

ATOMIC WEAPONS ESTABLISHMENT

AWE ALDERMASTON

CONSEQUENCES REPORT

© British Crown Owned Copyright 2019/AWE

Published with permission of the Controller of Her Britannic Majesty's Stationery Office.

This document is of United Kingdom origin and contains proprietary information which is the property of the Secretary of State for Defence. It is furnished in confidence and may not be copied, used or disclosed in whole or in part without prior written consent of Defence Intellectual Property Rights DIPR-PL - Ministry of Defence, Abbey Wood, Bristol, BS34 8JH, England.

Introduction

This document is the consequences report for the Aldermaston Site, as required under Regulation 7(1) of The Radiation (Emergency Preparedness and Public Information) Regulations 2019 (REPPPIR 2019).

The following information has been titled to relate specifically to the REPPPIR 2019 Schedule 4 items required to be included within this report.

Part 1 – Factual Information

1. **Regulation 7(3) Schedule 4, paragraph 1(a) - Name and address of the operator:**
AWE plc, Aldermaston, Reading, Berkshire, RG7 4PR.
2. **Regulation 7(3) Schedule 4, paragraph 1(b) - Postal address of the premises where the radioactive substance will be processed, manufactured, used or stored, or where the facilities for processing, manufacture, use of storage exist:**
AWE plc, Aldermaston, Reading, Berkshire, RG7 4PR.
3. **Regulation 7(3) Schedule 4, paragraph 1(c) - The date on which it is anticipated that the work with ionising radiation will commence or, if it has already commenced, a statement to that effect:**

The Aldermaston Site has been occupied in support of the UK nuclear deterrent since 1950 and work with ionising radiation has been conducted on the site since that date.

Part 2 – Recommendations

1. **Regulation 7(3) Schedule 4, paragraph 2(a) - The proposed minimum geographical extent from the premises to be covered by the local authority's off-site emergency plan:**
 - a. The proposed minimum geographical extent to be covered by the Local Authorities Off-Site Emergency Plan is an area extending to a radial distance of 1540m from the Aldermaston Site centre location.
This is illustrated on Map A in Appendix A.
 - b. In addition to the minimum geographical extent recommended above, an Outline Planning Zone, extending to a radial distance of 15km around the Aldermaston Site centre location, has been determined by the Secretary of State for Defence, in accordance with Regulation 9(1)(c).
This is illustrated on Map B in Appendix B.
2. **Regulation 7(3) Schedule 4, paragraph 2(b) – The minimum distances to which urgent protective actions may need to be taken, marking against each distance the timescale for implementation of the relevant action; and Clause 3(a) – The recommended urgent protective actions to be taken within that zone, if any, together with timescales for the implementation of those actions.**
 - a. The following distance is recommended for the urgent protective action of sheltering. This is the largest distance determined by detailed consequence assessment of a range of source terms and include consideration of a range of weather conditions and vulnerable groups within the population.

- b. The minimum distance to which urgent protective actions should be taken corresponds to an area with radial distance of 1540m.
- c. It is recommended that people are instructed, as soon as is practical, to immediately take-cover in a suitable building and to stay inside with the windows and doors all properly shut. This 'sheltering' action may be necessary for a period of up to two days, or at least until the initial contaminated plume has passed and monitoring of the ground contamination has been undertaken to determine the level of groundshine; and subsequent potential for further dose uptake (e.g. from contaminated locally produced foodstuffs).
- d. For exposure to tritiated water vapour, the most vulnerable humans are those dependent on their mothers for sustenance. Immediate protective sheltering action will contribute to dose savings, but further protective action may be required to prevent contamination from the mother delivering a dose to their off-spring over the next month (e.g. use of uncontaminated formula milk). These further protective actions may be required until a time when active monitoring of the environment, particularly the air (inhalation dose) and the ground (re-suspension dose), can be undertaken to declare that there is no further danger.
- e. It is recommended that the declaration of a Radiation Emergency, by the operator, to the Local Authority, is the trigger for implementing the off-site emergency plan and initiating all of the above recommended urgent protective actions.
- f. Category F weather conditions typically has an associated mean wind speed of 2ms^{-1} . From the event site, there will be approximately 800 seconds (approx. 13 minutes) from the initiation of the event until the leading edge of the plume travels to the minimum distance recommended for urgent action. Assuming no early warning of the incident starting, and that the Site Response Group could take up to an estimated 15 minutes to set up and formally notify the Local Authority, there could be no time available to inform the public, and for the public to find suitable shelter to obtain any dose saving.
- g. The benefit from dose saving is likely to be greater if there is any advance warning of an incident.

3. *Regulation 7(3) Schedule 4, paragraph 3(b) – Details of the environmental pathways at risk in order to support the determination of food and water restrictions in the event of a radiation emergency:*

- a. The release of radioactivity from the Aldermaston Site as a result of a fault condition has the potential to result in doses to the public through a range of exposure pathways, including:
 - i. First-pass inhalation of air in the plume of contamination;
 - ii. Short-term external irradiation during passage of the plume – Cloudshine;
 - iii. Long-term inhalation after resuspension, from ground contaminated by the initial plume;

- iv. Long-term external irradiation from ground contamination by the initial plume – Groundshine;
 - v. Ingestion of food crops contaminated by the initial plume;
 - vi. Ingestion of breast milk that has been contaminated by the mother's intake of a particular radioactive material;
 - vii. Irradiation as a result of a criticality.
-
- b. The relative importance of the different exposure pathways is dependent on the type of accident and the potential radioactive isotopes which may be released.
 - c. An emergency that results only in the emanation of radiation from the site without a Schedule 1 release of radioactive material (e.g. an accidental criticality event) does not lead to the need for local food and water restrictions.
 - d. The accidents which have been identified as relevant to emergency planning are those which result in the spread of radioactive material by atmospheric dispersion and these can, in some instances, be driven by fire. These are non-fission incidents, where the dominant material will be plutonium (which is an Alpha emitting actinide) or tritium (a soft Beta emitter).
 - e. For plutonium release emergencies, the consequences arise from fine particulates of plutonium oxide and the predominant exposure pathway to individuals outside the Aldermaston Site during the passage of the contaminated plume, would be by inhalation. As the contaminated plume travels downwind, deposition mechanisms would deplete particles from the plume and leave radioactive material on the ground. Most forms of plutonium are removed from biological pathways by being fixed in the soil and only small amounts are concentrated by biological processes into the food chain, primarily through grazing animals. However, the material can be resuspended by the action of the weather, or by farming practices, or any other disturbance processes, resulting in a potential for longer term inhalation doses. Minor dose contributions to the public, resulting from this type of scenario, may include cloudshine, long-term inhalation following resuspension, and groundshine.
 - f. For tritium release emergencies, the tritium is conservatively assumed to be present as inhalable tritiated water vapour. The predominant exposure pathway to individuals outside the Aldermaston Site during the passage of the contaminated plume would be by inhalation. As the plume travels downwind, deposition mechanisms would deplete the plume and leave radioactive material on the ground. Tritiated water is readily taken-up into biological pathways and may be ingested. In terms of the significance of different food groups, tritium is absorbed more readily by leafy vegetables due to the large surface area of the crop and the already high internal water content. However, ingestion of contamination due to a mother's intake of tritium can be a more significant dose pathway for infants than the direct inhalation dose for those infants. Given the nature of radiation emitted from a tritium release, dose contributions are dominated by first-pass inhalation and ingestion.
 - g. Overall, the primary concern for early response decision-making to radiation emergencies involving possible accidents at the Aldermaston Site only merits

consideration of the first-pass inhalation dose for exposure to actinides and therefore sheltering is the recommended urgent protective action. Given the properties of tritiated water releases, sheltering and finding uncontaminated milk substitutes, for vulnerable infants are recommended as a priority.

Part 3 - Rationale

1. **Regulation 7(3) Schedule 4, paragraph 4 – The rationale supporting each recommendation made:**

- a. The release of radioactive particles small enough to be readily transported in the open atmosphere also makes them respirable. Such particles have the potential to result in radiological doses to the public from a range of exposure routes, most notably:
 - First-pass inhalation of air from the plume of contamination;
 - Long-term inhalation after resuspension of ground contamination by the initial plume;
 - Ingestion of food crops contaminated by the initial plume;
 - Long-term external irradiation from ground contamination by the initial plume;
 - Ingestion of breast milk that has been contaminated by a mother's intake of a particular radioactive material.
- b. It has been assessed for the identified scenarios at the Aldermaston Site that the first-pass inhalation dose is the most significant by far, for initial emergency response purposes. This has resulted in the recommendation to shelter as the most appropriate urgent protective action. In the case of a scenario where tritiated water is released, urgent protective actions should also involve finding uncontaminated milk substitutes for vulnerable infants. This should be coupled with an immediate restriction on the consumption of all locally produced food, until the direction of the plume and the extent of the contamination has been fully investigated, examined and understood. Appropriate local instructions should then be made available to the public based on the prevailing conditions.
- c. The recommendation for the minimum emergency action distance at the Aldermaston Site originates from the Consequence Assessment carried out under REPPiR 2019. The guidance set out in the Approved Code of Practice is to use the largest candidate distances recommended for the urgent protective actions identified against the lower Emergency Reference Level. This 1540m distance about the Aldermaston Site Centre location is selected as the minimum geographical extent for urgent protective actions and is consistent with the established Detailed Emergency Planning Zone (See appendix C for definition).
- d. The REPPiR 2001 determination was based on a 5mSv dose contour using 55% Cat D weather conditions. Under REPPiR 2019, the minimum distance for urgent protective actions is based on a 7.5mSv dose contour. However, in accordance with the new requirements of REPPiR 2019, the 'reasonable foreseeability' argument is no longer allowed, and several different requirements have had to be taken into consideration, these being that the assessment must:

- Consider age, and other characteristics which would render specific members of the public especially vulnerable;
 - Include all relevant pathways;
 - Consider a representative range of source terms;
 - Consider a range of weather conditions to account for consequences that are less likely, but which have greater consequences.
- e. A further consideration is the geographical area around the site and the potentially significant period that these adverse weather conditions could be experienced.
- f. AWE has analysed the dose from a range of weather conditions and has decided to base its proposal on a weather category that is less likely, but which could provide significantly greater doses. Consideration of less likely weather categories, which occur around 12% of the time in the local geographical area provides the 7.5mSv dose contour at 1540m around the site centre location.

2. *Regulation 7(3) Schedule 4, paragraph 5(a) – The rationale for its recommendation on the minimum distances for which urgent protective action may need to be taken:*

- a. The minimum distances recommended are based on a full range of possible consequences from the identified radiation emergencies, evaluated in the Consequence Assessment made in accordance with Regulation 5(1) for the appropriate source terms, and is based on the requirement to identify a distance that has the potential to deliver a dose saving of 3mSv.
- b. The tritium source term released by a fire will release tritium in the form of tritiated water (HTO), which is readily absorbed through the skin by humans. Intakes of airborne HTO are dominated by inhalation with a lesser contribution by direct absorption. The HTO is rapidly distributed throughout the body and typically is excreted with a biological half-life close to 10 days.
- c. Sheltering from a plume of HTO will give some dose saving (40% is recommended by Public Health England (PHE) for emergency planning) to adults. This same ratio for the reduction in HTO intake will give larger dose savings for any humans dependent for sustenance on their mother. Some significant further protective action would be worthwhile in preventing tritium contamination being consumed via their mother (e.g. using uncontaminated formula milk).
- d. For the postulated accident in the main Aldermaston Site tritium facility the 3 mSv dose saving from prompt sheltering for pregnant women and the unborn child are at a distance of 1.35 km. The potential 3 mSv dose saving to a vulnerable infant from an effective ban on contaminated mother's milk would extend to 2.0 km.
- e. Given the relative proportions in the UK population of the two most vulnerable groups of humans (unborn child and vulnerable infant) dependent for sustenance on their mothers, it is considered proportionate to derive recommendations purely for sheltering providing immediate protection. The distance associated with the relevant vulnerable group, including the off-set from the tritium facility to the site

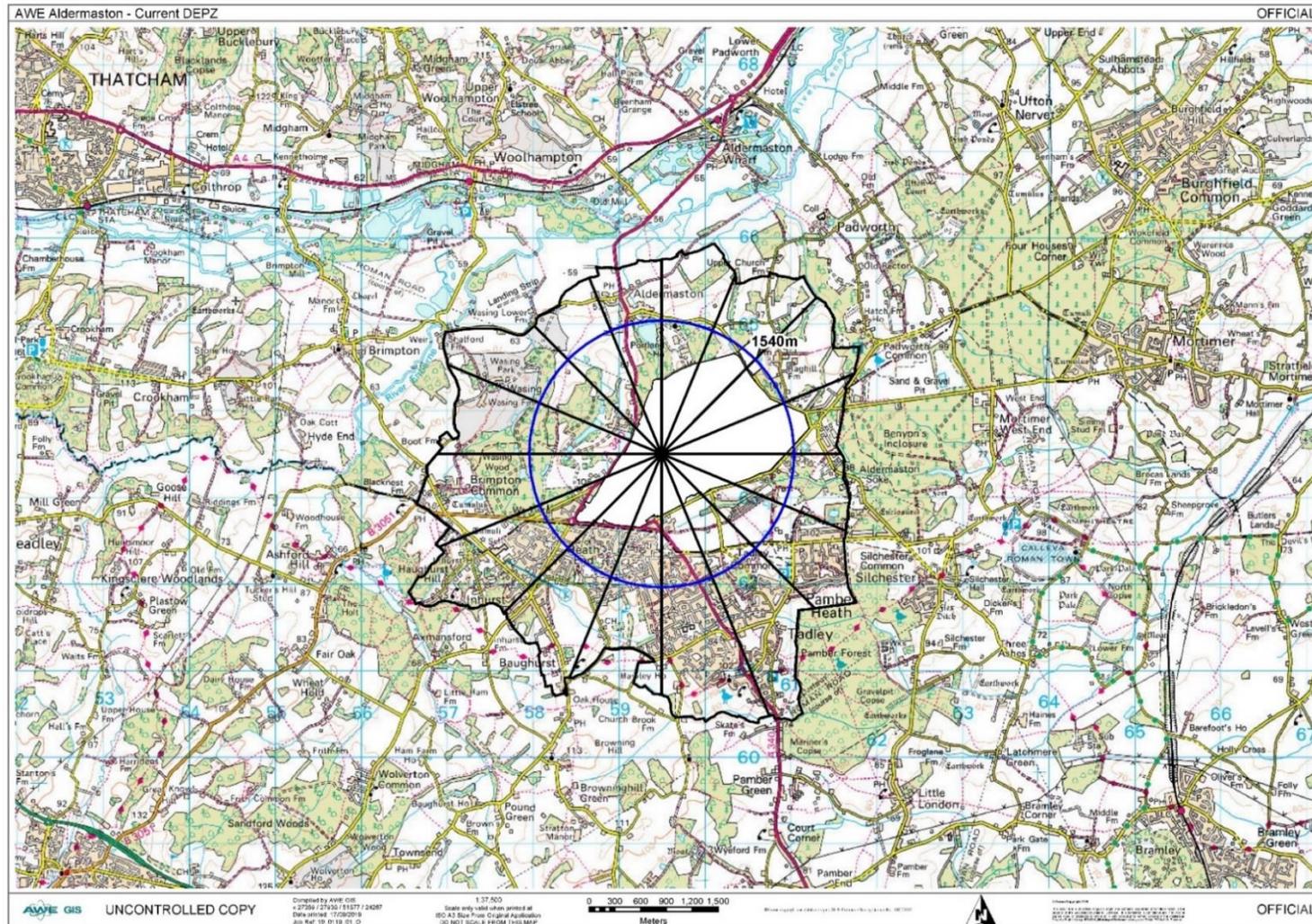
centre location, gives a nominal circle of radius 1.54 km, around the site centre location.

- f. This minimum distance for urgent action at the Aldermaston Site is wholly within the existing DEPZ boundary. Under these circumstances, this submission recommends that the current DEPZ is retained for AWE(A).

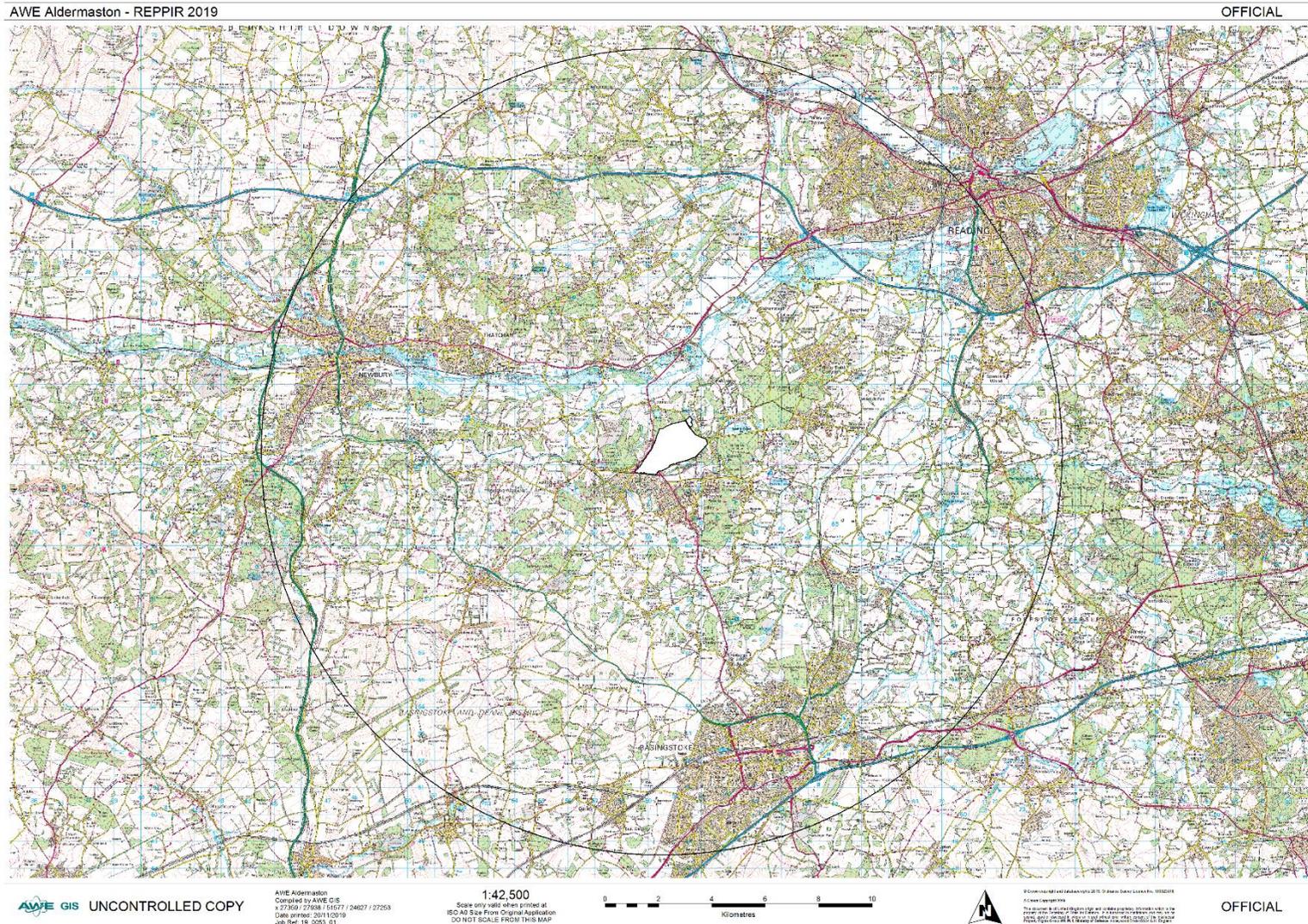
3. *Regulation 7(3) Schedule 4, paragraph 5(b) – The rationale for agreement that no off-site planning is required.*

- a. Given the content of this Consequences Report, this requirement does not apply to the Aldermaston Site.

Appendix A: Map A – The ragged bold black sector is the current boundary of the Detailed Emergency Planning Zone. The Proposed Urgent Protective Distance (blue circle), set at 1540m for the Aldermaston Site.



Appendix B: Map B – The Outline Planning Zone Boundary, set at 15Km for the Aldermaston Site.



Appendix C: Definitions

Detailed Emergency Planning Zone (DEPZ)	A zone determined in accordance with Regulation 8 of the REPPIR 2019 Regulations. This is now covered by the Local Authority's off-site emergency plan
Outline Planning Zone (OPZ)	A zone determined in accordance with Regulation 9 of the REPPIR 2019 Regulations and covered by the Local Authority's off-site emergency plan.