Contingency planning for emergencies arising from defence nuclear activities in Scotland.

Scotland Act

Emergency Planning and Civil Defence are not reserved in the Scotland Act 1998.[1]

Civil Contingencies Act and Regulations

Under the Civil Contingencies Act 2004 Scottish Ministers may make regulations about the extent of duties imposed on Local Authorities and Emergency Services and about the method in which these duties are performed.[2] These duties include assessing the risk of an emergency occurring and maintaining and publishing appropriate plans.[3] An Emergency is an event that causes serious damage to human welfare or the environment, or war and terrorism which threatens serious damage to the security of the United Kingdom.[4] The definition includes the contamination of land with radioactive material.

The Civil Contingencies Act 2004 (Contingency Planning) (Scotland) Regulations 2005 say that Scottish Ministers may issue guidance about the likelihood of a particular emergency and the extend to which it could damage human welfare and the environment.[5]

These regulations also clarify the duties of local authorities and emergency services. However these bodies need not perform these duties in relation to an emergency which is a radiation emergency within the meaning of the Radiation (Emergency Preparedness and Public Information) Regulations 2001 (REPPIR) which results from work with ionising radiation to which these regulations apply.[6] -To and

Application of REPPIR

REPPIR applies when there is a radioactive substance, above a specified quantity, on any premises.[7] A premise includes one or more installations. The definition of installation includes equipment, structures, quays and jetties, including floating jetties.[8] REPPIR applies to the rail transport of some radioactive substances, but not to transport by road, sea or air.[9]

REPPIR revoked the earlier Public Information for Radiation Emergency Regulations 1992 (PIRER), except the regulation in PIRER that deals with road, sea and air transport. This implies that this regulation in PIRER is still in force. However the MoD are exempt from the requirements of PIRER.

REPPIR applies where a radioactive substance is used in connection with the operation of a vessel when it is at a mooring or berth, except a mooring or berth at a licensed site or under the control of the Secretary of State for Defence.[10]

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[1] Civil Defence is specifically not reserved in the Scotland Act 1998 Schedule 5 para 9 (2) a
[2] Civil Contingencies Act 2004 Part 1 Para 2 (4)
[3] Civil Contingencies Act 2004 Part 1 Para 2 (1)
[4] Civil Contingencies Act 2004 Part 1 Para 1
[5] Civil Contingencies Act 2004 (Contingency Planning) (Scotland) Regulations 2005 Part 3 Para 11 (1)
[6] Civil Contingencies Act Regulations 2005 Part 2 Para 9 (c)
[7] Radiation (Emergency Preparedness and Public Information) Regulations 2001, Regulation 3 (1) a
[8] REPPIR Regulation 2
[9] REPPIR Regulation 3 (1) b & c
[10] REPPIR Regulation 2, definition of premises.

However a Health and Safety Executive (HSE) report says that REPPIR applies to Naval Bases and to Z berths and that HSE regulate the application of REPPIR to these sites.[11]

The Hazard Identification and Risk Evaluations for several Z berths say that REPPIR applies because nuclear submarines are "defined as premises under the regulations".[12]

The Regulation of the Nuclear Weapons Programme, JSP 538, says that REPPIR applies to all aspects of the nuclear weapons programme in the UK, except movements by road using Class B Packages.[13] An exception is that REPPIR does not apply to nuclear-armed submarines visiting UK overseas territory.

The current guidelines issued by the Ministry of Defence to local authorities and emergency services on Defence Nuclear Materials Transport Contingency Arrangements to not mention REPPIR.[14]

REPPIR permits the Secretary of State for Defence to exempt some activities from the regulations and this power has been used to exempt foreign warships visiting the UK.[15]

Although the road and sea transport of nuclear material are not covered by REPPIR, HSE's view is that nuclear-powered submarines are premises to which REPPIR applies.

The application of REPPIR to the transport of nuclear weapons by road and to nuclear weapons on submarines should be clarified. The extent to which the regulations apply to submarines in UK territorial waters should also be made clear.

Responsibilities under REPPIR

REPPIR requires that local authorities have in place arrangements to supply information to the public on any radiation emergency howsoever it may arise.[16]

With regard to all premise to which REPPIR applies, the operator must make a Hazard Identication and Risk Evaluation and submit it to HSE. This assessment must be revised when there are material changes. After 3 years the operator must either submit a new assessment or declare to HSE that there has been no change of circumstances.[17]

Local authorities are required to prepare an adequate off-site emergency plan where there are premise within their area to which REPPIR applies. The plan is

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[11] Regulation of weapons and naval programme activity, Nuclear Safety Directorate, HSE, 2/2/07
[12] Broadford Bay, Report of Assessment of the Hazard Identification and Risk Evaluation, MoD, 7 February 2005; Loch Ewe, Report of Assessment of the Hazard Identification and Risk Evaluation, MoD, 7 February 2005; Liverpool Z Berth, Report of Assessment of the Hazard Identification and Risk Evaluation, MoD, 7 February 2005.
[13] Regulation of the Nuclear Weapons Programme, JSP 538 Annex A page 5
[14] Local Authority and Emergency Services Information (LAESI) Edition 5,
[15] REPPIR Regulation 18 (2) and JSP 538 Annex A page 5
[16] REPPIR Regulation 17
[17] REPPIR Regulations 4 -6

required for reasonably foreseeable radiation emergencies which have been identified in the operator's risk assessment.[18]

A local authority may charge the operator for performing their functions in relation to the off-site emergency plan.

With regard to transportation, where REPPIR applies, the carrier is required to consult with local authorities when drawing up his emergency plan.

HSE's role in defence nuclear safety

The annex to the Concordat between the HSE and the Scottish Executive says with regard to Nuclear Safety:

> "This is a reserved matter. However, the Scottish Ministers have an interest because of the part they would play in the event of a nuclear incident – they have, for instance policy responsibility for the civil emergency services in Scotland – and because of the connection between nuclear safety and the protection of the environment, which is a devolved matter."[19]

The HSE's nuclear functions are largely carried out by the Nuclear Installations Inspectorate (NII).

The MoD must submit a HIRE to HSE where defence nuclear risks are covered by REPPIR. HSE may reasonably request a detailed assessment of any of the particulars in a HIRE.[20] However the HSE is constrained by their agreements with the MoD -

> "Under the terms of the MoD/HSE Agreement (naval programme) and the legal requirements of AWE Act 91 Amendment Order 1997 (weapons programme), the NII will not seek to influence reactor/weapon design."[21]

This means that information is supplied by the MoD to HSE on the basis that the nuclear weapon and the submarine reactor are each a black box. For example, HSE will not be supplied with the assessment which underlies the MoD's assertion that a Trident nuclear warhead is Single Point Safe, ie that it will not produce a nuclear yield if the explosive if detonated at only one point. Civil nuclear operators must supply HSE with detailed design information, which is assessed by HSE. However the MoD does not supply the equivalent information on naval nuclear reactors.

The key MoD nuclear sites in England are licensed by the NII. These include the Atomic Weapons Establishment at Aldermaston and Burghfield, the refit dockyard at Devonport and the naval fuel core fabrication facility in Derby. However none of the defence nuclear sites in Scotland are licensed. The apparent reason is that the sites in Scotland remain under the operation of the Ministry of Defence, rather than a contractor. However this is a legal rather than a practical difference. Maintenance work at Faslane is carried out by Babcocks and the Naval Reactor Test Establishment (NRTE) at Dounreay is, in practice, operated by Rolls Royce.

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[18] REPPIR Regulation 9
[19] Annex to the Concordat between the Health & Safety Executive and the Scottish Executive
[20] REPPIR Regulation 6 (5)
[21] Regulation of weapons and naval programme activity, Nuclear Safety Directorate, HSE, 2/2/07, para 2.5

The Revalidation and Assisted Maintenance Period (RAMP) carried out on HMS Torbay in 2007 is an illustration of this anomaly. This nuclear submarine is based at Devonport and the major upgrade would normally have been carried out in Devonport dockyard, a facility licensed by the NII. However the work was contracted out to Babcocks to be undertaken in the shiplift at Faslane, which is not licensed by the NII.

At unlicensed sites, such as the Clyde Naval Base and NRTE, formal regulation is by the Defence Nuclear Safety Regulator (DNSR). NII has a limited regulatory role under REPPIR and other regulations.[22]

With regard to supplying information to the public under REPPIR, the HSE state

> "MoD will facilitate NSD [Nuclear Safety Division of HSE] forming an opinion on the area within which members of the public need to be supplied with information on radiation emergencies under REPPIR." [23]

Application of ALARP

Nuclear operators are required, by REPPIR and licensing regulations, to keep risks As Low As Reasonably Practicable (ALARP). However the HSE recognise that there are anomalies in the application of ALARP to MoD activities –

> ".. what is acceptable in ALARP terms for civil practice may not be achievable for some MoD activities. This is because of the particular constraints imposed on the design of the hazard that arises from its incorporation into weapons of war and the fact that the NII is precluded from seeking to influence this design. In some cases, military requirements prevent the levels of designed safety that would be expected in a civil design, and the overall level of risk that might be acceptable at the ALARP point is higher than that for civil practice (lower levels may also be achievable)."[24]

In applying the ALARP principle to MoD activities, the HSE do not consider:

> "Present siting of MoD licensed sites.
> The need to sustain a nuclear weapons capability.
> The use of nuclear plant to power submarines.
> Proximity of explosives to some nuclear activities."[25]

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[22] Other regulations include HASAWA, IRRs and MHSWR. ibid para 5.8
[23] ibid Annex C, Constrains imposed by the HSE/MoD agreement para 5
[24] ibid Annex D ALARP Factors para 1
[25] ibid Annex D ALARP Factors para 5

Application of Safety Assessment Principles (SAPs) for Nuclear Facilities to submarines

The SAP principles are to assist NII inspectors in assessing the safety of nuclear facilities, including ALARP judgements. While they are used for defence nuclear sites which are licensed by the NII, the HSE recognise that SAPs may not apply to the design of nuclear weapons or reactors and that

> "the extent of application of these principles to safety cases associated with defence-related activities will be judged on a basis consistent with the ALARP principle, taking due cognisance of the unique operating purpose and that NII regulation only applies to discrete periods of their operating life-cycles".[26]

The military requirements for submarines conflict with some of the engineering principles in SAPs. Some of these are listed below.

The quotes in italics indicate the difficulties applying each principle to nuclear submarines and are from an HSE table that has the title "NRP [Naval Reactor Programme] ALARP constraints".[27]

Design for Reliability: Redundancy, diversity & Segregation EDR.2

"Redundancy, diversity and segregation should be incorporated as appropriate within the designs of structures, systems and components important to safety"

Naval Reactors – *"Limited redundancy, diversity and segregation of safety system"* and *"Limited space on a submarine for passive (and active) engineered safeguards."* This is due to *"space limitations arising from small diameter of pressure hull"* and the *"high degree of cross-connection of systems"*

External & internal hazards: Fire, explosion, missiles, toxic gases etc

- use & storage of hazardous material EHA.13

"The on-site use, storage or generation of hazardous materials should be minimised and controlled and located so that any accident to, or release of, the materials will not jeopardise the establishing of safe conditions on the facility"

– sources of harm EHA.14

"Sources that could give rise to fire, explosion, missiles, toxic gas release, collapsing or falling loads, pipes failure effects, or internal and external flooding should be identified, specified quantitatively and their potential as a source of harm to the nuclear facility assessed ... This identification should take into account: ... the adequacy of protection of the nuclear facility from the effects of any incident in an installation ..."

– effect of water EHA.15

"The design of the facility should include adequate provision for the collection and discharge of water reaching the site from any design basis external event or internal flooding hazards or, if this is not achievable, the structures,

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[26] Safety Assessment Principles for Nuclear Facilities, 2006, HSE; introduction para 24.

[27] The Regulation of weapons and naval programme activity, Annex D Table 1 ALARP Constraints indicates how the naval programme relates to these principles.

systems and components important to safety should be adequately protected against the effects of water."

- fire detection and fighting EHA.16

"Fire detection and fire-fighting systems of a capacity and capability commensurate with the credible worst-case scenarios should be provided."

- use of material EHA.17

"Non-combustible or fire-retardant and heat-resistant materials should be used throughout the facility"

Nord Rents - *"Limited ability to provide protection against fire and explosion hazards"* in a situation of *"proximity of explosives and other high-hazard materials"*. There is also *"extensive use of high pressure air and hydraulic systems"*.

Human factors: Task analysis EHF.

"Analysis should be carried out of tasks important to safety to determine demands on personnel in terms of perception, decision making and action."

"High 'shift' workload" because of the *"limited space for crew members"*

Key Principles: Defence in depth EKP.3

"A nuclear facility should be designed and operated that defence in depth against potentially significant faults or failures is achieved by the provision of several levels of protection".

"Limited space on a submarine for passive (and active) engineered safeguards."

Layout: Minimisation of the effects of incidents ELO.4

"The design and layout of the site and its facilities, the plant within a facility and support facilities and services should be such that the effects of incidents are minimised"

"Limited scope for minimising potential for interactions between safety-related plant and systems and failed structures against internal and external hazards."

Maintenance, inspection & testing: Reliability claims EMT.6

"Provision should be made for testing, maintaining, monitoring and inspecting structures, systems and components to safety in service or at intervals throughout plant life commensurate with the reliability of each item"

"Compact reactor plant layout with limited opportunity for significant in-service maintenance and inspection".

Reactor Core: Monitoring of safety-related parameters ERC.4

"The core should be designed so that safety-related parameters and conditions can be monitored in all operational and design basis fault conditions and appropriate recovery actions taken in the event of adverse conditions being detected."

"Limited ability to monitor core conditions during operation". The submarine has a *"highly reactive core"* and *"small reactor".*

Safety systems: Time for human intervention ESS.9

"The practice on UK civil nuclear power reactor facilities is that no human intervention should be necessary for approximately 30 minutes following the start of a requirement for protective action."

There is *"high reliance on operator intervention"* and the *"30 minute risk may not be applicable".*

Human Factors: Workspaces EHF.6

"Workspaces in which plant operations and maintenance are conducted should be designed to support reliable task performance, by taking account of human perceptual and physical characteristics and the impact of environmental factors"

"Limited space for optimising man-machine interfaces" and *"extensive remotely operated systems"*

Human factors: User Interfaces EHF.7

"User interfaces, comprising controls, indications, recording instrumentation and alarms should be provided at appropriate locations and should be suitable and sufficient to support effective monitoring and control of the plant during all plant states."

"Limited space for optimising man-machine interfaces" and *"extensive remotely operated systems"*

Human factors: Personnel competence EHF.8

"A systematic approach to the identification and delivery of personnel competency should be applied"

"High training demands on qualified staff"

Transparency

The Hazard Identification and Risk Evaluation reports produced by the MoD for Z berths at Broadford, Loch Ewe and Liverpool and for the Naval Reactor at Dounreay have been published. However these are only in outline and do not contain the details of the assessment. The reports include the following sentence:

> "Some sections of this report of assessment necessarily contain information in an abbreviated form and with limited technical detail. This has been done in the interest of national defence and public security ..."[28]

In a test of the safety plan for Liverpool Z berth the provisions for distributing Potassium Iodate Tablets were unworkable. Sefton Council felt that they did not have sufficient information to prepare an off-site plan and questioned the balance of risk and benefit of visits from nuclear submarines. Correspondence between Merseyside Fire Brigade and HSE shows that the complete risk assessment available to the HSE was classified and would not be passed to Sefton Council or any independent assessor.[29]

Terrorist risk

An interview on Al-Jazeera on 10 September 2002 suggests that Al Qaeda initially planned to include a nuclear plant in its 2001 targets.[30] There is a significant risk of a major terrorist attack in the UK and nuclear sites, including defence nuclear sites, are obvious potential targets.

SAPs say that terrorist risk should be assessed:

> "Terrorist or other malicious acts are assessed as external hazards"[31]

In a meeting with the NII in 2002, over Liverpool Z berth, Sefton council were advised:

> "terrorist threats were not considered to be reasonably foreseeable in the context of REPPIR planning"[32]

"Hostile acts" are excluded from the guidelines for risk assessment for the nuclear weapons programme in JSP 538, although the regulations do say that those with responsibility should take the possibility of hostile acts into account.[33]

Aircrash accident scenario

A review of the risk of an accident affecting the Faslane shiplift when working on a Trident submarine shows that the probability of the platform and block of the

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[28] Correspondence with HSE over the Z berth at Liverpool published on the HSE website under the Freedom of Information Act.
[29] ibid
[30] Nuclear Power Plants: Vulnerability to Terrorist Attack, Congressional Research Service, 4 February 2005.
[31] SAPs para 208
[32] Minute of Discussion between NII and Sefton Council on REPPIR and Liverpool Z Berth, 8 November 2002
[33] JSP 538 page 4-16 and Annex F page 4.

shiplift failing in the event of a crash involving a large aircraft should be taken as 1.[34]

Accident scenarios

The off-site emergency plans prepared for Z berths and the Clyde Naval Base have been drawn up on the basis that the worst reasonably foreseeable accident is a Loss of Coolant Accident on a submarine. A Reactor Containment Failure accident would have substantially greater consequences but is regarded by the MoD as not reasonably foreseeable.

The guidance provided to local authorities for a nuclear-weapons convoy accident are based on a accident in which there is a fire or explosion which results in the dispersal of plutonium, but not a nuclear yield. The MoD assert that an accident which results in a nuclear yield is not reasonably foreseeable.

The MoD's Regulations for the Nuclear Weapons Programme outline a range of accidents that are significantly more serious than those addressed in the safety schemes, such as the dispersal of plutonium from a large number of warheads. The regulations point out that, because warheads may be stored close to each other and the submarine reactor, a warhead accident can result in other knock-on nuclear accidents. This includes the possibility that a very small nuclear yield from one warhead could result in a significant yield from another warhead in the vicinity.

[34] Review of Radiological Accident Probability Assessments and Radiological Probabilistic Assessment for Vanguard Class SSBN whilst on the Shiplift at HMNB Clyde, Atkins for MoD, March 2003

[illegible]

~~Nuclear Warhead Accident Effects~~

Cat	Examples	Dose at 1 Km	BSL	BSO
a.	1. 1 or more warheads consumed in fire but radioactive material effectively contained within a facility. 2. Limited tritium leak.	0.1 - 1 mSv	10^{-1}	10^{-4}
b.	1. Up to 4 warheads consumed in fire. 2. Large partial HE event. 3. Total tritium reservoir failure.	1 - 10 mSv	10^{-2}	10^{-5}
c.	1. 1 or more warhead detonations with radioactive material contained within a facility. 2. More than 4 warheads consumed in fire. 3. 1 or more warheads consumed in fire, subsequent low energy criticality of debris when flooded.	10 - 10^2 mSv	10^{-3}	10^{-6}
d.	1. Uncontained detonation of 1 –3 warheads. 2. 1 or more warheads consumed in fire and subsequent high energy criticality of debris when flooded causing additional release of radioactive material.	10^2 - 10^3 mSv	10^{-4}	10^{-7}
e.	1. Uncontained detonation of 4 – 30 warheads	1 – 10 Sv	10^{-6}	10^{-8}
f.	1. Detonation of 1 or more missiles in a submarine with subsequent release of radioactive material from warheads.	10 - 10^2 mSv	10^{-6}	10^{-9}

Notes:
The first column indicates categories of accident.
The Basic Safety Limits (BSL) and Basic Safety Objectives (BSO) are targets of events per year, set by the MoD. Independent verification of whether these targets are met is not possible. The HSE are not provided with sufficient information, particularly on warhead or reactor design, to make a full independent assessment.

The safety case for the transport of nuclear weapons says that an inadvertent nuclear yield, of more than 2 kg TNT, equivalent would result in a dose of 1 – 10 Sv, and BSL/BSO figures which suggest that this should be in Category e.

SSP538 – [illegible] BSC [illegible] 10^{-8}

The Nuclear Safety Division of HSE should be asked to clarify which Defence nuclear activities are subject to regulation by REPPIR in Scotland and for the basis for their assessment.

To what extent can Scottish Ministers assess risks and provide guidance to local authorities with regard to defence nuclear risks ?

Is the Scottish Government bound by the Memorandum between the HSE and MoD ?