

**RADIATION (EMERGENCY PLANNING AND PUBLIC INFORMATION) REGULATIONS 2001
(REPPIR)**

THE LAY-PERSON'S ALTERNATIVE GUIDE TO REPPIR

RELATING TO THE

**ATOMIC WEAPONS ESTABLISHMENT (AWE)
ALDERMASTON AND BURGHEFIELD**

CLIENT: NUCLEAR INFORMATION SERVICE¹

Nuclear Information Service (NIS) engaged Large and Associates to prepare this *Lay Person's Guide* to REPPIR and, where appropriate, to evaluate and compare the Aldermaston/Burghfield REPPIR emergency arrangements in the light of lessons from the Fukushima nuclear accident.

REPORT REF N^o R3194-A1

This pdf version R3194-A1 includes hyperlinks shown thus R3194-A1 that will display the whole of the paper, photograph etc., referred to providing the host computer is internet connected. A separate Glossary and Explanation R3194-A2 is available and copies of correspondence, etc., relating to the preparation of this Guide are accessible within the [CZ3194](#) page of the [Large & Associates](#) web site. The printed copy of this document does not contain these links or a full citation of the source references.

1 ST ISSUE	REVISION N ^o	APPROVED	CURRENT ISSUE DATE
27 FEBRUARY 2012	R3194-A1-R8		27 APRIL 2012

A LAY-PERSON'S GUIDE TO REPPIR

SUMMARY

This *Lay-Person's Alternative Guide to the Radiation (Emergency Preparedness and Public Information) Regulations 2001* (REPPIR) examines and assesses the derivation and applicability the off-site emergency planning arrangements in place for the Atomic Weapons Establishment (AWE) nuclear weapon plants at Aldermaston and Burghfield.

REPPIR places the responsibility for providing an adequate *Off-Site Emergency Plan* (the *Plan*) with the West Berkshire Council (WBC). Under REPPIR, WBC is required to manage and resource (by coordinating the efforts and resources of its own and those of other agencies and parties) the *detailed emergency planning zones* (DEPZs) in which the Council has a duty to safeguard the health and welfare of the public.

In this *Guide*, WBC's *Plan* is compared to the emergency arrangements maintained by the similar United States Pantex nuclear weapons complex at Amarillo, Texas. Further comparisons are drawn with the evacuation and other radiological counter- and mitigation measures enacted in the aftermath of the accident at the Japanese Fukushima Daiichi nuclear power plants in March 2011.

The outcome of these comparisons is disturbing.

First, it is not at all clear how the AWE arrives at its recommendations on the extent and coverage of the radial DEPZs extending 3km and 1.5km from Aldermaston and Burghfield respectively. The AWE's published assessments are vague, failing to identify and describe the nature and severity of the accidents and incidents that it considers to be relevant and credible; and the types and quantities of the fissile and radioactive materials and compounds involved, and at risk of being dispersed via atmospheric release, are neither specified nor quantified in meaningful detail.

Whatever little information is available has to be gleaned from heavily redacted documents that have been winkled out via often drawn out *Freedom of Information Act 2000* (FOIA) requests. Even so, sometimes escaping the weeder's[†] scrutiny are snippets of information that are very revealing. For example, for Aldermaston a certain but unspecified (redacted) accident results in an off-site radiation dose exposure to individual members of public that could soar to about 560 times the annual permissible limit for a member of the public, or 110 times the level at which a *Radiation Emergency* has to be declared; nothing is learnt from past exercises of the off-site emergency plan, carried out every three years, because all data and records are shredded and destroyed following each exercise; and in the real emergency of August 2010, when a serious fire broke out in the Aldermaston explosives area, Berkshire Brigade fire-fighters responding to the shout were held back from tackling the fire because the AWE did not have a sufficient number of personal dosimeters on the Aldermaston site to equip each fire-fighter.

The Office for Nuclear Regulation (ONR) considers submissions from AWE identifying the accidents and incidents believed credible for the sites and activities involved. ONR refers to, but is not bound by, the AWE representations when it spells out to WBC the extent of the DEPZs to be established by the *Plan* around each plant. However like AWE, the ONR is equally taciturn about how it goes about setting the DEPZs, particularly in that there is little published of any interrogatory exchange with the operator AWE; there is no explanation or justification of how it arrives at the 5mSv radiation dose contour within which a *Radiation Emergency* has to be declared; it permits the operator to include for only *reasonably foreseeable* accidents in the absence of any publicly accountable justification, and it absurdly reasons that because it considers terrorist acts not to be *reasonable foreseeable*, then there is no need to account for such in REPPIR; and, hinted at by the somewhat woolly and no-knowing ways with which the ONR responds to FOIA requests, there is a nagging sense that it, itself, does not have complete access nor understanding of all of the plants, processes and materials deployed at the Aldermaston and Burghfield sites.

In fact, trawling through the publicly available records casts some doubt on the effectiveness of the ONR's involvement and scrutiny of the AWE's hazard identification and risk evaluation (HIRE). For example, from the ONR's final approval of the 2002 REPPIR HIRE after "*conveying to [AWE] the Schedule 5 shortcomings*" it becomes clear that ONR did not have then (nor probably now) direct access to the AWE source documents, having to rely upon just an outline '*Route Map*' of reference information; in 2008 when preparing to assess the HIRE

[†] See Glossary [R3194-A2](#) for explanation of this and other terms and jargon.

presently in use an internal ONR note records that “*It should be noted that we did not look at the 2005 versions [of the HIREs] despite having them ranked as a high importance item*”; and in its review of the 2008 HIRE (effectively the most recent AWE risk assessment), the ONR stated that it “. . . *does not have the time available to undertake detailed assessments of such [AWE HIRE] submissions*”.

Since it is denied incident-specific information, WBC has to prepare the *off-site plan* blind, placing a great deal of trust that AWE has covered and disclosed all possible accident/incident outcomes. This approach, particularly the complete dependency upon advance and adequate disclosure by AWE, has a number of serious shortcomings, including that it inevitably results in a generalised, all-contingencies approach that may be unable to focus resources and respond to specific types of incident outcome; incident-specific countermeasures may have to be devised anew as novel challenges are encountered in a real radiological incident; and because there is a dearth of information from AWE about so-called ‘*Cliff Edge*’ and ‘*Black Swan*’ events, the scale of and necessary response to the incident excludes the appropriate degrees of technological and scientific input in allocating specialised resources at the preparation stages of the *off-site plan*, rather than, as seems to be present practice, reaching out for such assistance only once such an emergency occurs.

A particularly weak feature of the WBC *Plan* is the allocation and availability of human resources. Generally, the *Plan* assumes that large reserves of human resources will be available *as-and-when-needed* but this approach is intrinsically flawed because very few, if any, of WBC’s own employees, the police and medical personnel (ambulance drivers, paramedics, etc), and sub-contracted personnel (transportation drivers, school and hospital staff, etc) will be permitted to undertake response actions in a radiological environment (for which they each have to agree in advance in order to be adequately informed of the risks and receive specialist training). Of the remaining emergency services, the County Fire Brigades personnel could exhaust their nationally and locally agreed single-incident radiation dose limits at which point they would be required to withdraw from the radiological environment. This situation would leave the immediate, post incident response (which is critical in incidents involving airborne particulate such as plutonium), completely dependent upon the availability and numbers of AWE employees trained as emergency responders available to implement the off-site counter and mitigation measures. Presently, just over 100 AWE employees are registered and trained to respond in a radiological environment, these are arranged in work shifts so, it follows, at the onset of any incident about 30 or so experienced and qualified responders will be spread between the two AWE sites, but the numbers may be further limited, particularly if there are ongoing pressing commitments on the AWE incident site or, indeed, if numbers of AWE employers have been incapacitated by the incident itself.

WBC’s *Plan* carries a pervading sense of ‘*muddling through*’, this being particularly illustrated by the acknowledgement that although extendibility of the DEPZ is included in the *off-site plan*, the response actions required are based on a generalised nuclear reactor accident because “*work is currently underway to develop this area (extendibility) to be appropriate for the AWE sites*”. In the interim, the specific response duties and actions of the various agencies involved with AWE incident are, for the purposes of resourcing and organising the *Plan*, confined to the 3km and 1.5km Aldermaston and Burghfield DEPZs. Remarkably, the present edition of WBC’s *Plan* has no specific advance and preset arrangements in the extendibility areas (which for Aldermaston stretches out 18km from the site) for warning the public, evacuee transport and established pick-up points, reception and rest centres, and additional human and equipment resources. Also, there is a presumption that there will be a spontaneous, self-evacuation by the public, although this is neither considered in account that it could be either a potential hindrance or advantageous in the implementation of the WBC *Plan* and, in this respect, very little data and analysis is included in the *Plan* in account of the delays and times taken for individuals and families to collect themselves together for either self, voluntary or enforced evacuation, at various times of the day and during various seasons of the year. Moreover, knowledge of these time scales is a particularly pertinent to the areas around Aldermaston and Burghfield, comprising a high density of commuters who are likely to need and/or be compelled to return to their homes to prepare for evacuation actions.

If, as claimed by AWE, for any reasonably foreseeable incident the declaration of a *Radiation Emergency* is confined to the DEPZs, the coverage of these detailed and prepared for response areas are, by comparison with other nuclear sites and radiological incidents, remarkably small. For example, the single 1.5km radius DEPZ for Burghfield compares to the twin 8km and 16km (the latter distance which is extendable in itself) emergency planning zones maintained around the Burghfield-equivalent nuclear weapons Pantex plant at Amarillo in the United States. Evacuation of the public, sometimes forcedly, from the urban and rural areas north-east of the crippled Fukushima Daiichi nuclear power plants in Japan involved about 140,000 individuals out to 60km and more, and

today, a year following the onset of the catastrophe, there remains an enforced radial, total exclusion zone of 20km around the plant. At this time, the Japanese government has under consideration revision of its off-site emergency requirements that are expected to specify a mandatory evacuation of all public within 5km of the plant, dose exposure triggered evacuation out to 30km, and fully resourced protection from the overhead radioactive plume and its fall-out to a distance of 50km from the source of any future radiological incident. These Japanese proposals for the protection of the public, learnt from the lessons of Fukushima, compare to the Aldermaston and Burghfield DEPZs of 3km and 1.5km respectively.

The underlying weakness of the *Off-Site Emergency Plan* belies WBC's confidence in the AWE's ability to reliably predict future abnormal events (its accident scenarios) and, from these, prescribe very tight DEPZs. This seems to be entirely at odds with the experience and practice of other nuclear weapons plants (Pantex), it ignores account of past nuclear accidents (Windscale, Chernobyl and more recently Fukushima), and it defies the axiomatic fact and common sense that accidents are not exactly or indeed generally predictable, and that in encountering such 'accidental' challenges high-technology ventures can give rise to unforeseen and catastrophic consequences (*Titanic*, *Piper Alpha*, space shuttles *Columbia* and *Challenger*, etc). If a future accident/incident and its radiological aftermath exceeds the limits of any one of AWE's nominated *scenarios* (which are not publicly available), there will arise need to implement countermeasures beyond the prescribed DEPZs. If so, resources within the DEPZ are likely to be quickly depleted and the numbers of intervention personnel available will rapidly shrink, leaving shortfalls in the skilled human responders available for the timely and effective implementation of countermeasures necessary to protect the short, interim and longer term health and well-being of the public which is, after all, the overriding purpose of the REPPIR *Off-Site Emergency Plan*.

JOHN H LARGE
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INTRODUCTION TO REPPIR

The *Radiation (Emergency Preparedness and Public Information Regulations 2001* (usually referred to as REPPIR) provide the main framework of emergency preparedness measures in the UK to ensure that members of the public are protected in the event of a radiation emergency.

In application, the regulations place various duties on the nuclear site operator (or the transport carrier or consigner), and local authorities to the effect that each must provide emergency plans that are adequate and fit for purpose. To a limited extent, REPPIR places duties on the emergency services.² Compliance with of REPPIR is overseen by the Office for Nuclear Regulation (ONR). The *On-Site Emergency Plan*^{3,4} is the responsibility of the nuclear site operator and the *Off-Site Emergency Plan* is the responsibility of the local authority.

With respect to any nuclear licensed site, REPPIR requires the local authority to:

- prepare off-site emergency plans as notified by the ONR
- consult the public when preparing the off-site emergency plan
- review and test the off-site emergency plan at least once every three years.
- train staff in their response roles as specified by the off-site emergency plan
- inform the public of the measures to be taken should a radiation emergency arise
- provide the public with information during any Radiation Emergency.

This *Lay Person's Alternative Guide to REPPIR* relates to the applicability of the *Off-Site Emergency Plans* for the Atomic Weapons Establishment (AWE) Aldermaston and Burghfield licensed nuclear sites, which is entirely the responsibility of the local authority, in this case the West Berkshire Council.

Following the Japanese nuclear accident initiated by the earthquake and tsunami of 11 March 2011, where it was necessary to evacuate upwards of 140,000 members of public beyond 30km and more from the Fukushima Daiichi nuclear plant, the UK government ordered the ONR to review the implications of the Fukushima incident for the UK's own nuclear installations.⁵ Amongst the ONR recommendations was that the emergency arrangements, particularly the extent and extendibility of the detailed emergency planning zone (DEPZ), should be reviewed⁶ by the *Nuclear Emergency Planning Liaison Group* (NEPLG).

NEPLG has yet to issue a final report and, because of this, the *Department of Energy and Climate Change* (DECC) has been unable to fulfil its promise to update its published guidance on the UK's response to a nuclear incident by December 2011.⁷ At this time, the DEPZs around all nuclear facilities in the UK, including the Aldermaston and Burghfield, remain at pre-Fukushima accident distances.

REPPIR AND THE ATOMIC WEAPONS ESTABLISHMENT

At the 67th meeting of the AWE Local Liaison Committee Meeting (8 December 2011)⁸ Action 67/1 required AWE staff (Paul Cooper) to liaise with the Office for Nuclear Regulation (ONR) to provide a 'lay-person's guide' to REPPIR risk assessments and associated processes, reporting this to the 68th meeting.

This *Alternative Guide* sets out the UK off-site emergency arrangements for the Aldermaston and Burghfield sites in lay terms. The off-site plans are also compared to the arrangements for the similar, although larger, United States Pantex nuclear weapons plant and reviewed in the context of the actual off-site response around the crippled Japanese nuclear reactor plants at Fukushima Daiichi following the radioactive releases of March 2011.

This guide evaluates the application of REPPIR at the Aldermaston and Burghfield sites by considering the actions and practices of the various parties involved, to the standards adopted or other, similar nuclear weapons plants, and the actual radiological outcome of the Fukushima Daiichi accident so far as these apply to members of public in the off-site domains of the AWE plants – these aspects are separately dealt with in different colour-tinted text boxes:

AWE: Aldermaston/Burghfield Off-Site Emergency Planning Zones – Roles of Emergency Services

ONR: Approach of the Office for Nuclear Regulation to Off-Site Emergency Planning

WBC: Role of West Berkshire Council in the Off-Site Emergency Plan

Fukushima: Actual Events and Emergency Actions taken Off-Site at Fukushima

Pantex: Comparisons with Emergency Plans of Similar and Other Nuclear Plants

UK: Application of Regulations and Standards

REPPIR

Definition: *The Radiation (Emergency Preparedness and Public Information) Regulations 2001* (REPPIR)⁹ apply to nuclear sites as defined by the *Nuclear Installations Act 1965* (NIA65) and licensed by the *Office for Nuclear Regulation* (ONR). REPPIR is enabled under the *Health and Safety at Work etc Act 1974* and satisfies the requirements of the *European Directive 96/29/Euratom*.¹⁰

Application: REPPIR applies to premises and transport operations involving radioactive materials and processes dealing with radioactivity. REPPIR Regulation 16(6) and Regulation

18(2&3) provide the Secretary of State for Defence opportunity to exclude certain information and/or exempt the activity from REPPIR.

AWE: The Secretary of State for Defence has not excluded either AWE Aldermaston or Burghfield and both are NIA65 licensed nuclear sites, handling, processing and storing radioactive materials and thus are subject to REPPIR.

However, Regulation 16(6) is applied insofar as certain information in the REPPIR Regulation 8 *Report of Assessment* or HIRE submission to Office for Nuclear Regulation (ONR - see later) is withheld from publicly available copies of REPPIR documents. To an unknown extent, Regulation 18(2&3) allows the Ministry of Defence (MoD) to withhold information from the ONR relating to the design and development (and materials employed, etc) of the nuclear and radioactive devices (nuclear weapons, etc) manufactured and assembled at Aldermaston and Burghfield. The restriction on full information transfer to the ONR is also likely to apply to the processes (A90), manufacturing and testing of nuclear weapon components and assemblies (ORION, etc).

Parties: Regulation 2 defines the parties charged with duties under REPPIR. These are the nuclear site *licensee*, the *local authority* responsible for the implementation of the *Off-Site Emergency Plan*, and the *Health and Safety Executive* who effectively oversees the application of REPPIR via the ONR.

AWE: For Aldermaston and Burghfield these parties are as follows:

Licensee: **AWE plc**, a wholly owned subsidiary of **AWE Management Ltd** comprising the consortium of *Jacobs Engineering Group*, *Lockheed Martin UK* and *Serco* who hold a 25 year contract (until March 2025) to operate the Atomic Weapons Establishment. Both AWE sites remain owned by the UK government who also hold a Golden Share in AWE plc.

Executive: Now effectively the **Office for Nuclear Regulation (ONR)**.

Local Authority: **West Berkshire Council**.

Radiation Emergency: REPPIR Schedule 1(1) defines the projected level of radiation dose exposure of any member of the public, irrespective of the health protection measures implemented during the first 24 hours following the radiological incident, beyond which a '*Radiation Emergency*' must be declared.

AWE Environs: The principal dose criterion is that if, for any member of the public, the individual dose projected over the period of one year following the incident equals or exceeds 5 milli Sieverts (5mSv) then a '*radiation emergency*' has to be declared.

This automatic trigger applies to any member of the public, irrespective of location, occupation, age, gender, etc. and is calculated for all possible uptake paths (direct exposure, inhalation, ingestion, etc). Dose exposures within the DEPZ, to which the *Radiation Emergency* applies can considerably exceed the 5mSv annual threshold.

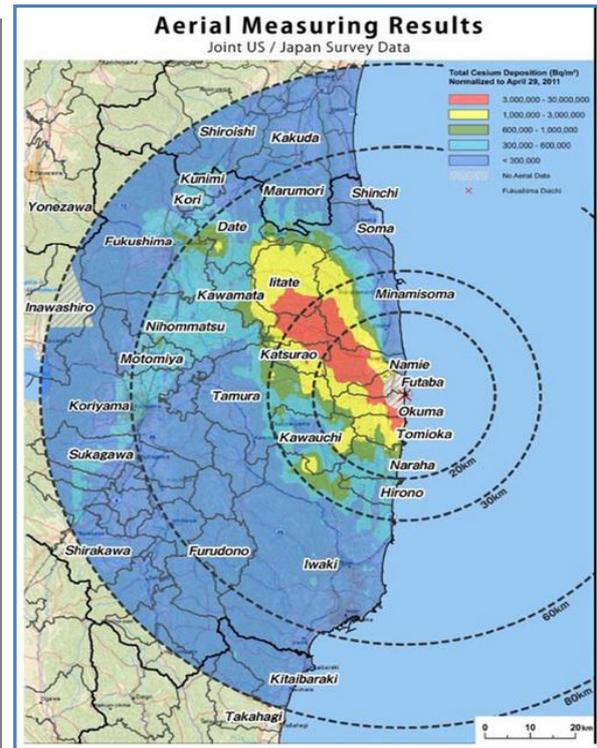
UK Tolerable Exposure: In the United Kingdom the *Ionising Radiations Regulations 2000 (IRR)*¹³ set a maximum limit of 1mSv per calendar year for '*non-incident*' tolerable dose exposure from all artificial sources of radiation (excepting medical exposures) via all uptake pathways.

Fukushima: In the first few weeks following the Fukushima Daiichi radiological incident commencing 11 March 2011, equivalent dose exposures up to and in excess of 20mSv were received by members of public living in the region of the nuclear power plant (NPP). Some of these doses extended out to beyond 60km+ from the Fukushima plant.

The map (right)¹⁴ shows the ground contamination north-east of Fukushima Daiichi on 29 April 2011, extending out to 60+km (3rd radial zone) from the plant.

Ground contamination is a persistent source of radiation exposure for members of public remaining in the contaminated zones.

In the 30km evacuated zone surrounding the Chernobyl nuclear plant even today, some 26 years following the accident in 1986, radiation levels remain too high for normal human occupation of the area.



UK Application: Given similar weather conditions, superimposition of the Fukushima Prefecture radiological conditions centred on the Aldermaston site would result in a 'Radiation Emergency' being declared over a radial segment out to at least 60km for the point of the radioactive release.

Driven by the prevailing wind from the South-West, the radiation fallout from the overhead plume would reach Reading, Slough and a large part of the western suburbs of London.

Amount of Radioactivity: REPPIR applies only to sites and transportation involving specific quantities of radioactive materials as defined by Regulation 3.

AWE: The principal radioactive materials utilised in the current design of UK nuclear warheads are Plutonium-239 (Pu-239) and highly enriched Uranium-235 (HEU-235).

Qualifying quantities for REPPIR are 150 grams of Pu-239 and 250 grams of HEU-235.

A single nuclear weapon produced by AWE is reckoned to contain several kilograms of Pu-239. At any time some part of the UK's unsafeguarded stockpile of around 3.5 tonnes¹⁵ of weapons-grade Pu-239 will be held on the Aldermaston/Burghfield sites either in storage, undergoing processing, and/or in the fissile pits of the tens of nuclear warheads being dismantled, assembled or refurbished at any one time. Current nuclear warhead designs incorporate about 10 to 20kg of highly enriched uranium (HEU). Most designs also have a tritium/deuterium booster with a few grams of radioactive tritium, and also include non-radioactive but highly toxic materials such as beryllium.

Release of just a fraction of the fissile materials of a single nuclear warhead would be more than sufficient to trigger a REPPIR defined *Radiation Emergency*.

Hazard and Risk Assessment: Regulation 4 requires the nuclear site *Operator* to make an assessment to identify the hazards and evaluate the risks (hazard identification and risk evaluation - HIRE) from the activities undertaken on the licensed site.

AWE: The latest AWE HIRE reports for the Burghfield¹⁸ and Aldermaston¹⁷ sites are dated June 2008. These '*publicly available*' versions are lacking in any significant detail, although some numerical predictions of public dose exposure are included.

The HIRE reports are scheduled to be reviewed every three years and updated versions were due to be prepared in 2011 but even redacted versions of the most recent HIRE reports have yet to be made publicly available.

For Burghfield, according to AWE the worst, reasonably foreseeable accident would deliver the REPPiR Regulation 2 one year projected 5mSv dose threshold out to a distance of no more than 1.5km from the point of release. For Aldermaston the 5mSv dose threshold would be exceeded not further than 3km from the point of radioactive release.

A subsequent but heavily redacted Regulation 5 review²⁰ by AWE of the REPPiR Regulation 4 HIRE submission for Aldermaston refers to '*future experiments*' and reveals that in the event of an unspecified accident the potential public dose exposures at 1km could reach 17mSv. At one (unidentified) public location at the site boundary fence, an individual could be exposed to a dose within a range between 90.5mSv to 558mSv, depending on the prevailing weather and atmospheric stability conditions.

Topics included in the HIRE: Schedule 5 of REPPiR sets out the particulars that must be included in the HIRE for evaluation by ONR.

ONR Assessment of AWE's HIRE: The HIRE assessments for both Aldermaston¹⁸ and Burghfield¹⁷ fall short of the REPPiR requirement in several important respects and some might consider these to be somewhat misleading.

For example, the Aldermaston HIRE generally identifies an outbreak of fire that "*could have the potential to affect areas beyond the AWE, Aldermaston site boundary*" but notes that "*Only major fires engulfing a whole building or areas which store significant quantities of nuclear material would have the consequences which merit instigation of these emergency arrangements requiring intervention beyond the boundaries of the AWE, Aldermaston site*". This reassuring claim skirts around the fact the release of just a few grams of plutonium-239 would have a significant radiological effect at and beyond the Aldermaston boundary. Indeed, because plutonium and some of its alloys, even in the absence of an external ignition source, can self-ignite when exposed to air,¹⁹ the release fraction to atmosphere and dispersal and disposition into the off-site public domain could be radiologically significant

Even with release of the heavily redacted Regulation 5 review,²⁰ very little meaningful information is publicly available of the actual incident scenarios nominated and analysed by AWE for the HIRE; and much the same scarcity of information applies to the numerical risks of accident and/or the vulnerability of the AWE plants to malevolent acts, and the severity of such events.

Again for example, there is nothing in the HIRE on the types of radioactive substances and quantities likely to be involved - Schedule 5(e); the maximum quantity of radioactive substances that could be released - Schedule 5(i); the factors that could give rise to an unintended self-sustaining chain reaction - Schedule 5(j); or assessment of the dispersal of radioactive substances released in the incident and the period of time over which the dispersal is likely to take place - Schedule 5(n) - a "*deficient*" situation that was first noted by the ONR in 2002.⁴⁴

The thoroughness of the ONR's assessment of AWE's HIRE is revealed by an internal e-mail of 8 August 2008 stating '*I have briefly reviewed the AWE's formal submissions . . . NII (now ONR) is unable to establish the extent of analysis that has been undertaken by AWE*', going on to declare that the '*. . . NII does not have the time available to undertake detailed assessments of such submissions*'.

Fukushima: Until the earthquake and tsunami of 11 March, both the operator TEPCO, and the Japanese nuclear safety regulator, NISA, reckoned that the worst 'foreseeable' accident would involve a loss of coolant event for a single nuclear power plant and that the radiological outcome, with the release being confined by the multiple containment barriers, would not spread into the public domain beyond the nuclear station site boundary.

Instead, the tsunami totally overwhelmed the Fukushima nuclear complex, resulting in a complete loss of off- and on-site electricity supplies, causing a prolonged station blackout during which three operational NPPs and a fourth defuelled NPP were utterly destroyed by lack of cooling.²¹ This was a series of events not considered credible by either the regulator or operator, so no contingency plans were laid for its possibility and, mainly as a result, the off-site emergency response to the ensuing radiological crisis was, at times, chaotic and in disarray.

During the early days of the incident, then Prime Minister Naoto Kan was advised by the Shunsuke Kondo cabinet report 'that the developing radioactive release could force the evacuation of Tokyo'²² over 250km to the south and with a population of tens of millions. By chance this dire situation was avoided as the winds steadied to the East taking the radioactive plumes out over the Pacific for several days, then swung round to the north-east heading towards Fukushima City, even so requiring the mandatory evacuation of up to 140,000 members of the public.

Today a year following, the 20km radial zone around the Fukushima Daiichi site remains completely evacuated.

Reviewing the R4/5 Report of Assessment - Setting the Off-Site Emergency Area:

Regulation 6 requires the ONR to review the operator's HIRE in terms of the Regulation 7 Operator's *On-Site Emergency Plan* (or Regulation 8 for transport operations involving radioactive materials) and the Regulation 9 *Off-Site Emergency Plan*. As part of this process the ONR determines and sets the detailed emergency planning zone (DEPZ – typically defines as a radial zone stretching out around the nuclear facility), advising the local authority of the need for and extent of the *Off-site Emergency Plan*. In this process the ONR is not at all compelled to accept the operator's HIRE assessment and adopt any off-site dose contours contained therein.

The Local Authority is charged with preparing and maintaining the Regulation 9 *Off-Site Emergency Plan* over the DEPZ area prescribed by the ONR.

ONR: The ONR provides no explanation or justification whatsoever on how it arrives at the extent of the DEPZ and, for the two AWE sites, its determination of the 3km and 1.5km DEPZs exactly coincides with the dose contour at which, according to the AWE, the projected one year dose falls below 5mSv.

On its part, AWE does not demonstrate in any meaningful detail how it arrives at the 5mSv dose contours from which it sets its recommendation for the DEPZ. Apparently, AWE undertakes these projections in complete secrecy, nominating specific accident situations which it also does not specify. The access afforded to the ONR of the AWE's calculations and accident scenarios is unknown, but it is likely to be limited, with some AWE correspondence with the MoD's Defence Nuclear Safety Regulator (DNSR) suggesting that ONR is kept 'outside the loop'.³⁹

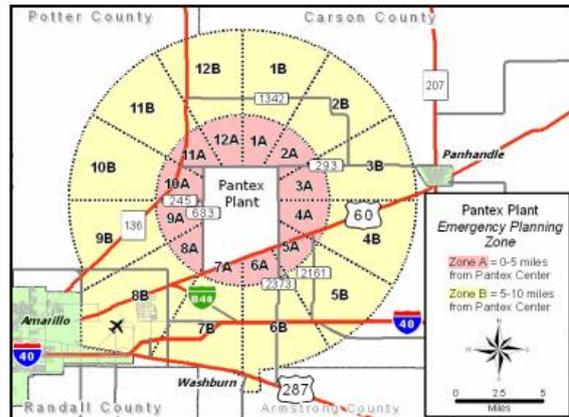
Similarly, ONR gives no account to the transportation of nuclear materials to, from and between the two AWE sites, nor for the assembled nuclear weapons that are road dispatched to and received from the Trident submarine arming base at Coulport in Scotland.

ONR Evidence to the Boundary Hall Planning Inquiry: Evidence presented at the 'Boundary Hall' planning inquiry²³ by ONR suggests that the DEPZ at AWE Aldermaston was determined by identifying the radii of dose contours for set piece release from each of the individual facilities on the site which handle radioactive material, and then setting an overall DEPZ limit for the site which enveloped all of the individual facilities radii. In the map shown in the HIRE report for AWE Aldermaston¹⁸ the DEPZ appears to be centred on the A90 facility – the main production and radioactive materials processing facility on the site – suggesting it is considered to present the 'worst case' accident.

AWE DEPZ: Generally taken from the centre of the each site, the DEPZs cover radial zones for AWE Aldermaston extending out 3k, and a tighter 1.5km for AWE Burghfield. For both AWE sites there is no specific extendibility zone declared because work is currently underway to determine the respective extendibility distances.²⁸

Pantex Plant EPZs: The US Pantex plant at Amarillo Texas undertakes much the same nuclear weapons activities as the AWE Burghfield plant. Pantex maintains two Emergency Planning Zones, the first inner radial zone at 8km and an extendable second zone at 16km.

The Amarillo Off-Site Emergency Plan assumes population sheltering and probable evacuation of a minimum of two radial segments (see right) that could involve upwards 40,000 to 50,000 inhabitants of the Amarillo suburbs.



DEPZ: If the Pantex Emergency Planning Zones were applied at Aldermaston, then much of the population of Reading (pop. 145,000) might require evacuation in a serious radiological incident (ie that of radiological severity acknowledged to be reasonably foreseeable by the Pantex plant operator).

It is not at all clear why these two very similar plants (Burghfield and Pantex), involved in much the same product (nuclear warheads), have significantly different off-site emergency zones (3km and 16km) to provide the same degree of radiological protection to members of the public.

Pantex Plant EPZ Actions: Members of Public in area surrounding the Pantex plant are warned by sirens throughout the 16km radius EPZ to follow the following instructions:²⁹

Sheltering:

- Stay indoors in your home, work place, or a nearby building. Once inside, do not leave unless you are told it is safe to go out or you are advised by your emergency management officials or law enforcement personnel to evacuate.
- Close all windows, doors, and fireplace dampers. This reduces the outside air that enters your home or work place.
- Turn off any heating or cooling system that draws in air from the outside. If it becomes stuffy, use portable or ceiling fans to circulate the air inside.
- If you have been outside during the period just before you were warned to take shelter, take a shower or at least wash your face and hands with a washcloth using soap and tepid water. Change into clean clothes; put the clothing you were wearing and the washcloth into a plastic bag.
- Keep your radio on and tuned to one of the local EAS stations- KGNC-AM (710) or KGNC-FM (97.9). Listen for information and instructions.
- Begin to assemble items you may need in case you are advised to evacuate.
- If you must go outdoors, cover your nose and mouth with a damp cloth to avoid inhaling any radioactive materials that might be present.

Evacuation:

You may have to be away from home for a few days. If possible, take along the following items:

- Extra clothing and shoes
- Spare pair of eyeglasses and important medicines
- Sleeping bag (or two blankets) and a pillow for each person
- Proper identification
- Checkbook, credit cards, and cash
- Portable radio and flashlight (with extra batteries)
- Special supplies for infants and elderly family members
- A list of family physicians and other important numbers
- Your address book or a list of phone numbers for relatives and friends.
- Turn off you lights. Leave your refrigerator and freezer on.
- If you plan to take your pets, bring a leash or carrier for them. Otherwise, leave animals with access to food and water.
- Lock windows and doors. Leave your home or work center as you would if you were going on a short trip.
- Do not worry about your home while you are away. Roadblocks will be established to keep people out of areas that have been evacuated.

Specificity of the Off-Site Emergency Plan: Regulation 9(3) requires the Local Authority to tailor its Off-Site Emergency Plan to '*reasonably foreseeable emergencies*'.

West Berkshire Council: In the absence of essential information about the detailed accident and radioactive release scenarios determined by AWE, it is difficult to envisage how, first, ONR is able to corroborate the AWE projections of public dose exposure and from this, second, how West Berkshire Council is able to draw up an effective *Off-Site Emergency Plan* when it can only model and resource its response to such non-specific situations.

Duty of the Operator to Provide Essential Information: Regulation 9(5)(a) places a duty on the operator to provide the local authority with '*any additional information the local authority may reasonably request to enable the off-site emergency plan to be prepared*'.

Reasonably, such additional information might be required in preparation for and during the running of exercises to test the *Off-Site Emergency Plan* as stipulated by Regulation 10.

West Berkshire Council: Even when testing the Off-Site Plan, little meaningful information is provided by AWE about the quantity and amounts of radioactivity released.

For example, in the November 2010 Exercise for the Aldermaston site, although the scenario included a hypothetical breach of the containment and a persistent fire in the radioactive material handling facility, with an acknowledged release of radioactivity for dispersion and deposition off-site, no information was provided on the type(s) of radioactive substances involved and the quantities released.

WBC has no records of the data used in the emergency exercises because all of this crucial information is destroyed by shredding after the exercise has been completed.²⁵

Fukushima: In the immediate and interim aftermaths of the Fukushima Daiichi incident, it is now established that the plant operator TEPCO held back, or was unable to disclose, full details of the radioactive release to atmosphere from the four reactor units crippled by the explosions – one of the reactors, Unit 3, was partially fuelled with mixed oxide (MOX) fuel utilising plutonium-239 not dissimilar to, but a less volatile form, of the Pu-239 oxide batches and elemental metal components in use at Aldermaston and Burghfield.

Recent sampling and analysis²⁶ has revealed plutonium ground contamination from the Unit 3 reactor MOX fuel, identified by its isotopic composition, in the 20 to 30km zone north-east of the Fukushima Daiichi nuclear plants.

This failure to fully inform the Fukushima Prefecture (ie the local authority equivalent to West Berkshire Council) of the scale and particular radioactive substances released resulted in confusion and disarray in the off-site emergency response with, so it is claimed by informed sources,²⁷ countermeasures being either incorrectly applied, not implemented at all, or implemented far too late.

Extendibility of the Off-Site Emergency Plan: Although not specifically required by REPPiR, it is generally accepted that the *Off-Site Emergency Plan* should be extendible to cater for extreme radiation emergencies not specifically identified by the Regulation 4 HIRE.

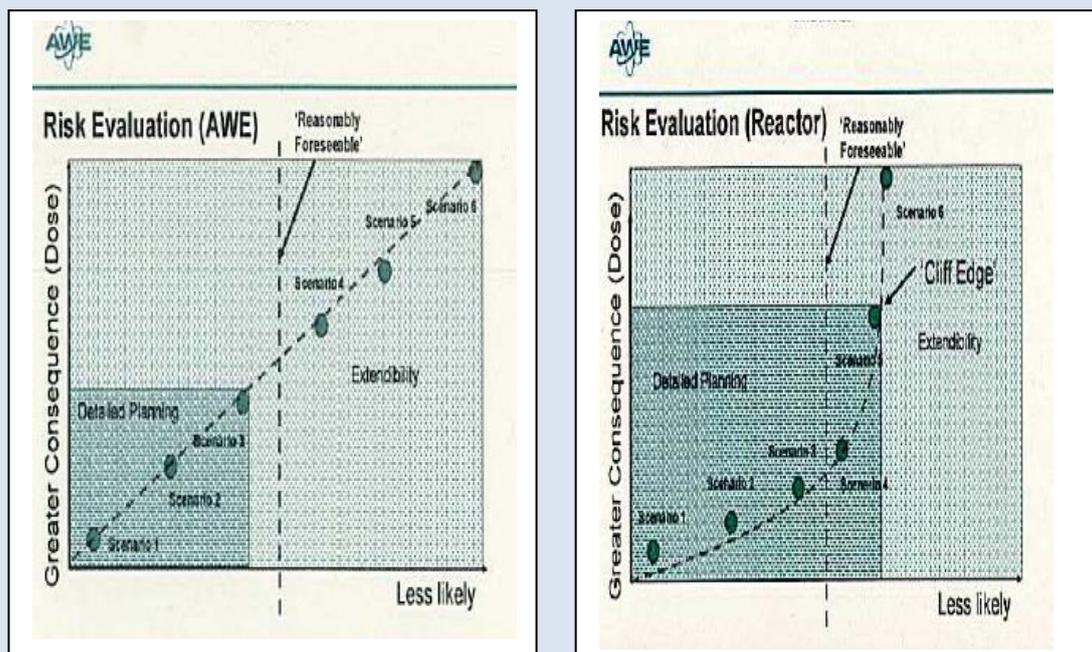
AWE DEPZ Extendibility: For both AWE sites although extendibility zones are declared, the *Extendibility* section of the Off-Site Plan response is in the broadest of terms and based of a nuclear reactor incident – this is because work is currently underway to determine appropriate response for the AWE sites and nuclear activities.

West Berkshire Council has responsibility to resource, organise and maintain the *Off-Site Emergency Plan* for the DEPZs of the Aldermaston and Burghfield sites – the responsibility for the '*extendibility*' of the *Off-Site Emergency Plan* remains ambiguous.²⁸

ONR Requirement for Extendibility: In response to a *Freedom of Information Act 2000* (FOIA) request²⁹ on whether the ONR required 'extendibility' of the DEPZs for AWE Aldermaston and Burghfield sites, the ONR was non-committal 'The regulations do not require the specification of an extendibility zone. Good practice for nuclear facilities is for the Local Authority's off-site plan to address the issue of extendibility in the light of the information provided by the operator'.³⁰

Unlike the AWE Aldermaston and Burghfield sites, all of the UK's nuclear power plant sites have an 'extendible' zone added to the DEPZ.

Extreme Accidents and Cliff Edge Effects: In its presentation to the 68th LLC meeting AWE showed slides showing the Risk v Consequences characteristics for AWE nuclear activities compared to those for a nuclear reactor (Slides 5 and 7):⁴¹

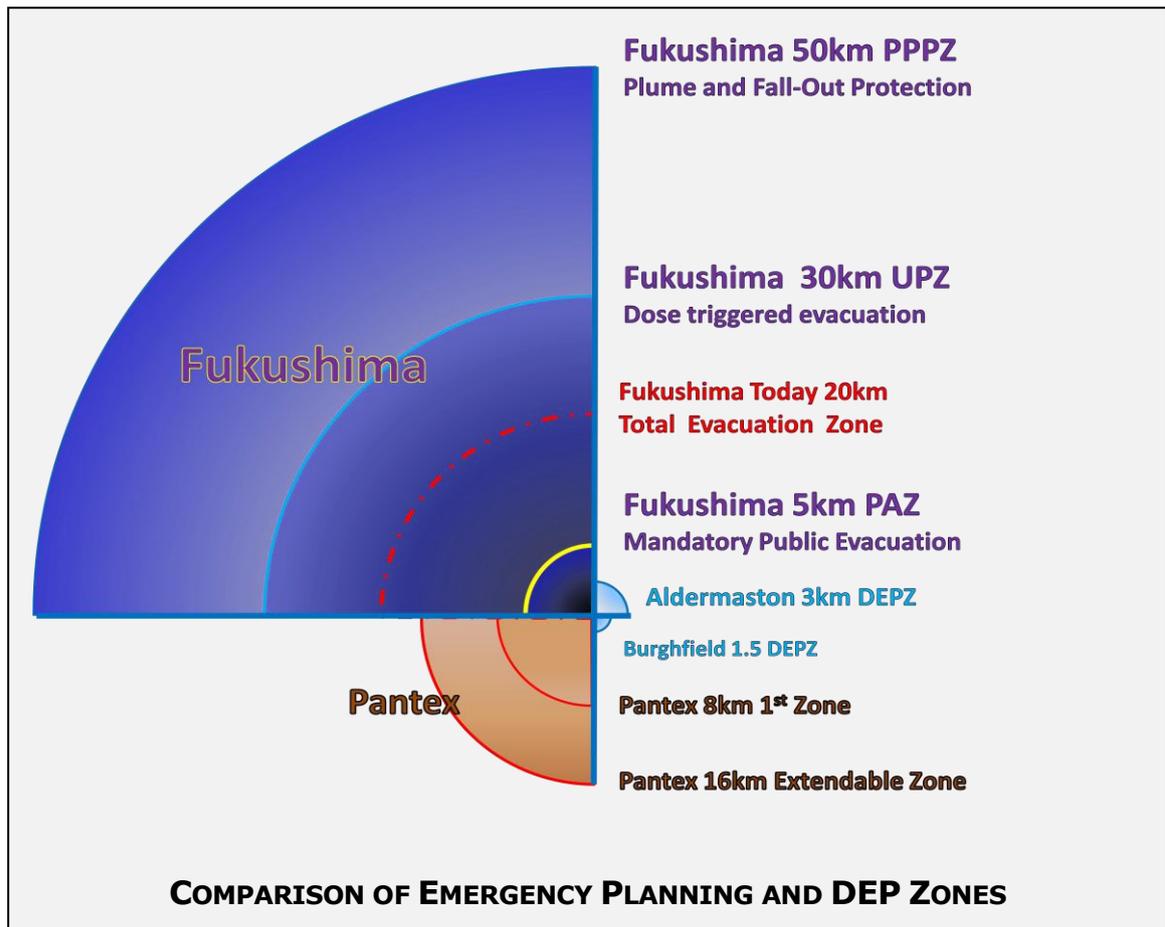


With these slides AWE seems to be claiming that for all foreseeable incidents at AWE sites (above left) there is no *Cliff Edge Effect* and that the radiological consequences for all *reasonably foreseeable* AWE incidents can be adequately managed within the DEPZ without *extendibility*. This contrasts to the reactor characteristic (above right) for which AWE claims *extendibility* is necessary in account of *Cliff Edge Effect*.

Fukushima: At the time of the 11 March accident the equivalent DEPZ, termed the 'radiological protection zone' (RPZ) extending out 8 to 10km, was in place around each Japanese nuclear power plant. At Fukushima, within a few hours of the first two reactor explosions a 3km zone of the RPZ was immediately and totally evacuated. As the radiological situation worsened the Japanese government ordered members of the public within 10km to evacuate, then out to 20km and, progressively sheltering and evacuation countermeasures were implemented out to 50, 60 and 80km from the Fukushima Daiichi site. Now, a year following, the 20km zone remains completely evacuated and agricultural, food and other controls remain in place out to the suburbs of Fukushima City (about 85km from the Fukushima Daiichi site).²⁷

At this time the Japanese government, via the Nuclear Safety Commission, is considering replacing the RPZ with three radial control zones:

- First, the 5km 'Precautionary Action Zone' (PAZ) within which all population would be unconditionally evacuated in the event of a radioactive release.
- Second, an 'Urgent Protection Zone' (UPZ) out to 30km in which a prescribed radiation level would automatically trigger mandatory evacuation – the UPZ would be resourced with radiation detectors and emergency clothing, prophylactic measures and equipment to protect the public would be available at all times.
- Third, the 'Plume Protection Planning Zone' (PPPZ) to 50km and to include such measures and equipment necessary to protect the public from an overhead plume and radioactive fall-out.



Reasonably Foreseeable Emergencies: Regulation 9(3) requires the *Off-Site Emergency Plan* to secure the health and safety of the public so far as is reasonably practicable by addressing each of the emergency situations and circumstances identified in the operator's HIRE.

AWE HIRE: On emergency situations and circumstances, the AWE HIRE assessment available to West Berkshire Council is written in non-specifics, that is only reviewing potential accidents in the most generalised terms. Indeed, the AWE is not prepared to reveal its own justification for how it determines the evacuation zones in the off-site areas, going so far as to redact even the authorship and reference citation of the report to which it refers.⁴⁰

In the absence of specific details, it may not be practicable for West Berkshire Council to prepare an appropriately detailed emergency plan.

Malevolent Acts: Regulation 4 requires the operator 'to demonstrate that all hazards . . . with the potential to cause a radiation accident have been identified' and that 'the nature and magnitude of the risks to employees and other persons (ie the public) arising from these hazards have been evaluated'.

ONR: Whereas the Regulation 4 requirement is to *identify all hazards and risks* in the HIRE, the ONR interprets REPPIR only to apply to *reasonably foreseeable* incidents, because, according to the ONR, terrorist and other malevolent acts are *not reasonably foreseeable*. Malevolent acts are thus excluded from the HIRE³¹ and, hence, no contingency for their occurrence is made in the *Off-Site Emergency Plan*.

Emergency Radiation Exposures: Regulation 14 requires that all employees who individually may be subject to emergency exposure as a direct result of their involvement and prescribed duties in the implementation and management of the emergency countermeasures, shall be identified in advance and provided with adequate information, training, and equipment, etc..

Regulation 14 is not concerned with doses received by employees engaged on the nuclear site who may have been subject to exposure as a direct result of the radiation incident that leads to the emergency, so only the doses received by employees involved in the response are subject to this regulation. Those personnel registered under Regulation 14(1)(a) are required by Regulation 14(1)(b) to receive training in the field of radiation protection, be knowledgeable of the personal risk involved and by Regulation 14(1)(c) to be equipped appropriately to restrict exposure of radiation dose to themselves.

Essentially, any individual employees who are **not** registered under Regulation 14(1)(a), should not be subject to radiation exposure deriving from the 'employed' activity within the area for which a *Radiation Emergency* has been declared (ie the DEPZ or any extension of it). Put another way, unregistered individuals such as local authority employees, police, ambulance and medical personnel, are not permitted to receive any additional dose burden as a result of their individual involvement in implementing the *Off-Site Emergency Plan*.

West Berkshire Council Employees – Radiation Exposure: Since West Berkshire Council employees and contractors are not registered under Regulation 14(1)(a) they could not be deployed into any area(s) in which they would be at risk to exposure from radiation during the response phase. Non-Regulation 14 registered individuals are not trained and equipped for, and could not be expected to engage or work in a radiological environment.²⁵

Emergency Services and Other Personnel Involved in the Off-Site Emergency Plan implementation: Most individuals employed Thames Valley Police, South Central Ambulance Services, and other 'emergency services' and local authority personnel, other than the Fire Brigades personnel, could not engage in the radiological environment because they are not registered under Regulation 14. There is little provision in the *Off-Site Emergency Plan* to cover for the expected duties of these unregistered personnel, so human resource difficulties are likely to arise during the early response phase of the emergency.

Fire and Rescue Services personnel have an agreed national and local radiation dose limitation system²⁹ that constrains the maximum annual whole body dose equivalent to 20mSv in any one year for male firefighters and, thereafter, if that exposure limit has been reached, no further exposure is permitted for two years. Female firefighters are not permitted to receive any radiation dose exposure.

West Berkshire Council Employees – Radiation Exposure: Indeed, because of the restraints of Regulation 14 it may be that as the radiological environment develops during an emergency in the off-site domain, key emergency services personnel would have to withdraw from further involvement in managing the emergency countermeasures necessary to protect members of the public.

AWE Regulation 14 registered personnel may be heavily involved in countering the source of the incident on-site, so much so that only limited numbers of AWE employees may be available to support the off-site response. In a serious incident, fire fighting and rescue teams may exhaust their dose limits and have to withdraw, and replacement fire fighters drawn from other Brigades may take considerable time to arrive at and prepare for a radiological 'shout'.

The resulting lack of personnel trained and equipped to engage in a radiological environment may render the *Off-Site Emergency Plan* under-resourced and ineffective.

In effect, only a limited number of AWE employees are registered under Regulation 14.¹¹

AWE Regulation 14 Personnel: The MoD states that *"The AWE Fire and Rescue Service has 105 R14 registered personnel who are capable of responding to both the Aldermaston and Burghfield sites. There are no other R14 registered personnel for the AWE Aldermaston and AWE Burghfield sites, and there are no other AWE sites or locations from which employees registered under R14 would respond to in the event of a radiation emergency."*

For the most recent exercise at Aldermaston (November 2010)¹¹ no assessment was made of the numbers of Regulation 14 AWE personnel available to respond in the off-site domain, there is no record of the activities that such personnel would or could have been required to undertake in implementing the off-site countermeasures, etc..¹² In the absence of any real-time or simulated activities of AWE Regulation 14 personnel in the off-site domain, the MoD has no information whatsoever recording the projected dose exposure of individual police officers involved in the off-site domain, acting in the absence of AWE Regulation 14 personnel.¹¹

Royal Berkshire Fire & Rescue Service (RBFRS): In August 2010 at Aldermaston, a real fire incident occurred in an explosives processing building, requiring the attendance of RBFRS personnel.

Even though both AWE and RBFRS had previously agreed a plan and regularly practise for such an incident, operational issues and delays were encountered because Brigades personnel responding to the shout were held back from the fireground whilst security checks were undertaken. Even after passing through security, firefighters then had to be escorted by AWE personnel through the Aldermaston site to the fireground.

Then, because RBFRS considered under its own protocols that there was a risk of exposure to radiation, all firefighters were required to be equipped with personal radiation monitors (thermoluminescent dosimeters - TLDs). However, not enough TLDs were available for all fire brigades personnel attending, so additional TLDs had to be brought from AWE Burghfield and distributed to fire crews, involving further delays before firefighters could tackle the incident.³⁵

The August 2010 incident demonstrates that the most carefully laid and rehearsed plans can go awry in real emergency situations.

Fukushima: For emergency services and local prefecture employees engaged in response and emergency countermeasures in off-site areas near the Fukushima Daiichi nuclear plants, it was necessary to revise the 'incident' dose limit to 250mSv. This hastily revised dose limit applied to many employees and contracted personnel (bus drivers, police officers, etc) who had received no prior training for working in a radioactive contaminated area.

ONR: In June 2011, the International Atomic Energy Agency (IAEA) *Fact Finding Mission Team* investigating the Fukushima nuclear catastrophe concluded that the remediation works in the off-site areas would "allow people evacuated to resume their normal lives".³⁶

Today, the many thousands of individual members of public (estimated to be upwards of 80,000) remain excluded from the 20km total exclusion zone around the Fukushima Daiichi NPP site – the UK's Chief Nuclear Safety Inspector, Mike Weightman, led the IAEA Fact Finding Mission and endorsed the Summary and Final IAEA Reports.^{37,38}

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1 [Nuclear Information Services](#)

2 The specific roles of each of the emergency services differ, because responsibilities of organisations when responding to nuclear emergency, both in relation to protecting the public and to protecting their own workforces, are governed by a number of Acts, principally the *Health and Safety at Work Act 1974* (HSWA), the *Nuclear Installations Act 1965* (NIA) and REPPIR. The REPPIR regulations adopt many of the emergency planning principles of the *Control of Major Accident Hazards Regulations 1999* (COMAH) and formalise these into regulations previous emergency planning arrangements with local authorities that have been in place around nuclear licensed premises for many years. Also, there is a general duty on all responders to do *all that is reasonably practicable* to reduce risk whilst the *Ionising Radiations Regulations 1999* (made under the HSWA) contain specific requirements for the protection of employees and the public from radiation.

The specific duties of the emergency services are summarised as follows:

Police: The police service does not have a specific statutory role in respect of either contingency planning for nuclear emergencies or for responding to those emergencies. The police role in England and Wales is based on custom, practice, the Common Law and positive obligations that may arise in respect of human rights. For Scotland, the Police (Scotland) Act 1967 states that the police have a duty to protect life and property and this would be their responsibility in the event of a civil nuclear emergency.

Fire and Rescue Services: Section 9 of *Fire and Rescue Services Act 2004* (FRSA) and the *Civil Contingencies Act 2004* (CCA) generally specify a duty of fire and rescue personnel to attend incidents for the rescue of people at risk, although no specific duties and responsibilities in the (non-fire, etc) off-site or DEPZ areas are specified for fire and rescue personnel by REPPIR.

Local Authorities: Under the CCA the local authority is only required to carry out those duties in relation to those functions performed as a local authority and, specifically, Regulation 12 of the *Civil Contingencies Act (Contingency Planning) Regulations 2005* are not required to perform duties in relation to an emergency, including a 'Radiation Emergency' as defined by Regulation 2 of REPPIR. In other words, REPPIR overrides the duties specified by the CCA so local authority employees must be trained for their response roles as laid down in the REPPIR *Off-Site Emergency Plan*, although Regulation 14 of REPPIR requires only those individuals who have agreed to register should be put at risk of receiving additional radiation dose exposure during a Radiation Emergency.

Ambulance Trusts: The Ambulance Service role in a nuclear incident forms part of the NHS's statutory responsibility for the care of sick or injured persons in the UK but, as for local authority employees, registration is required under REPPIR Regulation 14 insofar as any individual being placed at risk in a radiation environment.

3 AWE [Aldermaston Site Emergency Plan](#), Issue 3 January 2009

4 AWE [Burghfield Site Emergency Plan](#), Issue 3 May 2009

5 [Japanese earthquake and tsunami: Implications for the UK nuclear industry](#), Final Report. HM Chief Inspector of Nuclear Installations, September 2011

6 [Japanese earthquake and tsunami: Implications for the UK nuclear industry](#), Final Report. HM Chief Inspector of Nuclear Installations, September 2011 (para 793, p145) "*The radii established for emergency planning zones must, of course, depend on the radiological releases that are considered reasonably foreseeable and the practicability of implementation of the emergency plans. However, as it Item 10, Nuclear Emergency Planning, 25 January 2012, p4 is considered that licensees should review on-site measures to improve resilience to severe accidents in the light of the Fukushima accident, it follows that the practicability and effectiveness of the arrangements for extending countermeasures beyond a small DEPZ in the event of more serious accidents should also be reviewed. It is therefore considered that NEPLG should examine the need to enhance the UK's extendibility arrangements for extending countermeasures beyond the DEPZ in the event of more serious accidents.*"

7 [Government to Act on Nuclear Chief Inspector's Recommendations](#), DECC, Press Notice 2011/051, 21 June 2011

8 [67th Meeting of the AWE Local Liaison Committee](#), 8 December 2011

9 [Radiation \(Emergency Planning and Public Information\) Regulations 2001](#)

10 [European Directive 96/29/Euratom](#), 13 May 1996

11 MoD response to [M3194-A17](#), letter Ref N^o [12-03-2012-103003-00720 April 2012](#) (response under L1)

12 Further details of how many of the 105 R14 registered AWE Fire and Rescue Services (F&RS) personnel would actually be on site and available to be deployed in the off-site response has not been forthcoming from the MoD. However, it is not unreasonable to assume, that the AWE F&RS personnel would be divided into at least three watches. So about 30 or so R14 employees would be available split between the Aldermaston and Burghfield sites at any time and, depending on the scale of the on-site incident many, if not all of these would likely be engaged within the AWE site at the time of and/or immediately following the onset of the incident. AWE F&RS personnel called from the other AWE site (Aldermaston or Burghfield, whichever not the incident site) and those watches stood down, may experience difficulty in accessing and mustering at the incident site if any consequential radioactive release is effective in the off-site areas (high radiation dose, traffic jams, etc). None of these issues seems to have been addressed in the REPPIR Off-Site Plan nor, surprisingly so far as the records reveal, by the recent REPPIR exercises.

13 [Ionising Radiations Regulations 1999](#)

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- 14 Joint US/Japan Survey Data, US Department of Energy – NISA aerial surveys published regularly during the accident response period – [for example](#)
- 15 [Managing the UK Plutonium Stockpile](#), Parliamentary Office of Science and Technology, Postnote N° 237, February 2005
- 16 [Plutonium Strategy, Current Position Paper](#), Nuclear Decommissioning Authority, SMS/TS/B PLUT/001/A, February 2011
- 17 [Submission in Support of Radiation \(Emergency Preparedness and Public Information\) Regulations 2001 – Schedule 5 Risk for the AWE Aldermaston Site](#), AWE/DSDF/B/RP/AD/671, AWE, Iss 3, June 2008 - for comparison see [2005 Edition](#) of same – also see [ONR e-mail](#) approval of 6 August 2008.
- 18 [Submission in Support of Radiation \(Emergency Preparedness and Public Information\) Regulations 2001 – Schedule 5 Risk for the AWE Burghfield Site](#), AWE/DSDF/B/RP/AD/672, AWE, Iss 3, June 2008 - for comparison see [2005 Edition](#) of same.
- 19 Finely divided plutonium metal would be considered pyrophoric whereas massive plutonium (ie the finished fissile pit components) would be nonpyrophoric. The most numerous forms of pyrophoric are chips, lathe and milled turnings and swarf, and casting crucible skulls, plutonium hydride and sesquioxide (Pu₂O₃) are probably the most commonly occurring pyrophoric compounds in the production of fissile assemblies, pits and the like. The carbide, oxycarbide, nitride, and oxide phases with plutonium compositions between the sesquioxide and dioxide are all potentially pyrophoric, and known pyrophoric alloys include Pu-U and Pu-Ce. Much more published information and data is available for uranium metals which are pyrophoric in air at around 220oC, although the formation of surface hydrides reduces this self-ignition temperature to ambient.
- 20 [2008 Review of the AWE Accident Fault Sequences in Relation to the Review and Revisions of REPPIR Submissions for AWE\(A\) and AWE\(B\)](#), AWE/DSDG/B/RP/AD/2296, Iss 1, undated c2008 – see para 3.1.1.1 and note that the basis of the dose is not given, so it could be the dose received for an assumed and limited exposure time and **not** the REPPIR one year projected dose relating the declaration of a Radiation Emergency, or the committed dose over 50 years.
- 21 Large J H, *Incidents, Developing Situation and Possible Eventual Outcome at the Fukushima Dai-ichi Nuclear Power Plants*, R3196-A1, 8 April 2011
- 22 [Fukushima in Review: A Complex Disaster, A Disastrous Response](#), Yoichi Funabashi, Kay Kitazawa, 1 March 2012
- 23 Town And Country Planning Act 1990 – Section 77 [Application by Cala Homes \(South\) Ltd](#) Boundary Hall Site, Aldermaston Road, Tadley, Rg26 4qh Application Reference: Bdb/67609, 16 June 2011
- 24 [Pantex Area Emergency Preparedness 2012 Calendar](#), Pantex Plant Emergency Management Program, 2012 – see also [What to Do in Case of an Emergency at Pantex](#)
- 25 [Letter from Sue Broughton](#), West Berkshire Council, 3 February 2011 page 3 in response to Large & Associates request [M3194-A7](#) of 10 January 2011
- 26 Zheng J, et al, [Isotopic evidence of plutonium release into the environment from the Fukushima DNPP accident](#), Scientific Reports 2, Art 304, 8 March 2012.
- 27 [Report of Japanese Government to the IAEA Ministerial Conference on Nuclear Safety – The Accident at TEPCO's Fukushima Nuclear Power Stations](#), June 2011, Nuclear Emergency Response Headquarters, Government of Japan
- 28 [Atomic Weapons Establishments Off-Site Emergency Response Plan](#), V 1/2011, November 2011 – see para 4 *Extendibility*, page 114
- 29 Large & Associates FOIA Request [M3194-A15](#) 2 March 2012.
- 30 ONR response to [M3194-A15](#), email EIR 2012030027, 27 March 2012
- 31 *Berthing of Royal Navy Nuclear Powered Submarines at Southampton*, Large & Associates, 3185-A6 October 2010 – see footnote 7 - Navy Command [para 1, page 2] state “that malicious action as a result of saboteur or terrorist attack lie outside the scope of submarine operations and as such are not considered in the plant HIRE, however, access control, security and prevention of malicious intent are included in the specific assessment of each berth. It is MOD policy not to publish precise security arrangements”.
- 32 [What to Do in Case of an Emergency at Pantex](#), B&W Pantex
- 33 [Definitive Response to Request for Information No 2011-0014](#), Royal Berkshire Fire and Rescue Service in response to Large & Associates [M3194-A8](#) of 11 January 2011 – interestingly, the RBFRS refused to disclose details of the dose limitation system on ground that disclosure would not be in the public interest, although both national and local agreements are a matter of record.
- 34 [AWE Aldermaston B-Area Incident Response Review Report](#), Ministry of Defence DFRMO/3/3/3006, 17 September 2010
- 35 [Incident Debrief Corrective Action Report](#), Royal Berkshire Fire and Rescue Service FB 260, 999/260/000.006, 2 August 2010
- 36 [Preliminary Summary: IAEA International Fact Finding Expert Mission of the Fukushima Dai-ichi NPP Accident following the Great East Japan Earthquake and Tsunami](#), IAEA June 2011
- 37 [Summary Report of the Preliminary Findings of the IAEA Mission of Remediation of Large Contaminated Areas Off-Site the Fukushima Dai-ichi NPP](#), IAEA, October 2011

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- 38 [IAEA International Fact Finding Expert Mission of the Fukushima Dai-ichi NPP Accident following the Great East Japan Earthquake and Tsunami](#), IAEA June 2011
- 39 AWE – Defence Nuclear Safety Regulator (DBSR) correspondence on withholding information for the public, [3 letters July 2008](#).
- 40 [Route Map of Reference Information: REPPiR Schedule 5 Documents](#), AWE AWE/CAS/MHCAT [redacted] 008/2001, 9 June 2008 – see reference 6 ‘[redacted] The Justification of the Evacuation Zone for AWE, Aldermaston, MSTs/[redacted]/103/96, 1996’
- 41 [AWE Risk Assessment Process](#), Slide Presentation, Paul Cooper 68th Meeting LCC, March 2012
- 42 ONR [AWE Aldermaston and Burghfield Nuclear Licensed Sites, Residential Developments in the Nuclear Safeguarding Zones \(DEPZs\) – Justification for HSE/NIJ’s Position to ‘Advise Against’](#), HSE, c2011
- 43 Internal ONR telephone transcript discussing AWE 2008 REPPiR submissions of [11 March 2008](#), which finishes with “*I propose that we wait until the two HIREs and two RoAs arrive and then decide what to do with them. It should be noted that we did not look at to 2005 versions despite having them ranked as a high importance item.*”
- 44 [Nuclear Safety Directorate Assessment Report](#), BSD DIV 3 AR No 57 ARF 19795, 6 August 2002 – see also Project Assessment Report 082/02 [Assessment of the HIRE conducted by AWE PLC to meet the REPPiR](#), 4 October 2002