



**SUBMISSION IN SUPPORT OF  
RADIATION (EMERGENCY PREPAREDNESS AND  
PUBLIC INFORMATION) REGULATIONS 2001:**

**SCHEDULE 5 RISK EVALUATION  
FOR THE AWE ALDERMASTON SITE**

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## Preface

The UK nuclear industry has a long history of safe operation. The safety standards used in the design, construction, operation and maintenance of nuclear installations reduce to a very low level the risk of accidents which could have a consequence for the general public. Nonetheless, prudence requires the preparation of plans for dealing with such events. The licence granted under the Nuclear Installations Act 1965, which is used to control the activities on civil nuclear installations in the UK, requires adequate emergency arrangements to be in place.

The principal source of risk to the public from most nuclear accidents will be the release of materials which emit ionising radiations. The risk to health from ionising radiations has been the subject of intensive study and research for many decades. From the results of this work and observation of the effects on people exposed to such radiation, the International Commission on Radiological Protection [ICRP] has made recommendations on the principles to be adopted for protection against ionising radiations and on a system of dose limitation, both for people exposed to radiation at work and for members of the public in the event of accidents.

Everyone is exposed continuously to natural sources of ionising radiations. Many people receive additional low doses of radiation from artificial sources, such as medical X-rays. The principal harmful effect of small doses of radiation is to increase the possibility of cancer in later years, but very high doses can lead to other serious illnesses in the short term. Although a direct relationship between radiation dose and harmful effects has been observed only in people exposed to high doses of radiation, for the purposes of radiological protection it is assumed that any dose of ionising radiation, however small, carries with it some risk to health. In making its recommendation on annual limits of radiation dose to workers and members of the public the ICRP has used this cautious assumption.

The Health Protection Agency – Radiological Protection Division (HPA(RPD)), an independent statutory body within the UK, has specified Emergency Reference Levels [ERL] using the ICRP recommendations. These are sufficiently high levels of radiation dose to justify introducing a given countermeasure to stop the public receiving such a radiation dose. The application of the various countermeasures for AWE sites – evacuation, sheltering and the control of foodstuffs and water supplies – is based on these ERLs. The HPA(RPD) has balanced the risk from the potential radiation exposures and those which may be associated with the implementation of any of these countermeasures.

Provision is required under current legislation, Radiation (Emergency Preparedness and Public Information) Regulations 2001 (REPPIR), for the following aspects to be included in the response to any radiation emergency:-

- a) The control of the accident at the site.
- b) The assessment of the actual and potential accident consequences and alerting the relevant authorities and the public.
- c) Introduction of countermeasures to mitigate the consequences as regards [i] individuals who could be affected in the short term and [ii] longer term effects such as the contamination of food supplies, land and adjoining waters.
- d) Information to the public affected or likely to be affected by the event [was Public Information for Radiation Emergency Regulations (PIRER) but now in REPPIR].
- e) The return to normal conditions.

The Emergency Plans in place for the AWE sites are currently approved as adequate to deal with the items above. The Emergency Plans are based on Fault Study Analysis and are drawn up against reasonably foreseeable accidents for each site. The first concern is always to avoid any exposure to the public to radiation and therefore to rectify the fault before there is any danger to the public outside the site. Nevertheless, as soon as the fault occurs, the question of emergency action has to be considered and pre-determined actions would commence which might eventually require the notification of off-site agencies and the public. Precautionary emergency actions to protect the public may therefore be initiated in circumstances when the accident has not yet developed to a stage which has significant off site consequences.

Currently the emergency actions are based on (a) Identified Accidents and (b) the principle of extendibility, involving:

- a) A defined zone closely surrounding the installation, the Detailed Emergency Planning Zone [DEPZ] within which arrangements to protect the public by introducing countermeasures are planned in detail.
- b) Emergency Planning that is capable of responding to accidents which, although extremely unlikely, could have consequences beyond the boundaries of the DEPZ. The measures that are required to extend the detailed arrangements cannot be precisely planned because the nature and potential of accidents can vary, for example according to weather conditions, and the exact response would be based on an assessment made at the time. The response may make use of local and national plans prepared to deal with a wide range of emergencies.

In an emergency, those who normally provide services/carry out protective functions for the public will continue to do so, but in a co-ordinated manner which has been carefully planned and rehearsed. A considerable number of different authorities will be engaged, each applying its expertise to the situation as it develops. This off-site emergency response, both locally and nationally, depends on:

- a) Co-ordination between centres which will be dealing with public protection and information and those dealing with the incident on the site, and,
- b) A facility for co-ordinating local and national information and for making public the best available assessments.

The national response for dealing with a nuclear accident follows the key principles applied by Government in responding to any civil emergency. Firstly, the initial response should be at a local level where control of an accident and its most immediate effects can be dealt with effectively. Secondly, there should be a single lead department to co-ordinate the Government's response at the national level. Nuclear emergency planning in England is co-ordinated by the Department of Trade and Industry through the Nuclear Emergency Planning Liaison Group (NEPLG). The Ministry of Defence is the Lead Government Department, in the case of Defence nuclear emergencies, for co-ordination of the Central Government response, and also for providing strategic direction for the local level of response. This is exercised through the Nuclear Accident Information and Advisory Group (NAIAG), an interdepartmental body which would convene in MoD premises in Central London.

Over the lifetime of the AWE sites the Emergency Plans have been rehearsed and tested during numerous emergency exercises, both on site and off site, to the satisfaction of the Nuclear Installations Inspectorate, the industry Regulator. The

Emergency Plans are regularly reviewed in consultation with the Emergency Services at Off Site Plan Working Group meetings.

The introduction of the Radiation (Emergency Preparedness and Public Information) Regulations 2001 [REPPPIR] consolidate and enhance the current approach taken to emergency planning for accidents at AWE establishments.

## 1. Introduction

This document is the report to the Health and Safety Executive (HSE) of the hazard identification and risk evaluation assessment of the AWE Aldermaston nuclear licensed site, as required under regulations 5(2) and 6(4) of The Radiation (Emergency Preparedness and Public Information) Regulations 2001.

Section 2 gives the location and brief description of the site. Section 3 lists the major radioactive inventories on site while Section 4 gives the corresponding safety controls designed to ensure that there are no major releases from the site inventory. The sequences which could lead to a significant release of radioactivity from the site are described in Section 5 and the implications of such a release are outlined in the subsequent section. The final section gives a summary of this risk evaluation and presents some conclusions.

## 2. Location and Environment

Name and Address of Operator	Address of site
AWE plc, Aldermaston, Reading, Berkshire. RG7 4PR	AWE plc, Aldermaston, Reading, Berkshire. RG7 4PR

Aldermaston is a Nuclear Licensed Site located in the Royal County of Berkshire immediately east of the A340, approximately 15 km south west of Reading, 11 km north of Basingstoke and 13 km east of Newbury. The site is adjacent to the northern extreme of the village of Tadley. The Nuclear Licensed Site is extensive, covering 3.5 km<sup>2</sup>, and built on the site of a disused airfield. The site has been occupied in support of the UK nuclear deterrent since 1950 and contains research laboratories, manufacturing facilities, radiation generators, a pulsed nuclear reactor, buildings undergoing staged decommissioning and construction, and supporting infrastructure.

The site is subject to regular inspection and approval by the HSE's Nuclear Installations Inspectorate (NII). This regime superseded a similar HSE arrangement in July 1997.

The sheltering zone, of 3 km radius from the centre of the Aldermaston site (National Grid Reference SU 600 637), includes the villages of Tadley and Aldermaston, Baughurst, Pamber Heath and Silchester, plus several business parks with several hundred employees. The outskirts of the urban areas of Newbury, Basingstoke and Reading are within 15 km, where the boundary of the last is effectively delineated by the route of the M4 motorway. AWE liaises with the local council to provide leaflets to the households in the Aldermaston DPZ. The immediate villages have populations estimated from the 2001 Census as:

<b>Tadley (plus absorbed villages)</b>	<b>Up to 15,000</b>
<b>Aldermaston</b>	<b>Up to 1000</b>

The prevailing wind direction is from the south-west. The site is not over any major geological faults. No seismic events with a magnitude to damage conventional well built constructions have been recorded in several centuries. The underlying rock strata have no major faults other than that associated with the northern boundary of the Hampshire escarpment, several kilometres south of the Aldermaston site.

The AWE Aldermaston site is near the western end of a long round ridge of heathland running west-south west from Burghfield Common at an elevation of ~100m above sea level. To the north the land falls to the valley of the River Kennet, with its associated Kennet and Avon Canal, while to the east and south is a range of smaller valleys and to the west the valley of the River Enborne. The site has some protected species (flora and fauna) and heritage sites (i.e. Grimm's Bank). There are several Sites of Special Scientific Interest within 5 km of AWE Aldermaston, including Decoy Pond inside the fenced area controlled by AWE.

Figure 1 shows the outline of the site and maps the area around the site.

The Unitary Authority of West Berkshire District Council has a duty under REPIIR 2001 for the Aldermaston site. AWE recognises that the Basingstoke & Deane and Tadley councils have an interest in the safety of the Aldermaston site.

### **3. Radioactive Substances on Site**

AWE's mission is: "To deliver the UK's requirement for nuclear warheads and support for National Security".

The MoD holds the Defence Nuclear Stockpile of material with various component parts. The most radiotoxic form of this is plutonium and amounts to some 3.51 tonnes (as published in "Plutonium in Aldermaston – An Historical Account", April 2001 by MoD, ACSA(N)). Part or all of this stockpile may be held by AWE at its sites at any time.

The greatest part of the radioactive substances present on site is the nuclear material worked upon or stored by AWE. In the course of operations a small fraction of this has contaminated the fixtures, fittings and structure of buildings and some parts of the associated infrastructure. Operational controls are in place to minimise such contamination and subsequent waste generation. There are some areas of ground contamination.

The nuclear reactor operates in very short pulses, may have some activation products fixed inside the structural components of the reactor core. However, this fixed activity will not contribute to any significant releases of activity to the environment. The operational reactor does not create hazards defining the outer boundary of the DPZ.

The radioactivity of plutonium increases with age to a maximum, where the oldest material on site has effectively reached such a stage.

Contained tritium is handled on this AWE site and could, under some engulfing fire scenarios, lead to significant doses beyond the site boundary. Tritium accidents would

affect smaller areas than the corresponding plutonium scenarios.

There are other sources of radioactivity (substantially less significant than present in the main material) used for safety checks and normal industrial purposes (e.g. sources for radiography and in level gauges). These are well controlled, pose no threat to the public and have no potential for any off-site emergency response action.

Designated discharges from the site (liquid and airborne) are authorised within the scope of the Radioactive Substances Act 1993. Solid wastes are also generated on site, which are either stored on site or sent to a remote disposal site. The permitted discharges are governed by Discharge Authorisations agreed with the Environment Agency after due public consultation.

#### **4. Safety Controls**

Any nuclear plant operating in the UK must be supported by a safety case that demonstrates that the plant is safe in normal operation, its design is robust enough to ensure that any departures from normal operation do not lead to accidents, and provisions are made to intercept accidents as they develop or mitigate their consequences. This includes any decommissioning operations during the last phase of the plant life.

The design of the plant is based upon the fundamental requirement of radiological safety to do all that is reasonably practicable to minimise operational doses, risks and the initiation of abnormal events. The last factor requires consideration of how to prevent deviations from the planned normal operations escalating to major accidents. This is achieved by careful design with redundancy, diversity and segregation of safety functions to minimise dependencies between the protective systems which deal with deviations from the planned operating envelope. Further, mitigation is applied to minimise, so far as is reasonably practicable, the consequences of any accident. Hence there is a philosophy of having defence in depth in all nuclear plant to ensure, so far as is reasonably practicable, the safety of all people in and around the plant.

The primary design concept is to contain the radioactive material and radiation. This includes, where practicable, choosing to use material in a form which intrinsically retains radioactivity within the normal range of operational temperatures and environments. Extra containment barriers can be used to restrict the release of any radioactivity which does escape from its normal location. These barriers can be passive or dynamic, where approved codes of practice allow ventilation systems, decontamination systems or pressure vessels to be designed to allow work with radioactive materials without it contaminating the normally manned working areas or the wider environment. Massive barriers are used when radiation shields are required. The maintainability and fault tolerance of these safeguards is included in the design process (e.g. how to prevent a restart when an interlock is still disabled).

All these features ensure that the equipment used is well designed, built and maintained to keep operations within the safe working range defined for that particular nuclear plant.

#### Engineering Controls

The facilities within which hazardous materials are handled, processed and stored have a range of engineered features to maintain an acceptable level of safety for the workers, others on the AWE site and the surrounding public. These take full account of the

nature of the materials being worked on and the challenges to safety which can arise through human errors and mechanical failures.

All safety critical equipment is carefully designed, well built, thoroughly tested and examined, operated under carefully considered operational rules, maintained according to a maintenance schedule and operated within specification by trained staff. The safety arguments for the equipment and its operation are prepared by suitably qualified and experienced personnel and subjected to careful review both internally and external to the Company. All new equipment or changes in the operating rules are considered by a Nuclear Safety Committee containing external experts, with knowledge of the regulatory requirements, as well as Company representatives. This committee expects all papers and designs submitted to it to have been subjected to rigorous Acceptance Review by recognised staff independent of the management of the proposal. AWE have sufficient expertise to ensure the safe design, production and dismantling of nuclear warheads. Specialists scrutinise all the safety systems and operating procedures of the operational reactor.

### Systematic Analysis

Part of the safety assessment process includes a systematic identification of those factors with a potential to cause a major release of radioactivity or unacceptable reduction of safety margins used to control criticality hazards. This provides a comprehensive schedule of initiating events and the associated safeguards, mitigators and emergency response plans.

The probabilities and consequences of each potential accident are considered and combined as appropriate to evaluate risks. This process highlights those areas of the plant or operations or maintenance requiring attention to enhance safety. Improvements can be aimed at reducing the likelihood of an initiating event or at detecting its onset and either preventing it developing or mitigating its consequences. The primary consideration is to do all that is reasonably practicable to avoid the initiating event occurring, or at least to minimise its likelihood. Nevertheless, there may still be some identified events with the potential to develop into a major release. In these cases it is necessary to provide further protection to enhance safety.

The nuclear safety philosophy requires the systematic analysis to check that the protection provided is commensurate with the risks involved. Thus for potentially serious events there must be both **redundancy**<sup>1</sup> and **diversity**<sup>2</sup> in the methods used to detect the initiation of the fault and to bring the system back into a safe condition. These nuclear safety systems must also be **segregated**<sup>3</sup> so that the likelihood of them all being damaged at the same time (e.g. by a fire) is reduced and they must be robust enough to survive reasonably foreseeable spontaneous external events which may, for example, include major earthquakes and the effects of lightning strikes. For the operational nuclear reactor segregation extends to separating control systems from the designated safety mechanisms and any direct influence from operators.

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<sup>1</sup> Redundancy - In this context redundancy means there must be more than one safety system capable of doing the required function so that if one fails or is under maintenance that safety function is still done.

<sup>2</sup> Diversity - In this context diversity requires that the different systems are designed in different ways or work on different principles so that if there is a design or build fault on one system it does not affect the effectiveness of the others. The safety function would still be done when required.

<sup>3</sup> Segregation - Systems must be segregated by either distance or engineered structures in such a way as to greatly reduce the likelihood that they could all be damaged by the same spontaneous external event.

### Detection and Mitigation

The vast majority of operations with high nuclear safety risks performed within AWE Aldermaston involve manual operations in batch processes. Hence the detection systems are geared to providing mitigation, via warnings for staff to evacuate the affected areas or take shelter if sufficiently far removed from the imminent hazard.

Faults are detected by the continuous monitoring of the key parameters identified by the systematic analysis. At the AWE Aldermaston site the engineered systems include detectors for the onset of fires in active facilities.

A comprehensive and diverse set of protection systems are built into the facilities which work with materials sensitive to electrical discharges (e.g. lightning protection, earthing mats, etc.). Also AWE use an early warning of electrical storms as a service at Aldermaston to enable further safeguards to be implemented with respect to challenges to explosives from lightning strikes. Multiple containment barriers are used for all forms of fissile material even if the form is not amenable to dispersal during accidents. Ventilated areas provide additional dynamic containment capability in many facilities.

Separate systems are used to detect criticality incidents in those limited areas where such warning systems are justified. These Criticality Incident Detection Systems (CIDS) are designed to warn those persons in surrounding areas to immediately evacuate to minimise their dose from external exposure or intakes of radioactivity made airborne by the criticality excursion.

When the National Grid electricity supply to the Aldermaston site fails there are alternative power sources available which can maintain safety within high priority buildings. The continued electrical supply helps to restrict radioactive discharges to the engineered ventilation routes with their mitigation (i.e. filters). Uninterruptible Power Supply equipment is connected to those electrical systems considered essential to safety and additional temporary supplies can be supplemented by local generators.

### Management System

AWE has a Safety Management System with suitable and sufficient arrangements in place to meet the requirements of the Nuclear Site Licence for Aldermaston. These arrangements include the fundamental requirements of radiological safety for doing all that is reasonably practicable to minimise operational doses, risks and the initiation of abnormal events, particularly those which could escalate to major accidents. Further, mitigation of the consequences of an accident is also planned to be undertaken, so far as is reasonably practicable.

Conditions for the safe operation of individual facilities are provided by the specific Operating Rules and Safe Operating Envelopes derived from risk assessments of each facility, so complying with Nuclear Site Licence Conditions. The work needed to maintain the engineered safety features in each facility in a safe and reliable condition is specified in the Examination, Maintenance, Inspection and Test schedule for that facility. All safety features are subject to appropriate scrutiny and control of changes, whether these are to engineered systems, site services, procedures, organisational structures or resources.

The responsibilities of each member of the management team are defined within an assurance process for matters which affect nuclear safety, as required by the Nuclear Site Licence. Each facility has a Facility Manager with a support team. The overall

philosophy for control of the Aldermaston site during an emergency is outlined within the "Aldermaston Site Emergency Plan", agreed with the NII. The principal roles within the AWE organisation at Aldermaston are described in the following text.

Facility Managers co-ordinate the needs for particular buildings or complexes within the site and report to their Line Managers on all safety matters. Service providers maintain the plant and conditions of the facility structures and key engineered safety features, keeping the Facility Manager informed of the state of the buildings and systems. Health Physics cover and Radiological Protection Advisors are among the services provided.

Emergency Managers (EMs) are trained and appointed to take control of arrangements whenever they consider the conditions merit declaration of an emergency in any building or to any radioactive transport operation on the site roads. The declaration of an "Off-site Emergency" covers radiation emergencies defined by Schedule 1 of REPPiR 2001. The Emergency Manager may elect, under regulation 15 of REPPiR 2001, to disapply regulation 11 of the IRRs-1999 for those individuals taking intervention actions. This would be controlled in accordance with the AWE Intervention Dose Policy, which satisfies Schedule 8 of REPPiR-2001.

Local area support is provided within particular parts of the site by Facility Emergency Controllers, Shift Engineering staff, the Site Fire Service and other supporting staff depending on the time of day and operational status of the particular building. The resources of the site are made available during an emergency to ensure all the key information is gathered and distributed to the decision makers at AWE and in Local Authorities.

AWE have established a Site Response Group (SRG) and associated sections with the responsibility of preparing for and dealing with those events beyond the capability of an individual facility. This includes all those events which have the potential to affect areas outside a facility or which could extend past the site boundary. Communications systems and automatic alarms provide the capability for instigation of responses to all reasonably foreseeable emergencies. The Manager, Emergency Response & Site Control (MERSC), supported by the SRG, co-ordinates emergency preparedness at AWE Aldermaston for the actions needed on the site and the off-site information demands. AWE, Aldermaston has a full-time Fire Service on site.

A range of relevant expertise is available within AWE's central Assurance teams to support all aspects of Aldermaston operations. Additional services from the nearby AWE, Burghfield site could be made available to support the emergency response at Aldermaston if such assistance proved necessary.

### Staffing

Each department has a team of personnel; all team members are suitably qualified and experienced for the work which they are expected to perform. The minimum required manning levels are fully documented in the facility and team instructions, together with the action to be taken in the event that these levels cannot be met.

A continuous shift system is operated at Aldermaston, which ensures that there are adequate staff resources available at all times to deal with any abnormal event or emergency which might arise. This includes a call-out rota system for Emergency Managers and their deputies. The level of shift and emergency support team staffing has been subjected to an assessment undertaken as part of the safety case programme required by the Nuclear Site Licence Conditions.

### Procedures

It is a requirement of the Nuclear Site Licence that adequate assurance arrangements are made and implemented for all matters which may affect safety. These cover the provision of instructions for normal operations, dealing with abnormal conditions and contingencies through to how to instigate the arrangements to deal with an emergency having the potential to spread contamination beyond the site boundary.

Operating procedures for high hazard processes are designed to maximise the opportunity for responding to human errors and minimise the potential for deviations to propagate so far from planned safe conditions as to put the workers at imminent risk. This formulation of procedures recognises the human factors involvement in high risk operations at AWE Aldermaston.

Maintenance operations and other work (e.g. managing Work Control Centres) is also the subject of appropriate written procedures.

Facility Managers and their support staff have procedures to monitor the status of those requirements which comprise the Safe Operating Envelopes for the processes undertaken at any particular time in their specific facility. Appropriate actions are taken to suspend work and make safe if any of these conditions reach limiting values.

### Regulatory Control

The Nuclear Industry is regulated by the NII. This part of the HSE has assigned at least one site inspector for every licensed site besides maintaining a central pool of specialist assessors. A site inspector has the right to inspect any equipment or procedure at short notice and the right to require the Company to provide information. The NII can direct the shutdown of any process that it considers unsafe.

The NII require that the safety of plant and operations is considered in a systematic manner at all stages from planning, building, and operating through to decommissioning. A further requirement is that the safety case is subject to both continuous review and formal periodic review.

Any changes in procedures, plant or management structure has to be made in accordance with arrangements under the nuclear site licence approved by the NII. Major changes do not proceed to full implementation until the consent or agreement of the NII has been obtained.

### Emergency Organisation

AWE, Aldermaston provide a Site Emergency Plan for staff to follow on all matters which may affect safety in the event of a Site Incident or an Off-site Emergency being declared. All aspects of this plan are exercised to demonstrate this meets all the requirements of the Nuclear Site Licence, thus gaining the approval of the NII.

Implementing the plan provides support to the Emergency Manager on duty, who controls responses at AWE Aldermaston and can declare Local Emergencies (i.e. only affecting areas on the site) and Off-site Emergencies (i.e. involving off-site response by the Local Authority). External organisations would be notified as appropriate and the on-site arrangements would be called upon to respond to the particular accident.

Each Team Leader or Facility Manager is responsible for the preparation and issue of sufficient procedures and instructions to adequately cover their local emergency actions. A range of exercises of differing extent and complexity tests the interactions between teams and facilities relating to emergency responses. Arrangements are tested with the local Ministry of Defence Police and other MoD representatives.

AWE, Aldermaston has an on-site Fire Service with call-off arrangements for support from the Fire and Rescue Service in the Royal County of Berkshire. Internal arrangements cover any operational short-comings. Contingency actions to minimise the risks from operations are taken dependent on the manning levels achieved at any time in the Aldermaston Site Fire Service.

Additional services from the nearby AWE, Burghfield site could be made available to support the emergency response at Aldermaston if such assistance proved necessary.

AWE is represented on the Nuclear Emergency Planning Liaison Group (NEPLG) and is a member of the Nuclear Emergency Arrangements Forum (NEAF). These bodies bring together nuclear operators, government bodies, independent advisors and local authorities to ensure that best practice in emergency planning is communicated to all stakeholders.

## **5. Review of Foreseeable Accidents**

The majority of identified potential faults will not result in any release of particulate radioactivity to the open environment, by virtue of the prevention, mitigation and protection provisions installed and maintained in each facility. For a significant release of radioactivity from a nuclear facility to be possible it is necessary for an initiating event to propagate and overcome all the barriers between the hazardous radioactive materials present inside the facility and the outside environment, or for these all to fail at the time of demand. These barriers have been designed to accommodate the form of the material itself, any cladding and all the containments. The physical boundary of the facility forms part of the containment system as well. Given that all of these barriers are breached, then some radioactivity could be transported out of the facility and be dispersed into the atmosphere. For many postulated accident scenarios this would be through an authorised discharge point, so mitigation by appropriate filters would minimise the particulate release.

The most common type of accident in a facility which could have the potential to affect areas beyond the AWE, Aldermaston site boundary is fire or a seismic event. Only major fires engulfing a whole building or areas which store significant quantities of nuclear material would have the consequences which merit instigation of those

emergency arrangements requiring intervention beyond the boundaries of the AWE, Aldermaston site. The nature of fire accidents falls within the concept of accidents currently considered to be "reasonably foreseeable", being initiated by lightning strikes, drops, impacts or human errors and relying on human systems to maintain the protective and mitigating systems which would then be called on to perform. These scenarios do include some transport operations on the site roads.

Accidents with less severe off-site consequences include:

- Gross failure of filters on discharge routes.
- Accidents on site roads or in receipt bays where radioactivity escapes from breached packaging.
- Water loss faults where contamination leaves the site without appropriate control, including the effects of heavy rainfall scouring contaminated drains.
- Loss of radiation shielding.
- Fires or loss of containment impacts involving tritium containers.
- Fires in the stores containing radioactive waste.
- Criticality excursions.

Basic design features of the processes and products plus operational controls give assurance of the safety of all work with nuclear material, including storage. These controls have been subjected to criticality assessments and have been confirmed to give a high level of protection against an unintended nuclear chain reaction in all locations on the AWE Aldermaston site.

The safety case for each facility shows that all reasonable steps are taken to reduce the likelihood of these faults and to reduce the consequences should they be initiated.

## 6. Implications

It is recognised that despite the careful and systematic manner in which nuclear operations are conducted and the provision of multiple layers of protection in an effective state, there remains the remote possibility of a major accident at the AWE, Aldermaston site. The worst reasonably foreseeable accident, from those described earlier, would deliver the 5 mSv dose threshold for a radiation emergency within no more than 3 km from the point of release. These dose assessments include contributions from plume inhalation, external irradiation from the cloud of radioactivity and external irradiation from ground contamination over the year following the release. Ingestion dose is excluded from this estimate on the basis that the exposure route is generally slow acting and food bans can be effective, as described in subsequent text. More than one location on the Aldermaston site could experience this scale of infrequent event.

Accidental releases from the site could occur over periods varying from minutes to several days depending on the circumstances and the level of damage. Most facility based faults leading to significant off-site release would be expected to continue for a matter of hours. The AWE emergency arrangements assume releases would typically be truncated within a few hours, but that recovery operations on-site may take days.

In the event of a major release of radioactive material from site the dose to the general public would be minimised by the appropriate imposition of off-site countermeasures, as implemented by Local Authorities and their support services. These include the issue of instructions for the public:

- to shelter, which reduces the public cloud inhalation and irradiation doses, and,

to evacuate, which prevents further exposure by moving the public from the affected area.

Given the limited area of the Detailed Emergency Planning Zone the whole area could be requested to take shelter as a precautionary measure on the declaration of an Off-site Emergency. Subsequently, limited evacuation might be considered within this zone for the particular event, probably only involving the footprint of significant deposition left by passing particulate contamination.

Controls may also be applied to locally produced food under instructions from the Food Standards Agency. Since food production techniques can concentrate some radioisotopes it is likely that food bans will be effected over a wider area than evacuation or shelter instructions applied to work premises, public buildings or residential properties.

The timely imposition of countermeasures would require the existence of an off-site emergency plan. This confirms the need to continue with the existing plan. From these considerations of AWE operations, a Detailed Planning Zone surrounds the Aldermaston nuclear site to a distance of 3 km in all directions. It is considered unlikely that any person beyond this zone would be exposed to a dose high enough to require prompt countermeasures to be applied.

## **7. Summary and Conclusions**

Assessments demonstrate that it is extremely unlikely that there will ever be a major release of radioactivity from the AWE, Aldermaston nuclear site. The facilities on-site are carefully designed, built and operated in a manner that assures safe operation.

As discussed in this report, internal AWE scrutiny of safety of design and operation is intense. Further, the NII is a strong regulator with powers to demand improvements and to shutdown any operations about which it has concerns.

Even so, it is considered prudent to have adequate emergency plans to protect the general public in the event of a major release of activity. The scale of these plans is guided by the potential off-site release of radioactivity, typically in the event of a fire engulfing a whole building or during a high hazard transport operation. A DEPZ distance of 3 km is recommended for off-site emergency preparedness.

Best estimates for the worst reasonably foreseeable accidents indicate the potential for doses in excess of 5 mSv to unprotected members of the public extends to a range of up to 3 km from the AWE Aldermaston site. Shelter and evacuation are prompt countermeasures that could be applied to reduce the dose uptake by members of the general public. Food restrictions initiated by the Food Standards Agency may affect a wider area and for longer.

In line with REPIR and Regulatory requirements, the AWE Off Site Plan gives consideration for extendibility of the DEPZ for emergencies which are outside the design base and require sheltering to be implemented at a distance beyond 3km.

It is recommended that the current off-site emergency plan be maintained to assure the benefits are obtained from the timely and orderly imposition of the identified countermeasures that would be effective in the event of a significant accidental release of radioactivity.

**Figure 1** Major Features in Area Surrounding AWE Aldermaston

