



**Determination of the requirement for Off-site Emergency Planning and
Prior Information Areas for the Harwell 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 Harwell 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 areaⁱ (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 areaⁱⁱ within which prior information is to be distributed to the public. 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 mSv) in the 12 months following the emergency. It therefore constitutes an important component of the UK's overall emergency response framework.

This ONR Project Assessment Report (PAR) describes and explains the basis for its re-determination, 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 Harwell nuclear licensed site.

In relation to this area the responsible local authority is Oxfordshire County Council. Oxfordshire County Council is required to prepare an off-site emergency plan for the defined area with the purpose of minimising, so far as is reasonably practicable, radiation exposures to those likely to be affected by such an emergency. Such a plan reflects 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 that which it specifies, in this case Magnox Ltd., to undertake a Hazard Identification and Risk Evaluation (HIRE) in relation to their work with ionising radiations. The 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 operators to assess their HIRE, and to submit a Report of Assessment (RoA) to ONR, either prior to the start of the work with ionising radiation, following any relevant material change in this work, or review it within three years of the last assessment, whichever is the shorter.

Previous determinations by ONR for the Harwell site have concluded that a radiation emergency is reasonably foreseeable and have therefore specified an off-site local authority emergency planning area and prior information area represented by an area around the site with a radius of 1.2 km. The size of this area was appropriate when the site was fully operational.

This re-determination has been undertaken in response to REPPiR submissions to ONR by Magnox Ltd. (and previously Research Sites Restoration Ltd (RSRL)) which conclude that there is no longer a reasonably foreseeable radiation emergency that could occur at the

ⁱ 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'.

ⁱⁱ 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'

site. This is due to a significant reduction in the radiological hazard at the site following the shutdown of the reactors many years ago, subsequent decommissioning activity and the treatment and/or removal of radioactive waste from the site.

The 2013 RoA/HIRE for Harwell concludes *“that there are no reasonably foreseeable radiation accidents on the Harwell Site that would result in a radiation emergency as defined under REPPIR.”*

This conclusion was reiterated in a letter dated 3rd November 2016 submitted by Magnox Ltd who declared no Change in circumstances as follows:

“This letter is a formal declaration that since the last HIRE report was submitted by RSRL (as was) to ONR, there has been no detrimental material change in the work with ionising radiation to which to which an assessment has previously been made.”

ONR has made an assessment of the operator’s technical submissions in accordance with its regulatory processes, guidance associated with REPPIR itself, and the relevant ONR technical assessment guide. Following clarification and additional evaluation, ONR assessment agrees with Magnox Ltd. that there are no reasonably foreseeable faults that could lead to a radiation emergency at Harwell.

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

The recommendations of this report are that ONR write to:

- Oxfordshire County Council and Magnox Ltd. to notify them that a REPPIR off-site emergency planning area is no longer required for the Harwell licensed site.
- Oxfordshire County Council to notify them that there is no longer a requirement under REPPIR for the local authority to prepare an off-site emergency plan in respect of the Harwell licensed site.
- Magnox Ltd. to notify them that the requirement to ensure the appropriate provision of prior information to the public is no longer required under REPPIR. This should be copied to Oxfordshire County Council.
- Magnox Ltd. to notify them that there is no longer a requirement under REPPIR for an operator’s emergency plan.
- The department for Business, Energy & Industrial Strategy, the Nuclear Decommissioning Authority, the Food Standards Agency, and the Environment Agency to inform them of the removal of the REPPIR off-site planning and prior information areas for the Harwell licensed site.

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

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

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

LIST OF ABBREVIATIONS

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
ILW	Intermediate Level Waste
LC	Licence Condition
NDA	Nuclear Decommissioning Authority
NEAF	Nuclear Emergency Arrangements Forum
ONR	Office for Nuclear Regulation
PAR	Project Assessment Report
PRS	Periodic Review of Safety
REPPIR	Radiation (Emergency Preparedness and Public Information) Regulations 2001
RSRL	Research Sites Restoration Ltd.
RoA	Report of Assessment
SAPs	(ONR) Safety Assessment Principles
TAG	(ONR) Technical Assessment Guide
WEP	Waste Encapsulation Plant

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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 Great Britain (GB) 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 regulation of the nuclear industry, holding it to account on behalf of the public, and, in particular to this report, 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 (REPPiR) (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 emergencyⁱ. 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 publicⁱⁱ. A radiation emergency is defined in REPPiR as any event where a person off the site is likely to receive a radiation dose in excess of the thresholds in REPPiR (typically an effective dose in excess of 5 mSv) in the 12 months following that event. It therefore constitutes an important component of the UK's overall emergency response framework.

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

2 BACKGROUND

The UK nuclear regulatory system requires that every licensee must 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 plants to ensure that the licensees' provisions are robust and that any risks are reduced so far as is reasonably practicable.

Magnox Ltd. is the company responsible for the decommissioning of the Harwell 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. At the time of issue of the 2013 Harwell Site Report of Assessment (reference 3), Research Sites Restoration Ltd (RSRL) was the Licensee for the Harwell site. In March 2015 a site licence was issued to Magnox Ltd, at which time Magnox Ltd. took over responsibility as the Parent Body Organisation from RSRL. In addition to RSRL's 2013 RoA, information sought subsequently from Magnox was considered by ONR in this determination and the underpinning assessment.

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Many of the facilities on the Harwell site have undergone decommissioning and others are currently undergoing decommissioning. The five reactors that were originally the site have either been decommissioned or defueled. The amount of nuclear material on the site has steadily decreased over the past decade although there remains a number of facilities on the site that continue to hold radioactive material that is awaiting retrieval, processing, storage or removal from the site. Overall, the level of radiological hazard and risk presented by the site has substantially diminished in recent years. REPPIR came into force in 2001, and the REPPIR off-site emergency planning area around the Harwell site was determined at the time to be a circle of radius 1.2 km.

In relation to emergency planning, REPPIR requires the operator, in this case Magnox Ltd., to undertake an assessment (Hazard Identification and Risk Evaluation (HIRE) of their work with ionising radiation which is sufficient to demonstrate that all hazards arising from their work with the potential to cause a radiation accident have been identified and the nature and magnitude of the risks to employees and other persons arising from those hazards have been evaluated. Where the assessment shows that a risk exists from an identifiable radiation accident, the operator shall take all reasonably practicable steps to prevent any such accident and limit the consequences of any such accident which does occur. REPPIR regulation 6 requires that operators submit a Report of Assessment (RoA) of their HIRE to ONR and resubmit following any material change, and at least within 3 years of the last assessment, make a further assessment or, if there has been no change of circumstance which would affect the last RoA, sign a declaration to that effect and send it to ONR. REPPIR also makes provision for ONR to request additional information. In practice, it is usual for the HIRE itself to be requested to inform ONR's determination. In this case, one document entitled *the Harwell Site Hazard Identification and Risk Evaluation Report* (reference 3), was provided to ONR which was a report of the HIRE but also fulfilled the requirement for the RoA, and is referred to as the latter throughout this report.

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 which local authorities are required to prepare an adequate off-site emergency plan (regulation 9(1)) and which operators are required to provide specified prior information (regulation 16(1)) to members of the public without them having to request it and make that information publicly available.

The off-site emergency plan, in cases where one is required, should include urgent countermeasures and other protection measures that are relevant, reasonably practicable, and proportionate to the radiological risk in the event of a reasonably foreseeable radiation emergency.

In 2013 RSRL submitted an updated RoA (reference 3) under regulation 6 of REPPIR in line with requirements under regulation 5 for operators to undertake a review at least every 3 years. This updated RoA takes into account the relevant material changes due to decommissioning activities on the site since the 2009 RoA (reference 4) was submitted, notably with a change in the reference accident, and several of the other reasonably foreseeable accidents previously identified.

In this 2013 RoA RSRL Ltd makes the case that there are no reasonably foreseeable fault sequences associated with the facilities or for any future planned work on the Harwell Site for which safety cases have been produced, that could lead to an effective public off-site dose of 5 mSv or greater, with effective dose estimates significantly below the 5mSv threshold.

In addition to the information contained in the RSRL 2013 RoA, ONR sought and assessed further information about the Waste Encapsulation Plant (WEP) which was undergoing inactive commissioning for operation from 2017, about the external hazards considered and about the calculation methodologies and assumptions used in the dose calculations.

Furthermore, in November 2016, Magnox sent ONR a letter of declaration of no change to the 2013 RoA (reference 5).

3 SCOPE

This report sets out the basis for, and conclusions of, the ONR assessment of the REPIR off-site emergency planning and prior information areas relating to the Harwell nuclear licensed site. It has been undertaken in accordance with the guidance on REPIR (reference 6) and the supporting relevant ONR supporting Technical Assessment Guide (TAG) (reference 7) which incorporates ONR's principles for determination of REPIR areas, and related guidance.

ONR's principles recognise the learning that has emerged from global events such as occurred at Fukushima Japan in 2011 and the subsequent need to review the scope of off-site emergency planning. They also reflect ONR's commitment to seek 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 separate to the process of determining the REPIR 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 REPIR, 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 REPIR OFF-SITE EMERGENCY PLANNING AREA

This process requires that ONR:

- A. Conduct an initial independent technical assessment of the information provided by the operator in their HIRE and RoA, seeking and using additional information as appropriate; and
- B. Where the potential for a REPIR defined reasonably foreseeable radiation emergency exists, establish and consider any other relevant practical and strategic factors relating to the planning and practical implementation of protection 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 consider 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 REPIR 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 7). Whilst the determined REPIR 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 7) emphasise that, in the undertaking of the determination, it is important to ensure that a sensible balance is achieved between the assessment of the technical report provided by the operator and such additional practical and strategic considerations that, in ONR's opinion, are judged necessary in the interests of providing confidence in public safety. As a consequence, the extent of the REPIR 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;
- avoidance of bisection of local communities where sensible to do so;
- inclusion of immediately adjacent groups of vulnerable people;
- the need for the REPIR off-site emergency planning area to provide for an adequate and credible emergency plan, for the purposes of public protection;
- consideration of the implications of the extent of the REPIR 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 emergency planning areas is based on the most significant reasonably foreseeable event. Such an event could be caused by possible plant and equipment failures, breakdown of administrative arrangements, and potential unauthorised behaviour of employees or the public.

For radiation emergencies that are judged not to be reasonably foreseeable (e.g. the likelihood of which is so remote that detailed emergency planning against their consequences is not justified), the guidance associated with REPIR recommends, as good practice, that local authorities should be capable of extending their emergency response beyond the REPIR off-site emergency planning area should it be required.

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 REPIR 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, see the report in the Lancet by Koichi Tanigawa et al. in relation to the urgent countermeasures taken following the Fukushima accident in Japan in March 2011 (reference 8). Within a REPIR 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 are 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 REPIR 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 REPIR Schedule 1). When assessing the extent of exposure, REPIR 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 measures 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 Harwell RoA (reference 3) provides a description of the remaining radioactive substances on the site, (which exceed the levels specified in Schedule 2 of REPIR). These include the following materials:

- A wide range of solid waste held in the solid waste complex
- A wide range of low level radionuclides
- Radioactive effluent waste
- Residual radioactivity in the redundant facilities including shut down research reactors.

RSRL state that all sources of radioactivity are strictly controlled and are either stored on site or prepared for disposal as waste.

As a consequence of the residual inventory, some (although not necessarily all) provisions of REPIR will continue to apply until such a time as the total inventory of radioactive material held on the Harwell site falls below the levels specified in Schedule 2 and 3 of REPIR.

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 REPIR (reference 2) and its associated guidance (reference 6). REPIR is made under the Health and Safety at Work Act 1974 and implements the articles on intervention in cases of radiation emergencies contained in the European Council Directive 96/29/EURATOM - Basic Safety Standards for the Protection of the Health of Workers and Members of the Public against the Dangers from Ionising Radiation (reference 9).

4.3.2 SAFETY ASSESSMENT PRINCIPLES & 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, cognisance has been taken of SAP: AM.1 - Accident management and emergency preparedness (reference 10).

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 relevant to this assessment:

- The technical assessment of REPIR submissions and the determination of detailed emergency planning zones, ONR NS-TAST-GD-082 Revision 2, 2013 (reference 7). This TAG incorporates ONR's revised principles for 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 this assessment:

- A guide to the Radiation (Emergency Preparedness and Public Information) Regulations 2001 (reference 6).

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

- IAEA Safety Standard Series – Preparedness and Response for a Nuclear or Radiological Emergency GS-R-Part 7 (reference 11).
- IAEA Safety Standards – Arrangements for Preparedness for a Nuclear or Radiological Emergency GS-G-2.1 (reference 12).

5 ASSESSMENT OF TECHNICAL SUBMISSIONS

ONR has subjected the RSRL RoA (reference 3) and supporting documentation to expert and detailed technical assessment. A summary of the submissions and ONR's technical assessment of them (reference 13 and 18) are detailed in sections 5.1 and 5.2 respectively.

5.1 RSRL/ MAGNOX LTD. HAZARD IDENTIFICATION & RISK EVALUATION (HIRE) – REPORT OF ASSESSMENT

As Harwell is a decommissioning site, almost all the radioactivity which remains on the site is either radioactive waste arising from operations or is contained in mostly structural material which has or will become radioactive waste as decommissioning of the site progresses.

In accordance with REPPiR regulations 5 and 6, RSRL undertook a review of their HIRE and RoA (reference 3) and identified and assessed all hazards on site with the potential to cause a radiation accident. As part of the HIRE, RSRL reviewed the extant site safety case fault schedules to identify faults which were considered to be reasonably foreseeable, and with a likely public dose consequence of 5 mSv or greater for further assessment.

Two reasonably foreseeable internal fault sequences (faults arising directly from operations on site) were identified in the HIRE with the likelihood of occurrence deemed to be reasonably foreseeable. These were; a) a fire in a cell in the New Vault Store, resulting in the release of radioactivity from stored contaminated items including storage drums, and b) the loss of shielding of a Vertical Loading Flask followed by a fire during transport between buildings. Of the two internal faults identified, dose assessments were carried out, although further information was sought to understand and clarify dose assessment assumptions to ensure that they were aligned with the best estimate requirements of REPPiR (see 5.2). Since the 2013 RoA was sent to ONR, the fault involving the loss of shielding of a Vertical Loading Flask followed by a fire during transport between buildings was declared to be no longer viable as all the moves using this flask were completed and the flask was removed from service (reference 14).

No reasonably foreseeable initiating events from external hazards (faults arising from event not associated with operations on site, such as earthquakes) were identified in the HIRE. Further information was sought to understand how lower frequency, external initiating events would impact, and in particular if these could give rise to cliff edge effects, see section **Error! Reference source not found.**

Since the time of issue of the RSRL RoA, a new Waste Encapsulation Plant has been built and is currently undergoing commissioning. In November 2015, Magnox (having previously obtained the site licensee from RSRL) provided ONR with a review of the hazard that would be associated with the plant once it commenced operations, see 0.

In line with the REPPiR requirement to review the HIRE every three years, in November 2016 Magnox provided ONR with a letter of declaration of no change (reference 5). The declaration stated that the assessment described in RSRL's 2013 RoA was still valid notwithstanding the further information provided to clarify and update the details of the HIRE. This further information encompassed details of the dose assessments, the WEP and the cliff edge effects as described in the sections below.

5.2 DOSE ASSESSMENT

The 2013 RoA referred to dose assessments from plant safety cases that were not immediately comparable with to the doses as defined in Schedule 1 of REPPiR. ONR

requested further details of the assumptions made in the dose calculations and Magnox provided ONR with an Engineering Advice Note (reference 15). This note assessed the differences between the safety cases and REPPiR calculations and recalculated doses to take account of the most exposed person. The most exposed person was assumed to be located at the nearest accessible point and downwind to the scene of the incident and then, to take a subsequent interest and remain at the scene for 24 hours. The most exposed person is then assumed to remain in the general vicinity for the following year. REPPiR effective doses comprise of the sum of exposures from all pathways, both external and internal exposures, including ingestion of food and drink, although Magnox calculated that the doses for the most significant reasonably foreseeable accident were dominated by inhalation pathways. In all cases, taking into consideration the REPPiR dose assumptions, effective doses to the public from the scenarios assessed were demonstrated to be well below the threshold that would trigger an off-site radiation emergency as defined in REPPiR.

5.3 WASTE ENCAPULATION PLANT (WEP)

No hazards associated with the WEP were identified in RSRL's 2013 RoA as the plant had not yet been built and there was still uncertainty at that time about how it would be used. At the time of publication of this report, the WEP is undergoing inactive commissioning and is due to come online during 2017. In advance of commissioning, Magnox carried out a further assessment for this new plant, which is detailed in the Fire and Explosion HAZAN for the WEP Safety Case (reference 16) and aligned it with the best estimate requirements of REPPiR (reference **Error! Bookmark not defined.**). The fault that was identified involves the build-up of hydrogen in the WEP cell during the grout curing process following the failure of the ventilation plant and backup air injectors in that area. A best estimate calculation of effective dose to the public is assessed to be well below the 5mSv threshold.

5.4 EXTERNAL HAZARDS

RSRL's 2013 RoA did not contain a detailed discussion of the off-site consequences associate with external hazards impacting the waste storage and processing activities. ONR had previously reviewed these fault sequences as part of a Periodic Review of Safety (PRS) (reference 17) and these faults were reviewed again as part of the Assessment of the Harwell 2013 REPPiR Submission (reference 13). A seismic event of 1 in 10,000 years was considered to have the most severe consequences for all external natural hazards. The maximum REPPiR effective dose to the public was calculated to be 3.65 mSv which assumes that all the buildings containing radioactive materials undergo seismic collapse so does not take into account the buildings that are seismically qualified.

Magnox produced an engineering advice note (reference 15) to assess effective doses to the public from an aircraft crash and concluded that the estimate effective public dose in line with the requirements for REPPiR will be less than 2.2 mSv.

5.5 CONCLUSIONS OF THE RoA

The 2013 RoA (reference 3) concludes that none of the events described above could lead to a reasonably foreseeable radiation emergency as defined by REPPiR (i.e. all events/faults are deemed both not reasonably foreseeable and have likely effective public doses of less than REPPiR Schedule 1 effective dose thresholds in the following 12 months) and the Declaration of No Change (reference 5) sent from Magnox to ONR in November 2016 reiterates that this conclusion remains valid.

5.6 ONR TECHNICAL ASSESSMENT OF THE RSRL/ MAGNOX LTD. HIRE AND RoA

REPPiR and ONR guidance (references 6 and 7) 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, consideration has been given as to whether analysis undertaken by RSRL and then Magnox Ltd. for the fault scenarios is appropriate to support the conclusions of the RoA/HIRE and that these faults are not likely to lead to a reasonably foreseeable radiation emergency as defined in REPPIR.

The licensee identifies the most significant reasonably foreseeable fault as being associated with a fire in the new vault store, resulting in the release of radioactivity from stored contaminated items, including oil drums. ONR's assessment agrees that this fault sequence will be most significant reasonably foreseeable event when the new vault store comes into use. ONR's assessment believes the Magnox calculations of the dose to be reasonably conservative because the release fraction assumed by RSRL/ Magnox Ltd. takes no credit for the fraction of the release that would be in non-respirable form, nor for the high efficiency stack particulate filters that are assumed to be damaged. ONR also agrees with the licensee's assessment that the release could viably exit the facility at the height of the stack, as the room would be highly likely to maintain its containment for 30 minutes. Noting the importance of dose estimation in this determination, ONR requested further information on the assumptions made to calculate doses to the public to ensure that doses could be compared to the threshold doses in REPPIR Schedule 1. In response, Magnox reassessed the doses based on a one-year exposure period and to include all exposure pathways (reference **Error! Bookmark not defined.**). This assessment showed that public doses remained below REPPIR dose thresholds. ONR agrees with Magnox that the fault sequence involving a fire in the new vault store, the most significant reasonably foreseeable event, would give rise to doses well below the REPPIR Schedule 1 dose thresholds.

ONR's technical assessment (reference 13) of the RoA and subsequent related documentation (references **Error! Bookmark not defined.**, **Error! Bookmark not defined.**, 16, 17 & 18) considers that all the significant faults that could be considered to be 'beyond reasonably foreseeable' have also been assessed appropriately, and in particular to identify any cliff edge effects, i.e. circumstances where a small perturbation in the initial fault condition potentially leads to a very significant change in the fault dose consequences. ONR is satisfied that the licensee's assessment of seismic impact is bounding as no credit is taken for seismic qualification of some of the radioactive material-containing buildings. ONR are satisfied that public doses would be lower than the 5 mSv REPPIR threshold for an event of this type. Similarly, ONR's assessment proposes that the likelihood of an aircraft crash into one of the radioactive material-containing buildings at the Harwell site would be less than 'reasonably foreseeable'. Despite this, ONR are satisfied that calculations of the off-site effective public doses from an aircraft crash would also be below the 5 mSv threshold. ONR's technical assessment also considered terrorist or sabotage events as potential causes of a radiation emergency and concluded that there was no reasonably foreseeable security event that could give rise to an off-site radiological release greater than that identified for a process-based initiating event. The conclusions of these assessments, when compared to assessments prior to 2013, can be explained by the reduction in hazard on the site seen in recent years as radioactive material has been removed or processed.

Conclusion 1: ONR is satisfied that the technical submissions made by RSRL/ Magnox Ltd. demonstrate that members of the public are not likely to be exposed to doses in excess of the values of REPPIR Schedule 1 from a reasonably foreseeable radiation accident occurring at the Harwell site. I.e. A radiation emergency, as defined in REPPIR, is no longer judged to be reasonably foreseeable.

6 OFF-SITE EMERGENCY ARRANGEMENTS

ONR is satisfied that a radiation emergency as defined in REPPIR is no longer reasonably foreseeable at the Harwell site. This is as a result of the doses associated with such

emergencies falling below the threshold for applicability of regulations 7, 9 and 16 of REPPIR (which relate to the requirement for an operator's emergency plan, the determination of an off-site planning area by ONR, the preparation by the local authority of a corresponding off-site emergency plan, and the provision of prior information by the operator).

Consequently, there are no longer legal provisions under REPPIR relating to the Harwell 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
- for the operator to prepare a REPPIR operator's emergency plan.

As the local authority is no longer required to prepare an off-site emergency plan under REPPIR, Step B of ONR's determination process (relating to the application of other practical and strategic factors to a planning area) is not required.

Although a radiation emergency is no longer reasonably foreseeable (and consequently a local authority off-site emergency planning area and a prior information area are no longer required by REPPIR), the radioactive inventory of the Harwell site continues to exceed the specified quantities set out in REPPIR Schedule 2. Consequently, under REPPIR regulations 5(1) and 5(2), the licensee continues to be required to review their HIRE every three years or sooner if a revision and resubmission is required because of a material change in the work with ionising radiation. Whilst not anticipated, should such a re-submission suggest any material increase in the risk profile of the site, ONR will make a further re-determination to consider whether further measures under REPPIR to protect the public in the event of a reasonably foreseeable radiation emergency would be justified.

Although there is no longer a direct requirement under REPPIR for an operator's plan, or for the provision of prior information by the operator in respect of the Magnox Ltd. Harwell site, the operator will continue to have relevant legal duties under other legislation that are not directly affected by this determination.

Similarly, nuclear licensees have general duties to ensure, so far as is reasonably practicable, the safety and welfare of employees and other persons; to make and implement adequate arrangements for dealing with any accident or emergency (under standard licence condition 11 attached to the nuclear site licence); and to prepare contingency plans under the Ionising Radiation Regulations 1999 as appropriate.

ONR, where relevant, will continue to deliver regulatory oversight of the other legal duties as they apply to Magnox Ltd.

Conclusion 2: As a result of ONR's conclusion that a radiation emergency is no longer reasonably foreseeable, there is no longer a 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 by the operator of prior information to the public in respect of the Harwell nuclear licensed site.

7 CONCLUSIONS

This report describes ONR's assessment of the RoA for the Harwell nuclear licensed site and the consequential requirements (or otherwise) for REPPIR off-site emergency planning and prior information areas, which were previously prescribed as an area with a radius of 1.2 km around the Harwell Site.

The conclusions of this report are that:

- ONR is satisfied that the technical submissions made by RSRL/ Magnox Ltd. demonstrate that members of the public are not likely to be exposed to doses in excess of the values of REPPIR Schedule 1 from a reasonably foreseeable radiation accident occurring at the Harwell site. I.e. A radiation emergency, as defined in REPPIR, is no longer judged to be reasonably foreseeable.
- As a result of ONR's conclusion that a radiation emergency is no longer reasonably foreseeable, there is no longer a 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 by the operator of prior information to the public in respect of the Harwell nuclear licensed site.

8 RECOMMENDATIONS

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

- Recommendation 1: Oxfordshire County Council and Magnox Ltd. to notify them that a REPPIR off-site emergency planning area is no longer required for the Harwell licensed site.
- Recommendation 2: Oxfordshire County Council to notify them that there is no longer a requirement under REPPIR for the local authority to prepare an off-site emergency plan in respect of the Harwell licensed site.
- Recommendation 3: Magnox Ltd. to notify them that the requirement to ensure the appropriate provision of prior information to the public is no longer required under REPPIR. This should be copied to Oxfordshire County Council.
- Recommendation 4: Magnox Ltd. to notify them that there is no longer a requirement under REPPIR for an operator's emergency plan.
- Recommendation 5: The department for Business, Energy & Industrial Strategy, the Nuclear Decommissioning Authority, the Food Standards Agency, and the Environment Agency to inform them of the removal of the REPPIR off-site planning and prior information areas for the Harwell licensed site.

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

9 REFERENCES

- 1 The Energy Act 2013, Chapter 32.
Part 3, Chapter 1, 'The ONR purposes', paragraph 68(1).
Part 3, Chapter 4, 'Function of the ONR', paragraph 78, 'Principal function'.
The Stationery Office. December 2013. ISBN 978-0-10-543213-5
- 2 Radiation (Emergency Preparedness and Public Information) Regulations 2001
- 3 Harwell Site Hazard Identification and Risk Evaluation Report, Ref:EDMS347868 Issue 7
November 2013.
- 4 RSRL Harwell REPIR Hazard Identification and Risk Evaluation Report 2009
- 5 Letter from Magnox Ltd. to ONR, 3rd November 2016, Magnox Ref: Har-50043N
- 6 A guide to the Radiation (Emergency Preparedness and Public Information) Regulations
2001. L126. 2002. <http://www.gov.uk/pubns/priced/l126.pdf>
- 7 ONR technical assessment of REPIR submissions and the determination of detailed
emergency planning zones, ONR NS-TAST-GD-082 Revision 2 2013. [www.onr.org.uk/depz-
onr-principles](http://www.onr.org.uk/depz-onr-principles)
- 8 Koichi Tanigawa et al. Loss of life after evacuation: lessons learned from the Fukushima
accident. Lancet: Volume 379 Issue 9819 889-891, 10 March 2012
- 9 Council Directive 96/29 Euratom of 13 May 1996 laying down basic safety standards for the
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- 10 ONR Safety Assessment Principles for Nuclear Facilities, 2014 Edition, Revision 0. AM.1
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- 11 IAEA Safety Standards Series (General Safety Requirements) No GS-R Part 7 dated
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- 12 IAEA Safety Standards – Safety Guide No GS-G-2.1 2007. Arrangements for
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pub.iaea.org/MTCD/Publications/PDF/Pub1265web.pdf](http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1265web.pdf)
- 13 ONR Assessment of Harwell 2013 REPIR Submission, Revision 0, ONR-DFW-AR-15-
023
- 14 Email: VLF withdrawn, June 2016.
- 15 Engineering Advice Note – Supplementary Fault Assessment for the Winfrith and Harwell
HIRE Report of Assessment, Ref: M/EF//GEN/EAN/00100/16 Issue 2 July 2016.
- 16 WEP HAZAN 3: Fire and Explosion Hazards, Ref: 462/SD/493/03, Issue B.
- 17 Periodic Review of Safety (Contact Handled Intermediate Waste): Ref: B462/OSC/PRS/35
Issue 3, 3 March 2015.

18 File note: Assessment of the Harwell Letter of no Change to the November 2013 REPIR Submission, 8 December 2016.