including the dose expected in the year following the event to allow direct comparison to the REPPiR thresholds which define a radiation emergency. This fault is presented as the reference accident for the site and gives rise to a public dose of 1.1 mSv, which is significantly below the REPPiR 5 mSv threshold for a radiation emergency, hence the assessment concludes:

'...there are no reasonably foreseeable radiation accidents on the Winfrith site that would result in a radiation emergency.'

The revised dose estimates assume that the exposed person was initially at the site boundary as close as possible to the accident, that this point is exactly down-wind of the site of the accident, and that they remain there for 24 hours. The person is then assumed to remain resident for the following year close to the site fence.

The exposure pathways considered include:

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

5.2 ONR TECHNICAL ASSESSMENT OF THE MAGNOX LIMITED HIRE/ROA

REPPiR and ONR guidance (reference 3, 4) suggests 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". Unwarranted conservatism can give rise to a disproportionately large off-site emergency planning area. Acknowledging, that it may be appropriate to apply some conservatism, for example to simplify the analysis of off-site dose estimation. Therefore, careful consideration has been given as to whether the analysis undertaken by Magnox is appropriate to support the conclusions of the RoA.

ONR undertook a detailed technical assessment (reference 11, 12) of the Winfrith RoA and declaration of no change during the course of which ONR sought clarification of the information provided. ONR's assessment focussed on the following areas to form a view on the adequacy of the Magnox Ltd. submission:

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

ONR has examined the fault frequency and source term assumptions used by Magnox Ltd in its assessment. ONR accepts that the approach adopted by Magnox Ltd. to identify candidate reasonably foreseeable faults which could lead to a radiation emergency satisfies the expectations of REPPiR guidance.

ONR examined the validity of the public dose assessment methods used by Magnox Ltd. While these lead to doses lower than would be found if explicitly following REPPIR requirements, ONR agrees that the use of 0.5 mSv in lieu of the 5 mSv definition of a radiation emergency adequately addresses the differences.

ONR's technical assessment concludes that Magnox Ltd.'s submission adequately meets the requirements of REPPIR

ONR supports Magnox Ltd.'s conclusion that the fault which could generate the greatest off-site public dose consequence, and should hence be used as the reference accident, is the collapse of the SGHWR building due to an aircraft impact resulting in a radiological release. This would give an estimated effective dose of less than 5 mSv to a member of the public at the site fence.

ONR is therefore satisfied that a radiation emergency as defined in REPPR is not reasonably foreseeable at the Winfrith site.

Consequently, REPPIR regulations 7(1), 9(1) and 16(1) do not apply and there is no legal requirement under REPPIR relating to the Winfrith site for:

- ONR to determine a local authority off-site emergency planning area;
- The local authority to prepare an off-site emergency plan;
- The operator to provide prior information under REPPIR; and
- The operator to prepare a REPPIR operator's emergency plan.

The application of Step B of ONR's determination process (relating to the consideration of other practical and strategic factors to identify an off-site planning area) is therefore not required.

6 CONCLUSIONS

This report describes ONR's assessment of Magnox Ltd.'s RoA and declaration of no change for the Winfrith nuclear licensed site and its determination of the requirement for REPPIR off-site emergency planning and prior information areas.

This report concludes that:

- ONR is satisfied that the technical submission made by Magnox Ltd demonstrates that members of the public are not likely to be exposed to effective doses at or in excess of 5 mSv in the year following a reasonably foreseeable radiation accident (or other relevant dose criteria in Schedule 1 of REPPIR).
- There continues to be no requirement under REPPIR regulations 7(1), 9(1) and 16(1) for an operator's emergency plan, the identification of off-site planning and prior information areas by ONR, the preparation of a local authority off-site emergency plan, or for the provision of prior information by the operator in respect of the Winfrith nuclear licensed site.

7 RECOMMENDATIONS

As a result of the conclusions of this report, it is recommended that ONR write to:

- Recommendation 1 Magnox Ltd. and Dorset County Council to notify them that a REPPIR off-site emergency planning area is not required for the Winfrith nuclear licenced site.

ONR will continue to seek assurance that, the operator continues to make adequate provisions and maintains emergency arrangements for the Winfrith nuclear licenced site. These include the residual emergency and contingency related legal requirements of the Health and Safety at Work Act etc., the Nuclear Installations Act and the Ionising Radiations Regulations 1999.

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