Office for Nuclear Regulation

A guide to Nuclear Regulation in the UK

2016 update

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Introduction

The The Office for Nuclear Regulation (ONR) independently regulates safety and security at 37 licensed nuclear sites in the UK. These include the existing fleet of operating reactors, fuel cycle facilities, waste management and decommissioning sites and the defence nuclear sector. In addition, we regulate the design and construction of new nuclear facilities and the transport of nuclear and radioactive materials and work with the international inspectorates to ensure that safeguards obligations for the UK are met. We co-operate with international regulators on safety and security issues of common concern, including associated research.

The responsibility for delivering a safe and secure nuclear industry rests with the nuclear industry itself. Our role, captured in our mission statement, is to provide efficient and effective regulation of the nuclear industry, holding it to account on behalf of the public. We use a wide range of regulatory tools to influence positively those we regulate, and to encourage the achievement of sustained excellence and continuous improvement in safety and security performance across the nuclear sector.

As ONR acts on behalf of the public, it is vital that we regulate with rigour, diligence and with an appropriate level of assurance that our work is targeted and proportionate to the hazards and risks presented by the industry at the right quality and cost.

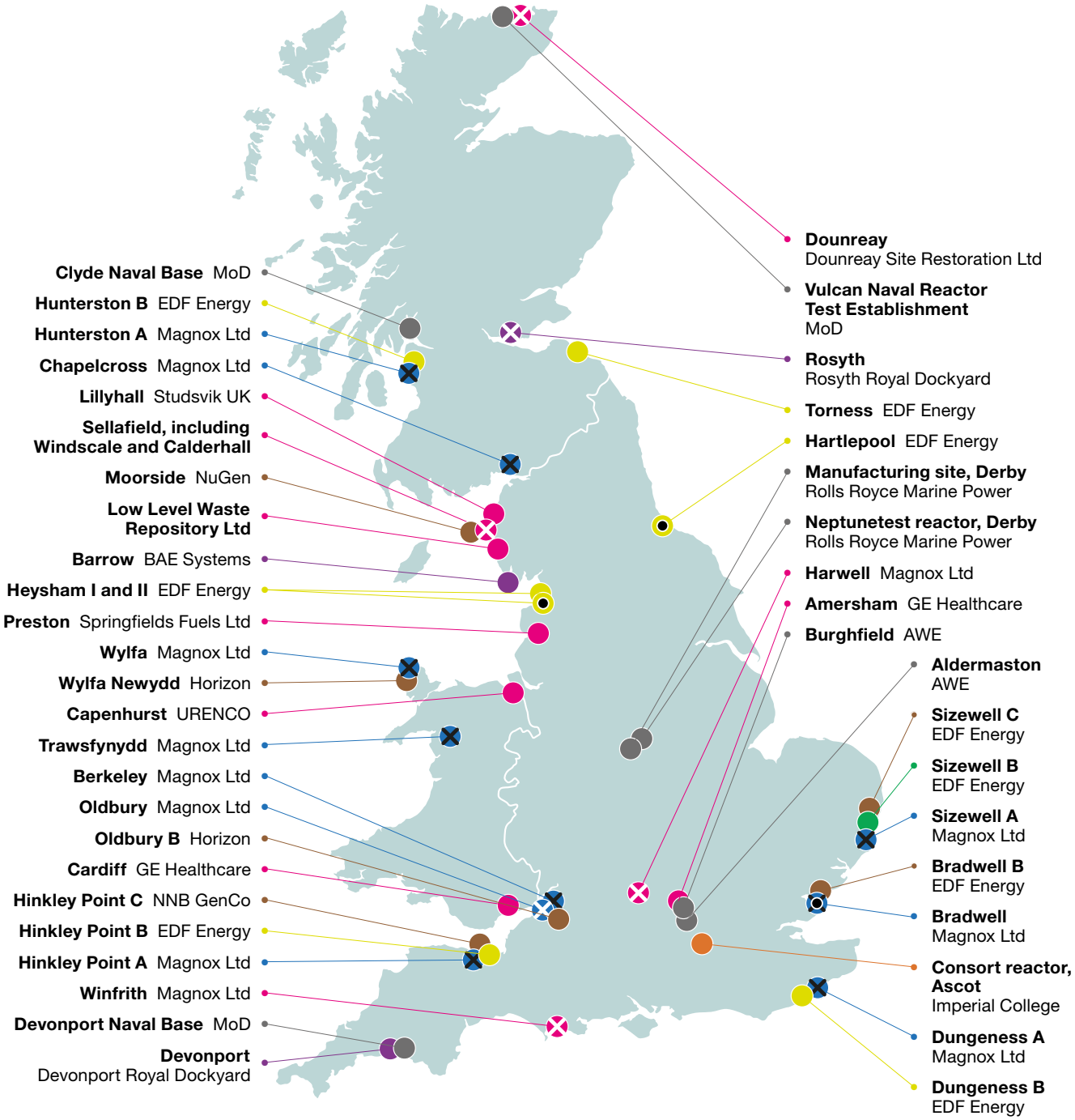
In performing our interventions we are required to comply with the Regulators' Code, which requires regulatory frameworks to support business through innovation with the aim of breaking down barriers and boosting UK productivity. In addition, the Government requires that UK regulatory frameworks support innovation, emerging technologies and the digital economy.

We adopt a modern enabling regulatory approach to all aspects of our regulation, with the aim being to achieve longer-term strategic safety and security delivery. Our approach involves working with licensees and duty holders, and other relevant stakeholders, to seek effective delivery against clear and prioritised safety and security outcomes. We are clear with licensees and duty-holders that our independence in regulatory decision making is not compromised and we continue to hold them to account in accordance with our mission.

This guide describes our regulatory activity and explains how we carry out our work in a clear and straightforward manner. It puts the regulation of the nuclear industry into context showing that despite its hazards, all the activities we regulate are performed in a safe and secure manner.

Richard Savage
Chief Nuclear Inspector

Regulated nuclear sites in the UK



The UK nuclear industry

Nuclear power has been produced commercially since the 1950s and grew out of the policy need for a UK nuclear deterrent. At Windscale in Cumbria, two reactors were built to produce plutonium for defence purposes. These were then followed at the adjacent Calder Hall site by four energy producing reactors designed to supply electricity. This saw the UK host the world's first commercial nuclear power station in 1956.

Today, the UK's nuclear activity consists of:

- generating electricity through power-producing nuclear reactors;
- non-power-producing nuclear facilities, e.g. producing and reprocessing nuclear fuel;
- decommissioning of nuclear power reactors and other facilities;
- new nuclear build; and
- defence facilities (licensed and non-licensed sites).

Table 1: UK operating (power producing) reactors

Power Station	*Owner*	*Operator*	*Reactor Type*	*Electrical Output per Unit (MW)*	*First Power Generation*
Dungeness B (two reactors)	EDF Energy	EDF Energy Nuclear Generation Ltd (NGL)	AGR	520	1983
Hartlepool (two reactors)	EDF Energy	EDF Energy Nuclear Generation Ltd (NGL)	AGR	595	1983
Heysham 1 (two reactors)	EDF Energy	EDF Energy Nuclear Generation Ltd (NGL)	AGR	585	1983
Heysham 2 (two reactors)	EDF Energy	EDF Energy Nuclear Generation Ltd (NGL)	AGR	615	1988
Hunterston B (two reactors)	EDF Energy	EDF Energy Nuclear Generation Ltd (NGL)	AGR	430	1976
Hinkley B (two reactors)	EDF Energy	EDF Energy Nuclear Generation Ltd (NGL)	AGR	430	1976
Torness (two reactors)	EDF Energy	EDF Energy Nuclear Generation Ltd (NGL)	AGR	600	1988
Sizewell B (single reactor)	EDF Energy	EDF Energy Nuclear Generation Ltd (NGL)	PWR	1188	1995

This table does not include the reactor sites that are no longer operating

Power-producing nuclear reactors

There are eight operating power stations, producing electricity for the national grid with three different types of reactors (refer to Table 1).

Magnox, First Generation Reactor

The ten 'first generation' Magnox stations which started operation between 1956 and 1971 were carbon dioxide gas-cooled graphite-moderated reactors using natural uranium fuel in a magnesium alloy cladding. The last reactor at Wylfa stopped generating in December 2015. All Magnox stations are owned by the Nuclear Decommissioning Authority (NDA) and operated under contract by Magnox Ltd. They are in various stages of preperation for long term care and maintenance.

Advanced Gas-cooled Reactors (AGR)

Seven stations owned and operated by EDF Energy (eight if we include Heysham 1 and 2 as separate operating reactors). These have two reactors each and were commissioned between 1976 and 1988. They are 'second generation' nuclear reactors, which use enriched uranium oxide fuel in stainless-steel cladding, allowing for higher temperatures in the carbon dioxide coolant gas and more efficient electricity production.

Wylfa power station (courtesy of Magnox Ltd)

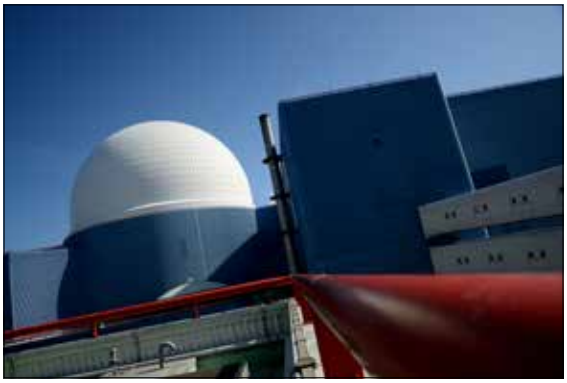
Dungeness B power station (courtesy of EDF NGL

The UK's nuclear power stations produce about 18% of the country's electricity.

Pressurised Water Reactor (PWR)

One station owned and operated by EDF Energy. Located on the Suffolk coast, Sizewell B is the UK's newest nuclear power station. It began operations in 1995 and uses enriched uranium oxide fuel, clad in zirconium alloy. PWRs are the world's most common type of nuclear reactor.

Between them, the UK's nuclear power stations produce about 18% of the country's electricity.



Sizewell B power station (courtesy of EDF NGL)

There are ten Magnox reactor stations now being decommissioned. These are:

- Berkeley
- Bradwell
- Hinkley Point A
- Hunterston A
- Sizewell A
- Chapelcross
- Dungeness A
- Trawsfynydd
- Oldbury
- Wylfa

Table 2: Non-power-producing nuclear facilities

Site	*Owner*	*Operator*	*Current activities*	*Status*
Dounreay, Caithness Scotland	NDA	Dounreay Site Restoration Limited	Originally used for research, development and prototype operation of fast reactors, it is now being decommissioned. The site still stores used and unused nuclear fuel, together with liquid reprocessing liquors and other waste.	Decommissioning of the reactors and other plants is well advanced
Winfrith, Dorset	NDA	Magnox Ltd	Former nuclear power research and development site, housing laboratories and research/prototype reactors.	Decommissioning
Harwell, Oxon	United Kingdom Atomic Energy Authority	Magnox Ltd	Former nuclear power research and development site, housing laboratories and research reactors. The site still stores intermediate level radioactive waste arising from its historic operations.	Decommissioning
Springfields, Preston	NDA	Westinghouse Electric UK Limited	Manufacture of fuels for AGRs and light water reactors, manufacture of uranium hexafluoride, processing of residues.	Operational and decommissioning/ demolition of redundant plants and buildings
Capenhurst Works, Chester	Urenco Ltd	Urenco UK	Plants producing enriched uranium for international markets. The site stores depleted uranium hexafluoride. Part of site operated by a tenant on behalf of the NDA to provide the UK site for uranic materials storage.	Operational and storage
Low Level Waste Repository, Cumbria	NDA	LLW Repository Ltd	UK's national low level waste disposal site.	Operational
Metals Recycling Facility, Cumbria	Studsvik UK	Studsvik UK	Decontaminates and recycles metal waste as part of the UK's low level waste strategy.	Operational
Imperial College Consort Reactor, Berkshire	Imperial College	Imperial College	At the early stages of a decommissioning programme.	Decommissioning
GE Healthcare Limited, Amersham and Cardiff sites	GE Healthcare	GE Healthcare	Manufacture of radiopharmaceutical products and waste storage.	Operational
Sellafield, Cumbria	NDA	Sellafield Ltd	The largest nuclear site in Europe with possibly the world's largest radioactive materials inventory in one place. Operations centre around the nuclear fuel cycle, with two spent fuel reprocessing plants and a number of waste and effluent treatment plants and associated storage facilities. Many are at different stages of decommissioning. A key activity is moving radioactive materials from ageing legacy facilities to more robust modern facilities. The site also houses the decommissioning Calder Hall Magnox reactors.	Operational - reprocessing plants and decommissioning

Non-power-producing nuclear facilities

There are a number of other nuclear facilities, which do not generate power but are dedicated instead to activities such as producing nuclear fuel, processing used nuclear fuel, and storing or treating radioactive material. Some of the sites are being decommissioned because they are no longer needed. Many of these sites are owned by the NDA and operated on the NDA's behalf by contractors. ONR works with the NDA to optimise the safe decommissioning of its sites (see Table 2).

Sellafield (courtesy of Sellafield Ltd)

Sellafield

Sellafield is a large and complex nuclear fuel reprocessing site situated in Cumbria. The site is owned by NDA and has a workforce of around 10,000. Construction of the site commenced around 1950 and it is the location where the spent nuclear fuel from the UK's civil nuclear reactors is stored and reprocessed. Reprocessing involves dissolving the nuclear fuel in concentrated acid. The resultant highly active liquors are then turned into glass (vitrified) for long term storage whilst the uranium and plutonium extracted from the fuel are stored for future use. It is planned that reprocessing of Magnox fuel (from UK's oldest reactors) will be completed in 2020 while Advanced Gas cooled Reactor (AGR) fuel reprocessing will cease in 2018. Significant quantities of radioactive wastes from past reprocessing activities are stored on the site in facilities that do not meet modern standards. These facilities pose unacceptable risks to the public and workers and dealing with them is a national priority. Reducing these risks is consequently ONR's main focus and strenuous efforts are being put into the recovery and treatment of these wastes; a process anticipated to take between two and three decades to complete.

Defence facilities

Nuclear licensed sites

There are seven licensed nuclear sites which are operated in support of the MoD's Defence Nuclear Programme. These sites provide and maintain the warheads for the UK's nuclear deterrent, and support for the UK fleet of nuclear powered submarines, including:

- submarine reactor fuel manufacture, including a test reactor;
- submarine construction and commissioning;
- submarine maintenance, refuelling and decommissioning.

HMS Astute (courtesy of BAE Systems)

Nuclear non-licensed sites

Several naval sites undertake nuclear-related activities but are exempt from aspects of ONR regulation as they are under the control of the Crown (MoD). On these sites, nuclear and radiation safety is regulated jointly by the Defence Nuclear Safety Regulator (DSNR) and ONR. ONR is also the enforcing authority for conventional safety regulation within these sites.

ONR regulates these sites through the Health and Safety at Work etc Act 1974 (HSWA), the Ionising Radiations Regulations (IRR99) and the Radiation (Emergency Preparedness and Public Information) Regulations 2001 (REPPIR). These sites are HM naval bases at Devonport and Clyde (comprising the Faslane and Coulport sites), the Vulcan Naval Reactor Test Establishment at Dounreay and, 5 Basin at Devonport.In addition, there are a number of submarine operational berths around the UK, including Southampton, Portsmouth, Portland and Clyde where ONR enforces IRRs and REPPIR only.

Table 3: Nuclear defence licensed sites

Site	*Owner*	*Operator*	*Current activities*
Atomic Weapons Establishment, Aldermaston, Berkshire	MoD	AWE plc	Manufactures and maintains the warheads for the UK's submarine launched nuclear deterrent.
Atomic Weapons Establishment, Burghfield, Berkshire	MoD	AWE plc	Manufactures, maintains and decommissions the warheads for the UK's submarine launched nuclear deterrent.
Rolls Royce Marine Power Operations Limited, Derby, Derbyshire (two sites)	Rolls-Royce plc	Rolls Royce Marine Power Operations Limited	Carries out the manufacture of nuclear fuel for submarine reactors. They also operate a low energy naval research reactor. These are separate licensed sites with a single operator.
Devonshire Dock Complex, Barrow in Furness, Cumbria	BAE Systems Maritime - Submarines	BAE Systems Marine Limited	Carries out submarine construction and commissioning activities. Currently the Astute Class hunter killer submarines are being built there for the Royal Navy.
Devonport Royal Dockyard Limited, Plymouth, Devon	Babcock International Group	Devonport Royal Dockyard Limited	Carries out the maintenance and refuelling of the Royal Navy's submarines. Plant and site modifications are currently being progressed that will enable future defuelling activities to be carried out on redundant hunter killer submarines.
Rosyth Royal Dockyard Limited, Fife	Babcock International Group	Rosyth Royal Dockyard Limited	Most of the nuclear related facilities have been decommissioned, leaving only a small inventory of radioactive waste. Defuelled submarines are stored at Rosyth off the licensed site, but are occasionally brought onto the licensed site for work to be carried out.

Safety of the nuclear industry

Hazards of radiation and the risks from exposure

Communicating the difference between what constitutes a hazard, as opposed to something which represents a risk, is a challenge that ONR faces when providing reassurance to a wide variety of groups, including communities living in the vicinity of nuclear sites, the wider public and government.

The terms 'hazard' and 'risk' are often used interchangeably in everyday vocabulary. Common definitions when discussing workplace health and safety are that:

- a **hazard** is any thing that has the potential to cause harm; and
- **risk** is the likelihood of the hazard arising, combined with the effect of the hazard.

The primary hazards associated with the nuclear industry arise from radiation given off by radioactive materials. The risk represents the likelihood that people are exposed to that radiation. Table 4 below gives an indication of some of the risks we face in everyday life. These can be contrasted with the risk of dying as a result of a nuclear accident, which in the UK is about 1 in 100 million per year.

The harm to people's health from radiation depends on the amount of radiation being given off by the substance per second and how energetic that radiation is. An important property of a radioactive substance is that the rate of radiation emitted will diminish naturally over time. This is measured by its half-life – the time it takes for a radioactive substance to reduce its radioactivity by half. This can range from seconds to millions of years depending on the particular substance.

There are various ways in which radioactive substances can affect the body, for example by direct exposure to the radiation or, by internal exposure due to ingestion or inhalation of the substance, or by entering the bloodstream via wounds.

Table 4: Annual risk of death for various causes averaged over the entire population (taken from Annex 4 of HSE's *Reducing risks, protecting people*)

Cause of death	*Annual risk*
Cancer	1 in 387
Injury and poisoning	1 in 3 137
All types of accidents and all other external causes	1 in 4 064
All forms of road accident	1 in 16 800
Lung cancer caused by radon in dwellings	1 in 29 000
Gas incident (fire, explosion or carbon monoxide poisoning)	1 in 1 510 000
Lightning	1 in 18 700 000

Some ingested or inhaled substances will be excreted and exposure is less as a result. The degree of harm depends on the combination of these factors and, although highly complex, the International Commission on Radiation Protection provides recognised models for measuring exposure and assessing harm.

Potential harm to an individual is normally considered to be either direct or latent. Direct harm usually affects those who receive a very large dose of radiation, for example workers in close proximity to a nuclear accident or those exposed to a highly radioactive source. Effects may include vomiting, damage to the skin and internal organs and, at high enough exposures, death.

Sellafield (courtesy of Sellafield Ltd)

Latent harm manifests itself as an increased risk of various types of cancer, some of which may lead to death, or possible genetic defects. These latent effects may not become apparent for many years after exposure and may not materialise at all.

Estimates of the likelihood of latent effects are based on the assumption that the increase in cancer risk is directly proportionate to the increase in exposure to radiation, no matter how small that increase may be. Such risks arise from both naturally occurring as well as man-made sources of radiation.

Nuclear emergency planning is based on the prevention of direct effects and limitation of the risk of latent effects.

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The risk represents the likelihood that people are exposed to that radiation, combined with the effect of the radiation.

Measuring exposure

For nuclear power station reactors, the main hazard derives from the large amount of radioactivity in the fuel which has been created by nuclear fission. To ensure that this radioactivity is not released, nuclear power stations employ the barriers of controlling, cooling and containment.

- **Controlling** nuclear and chemical reactions to limit the release of energy will prevent the degradation of the containment and escape of radioactive material.
- **Cooling** the radioactive material, if it is heat-generating, ensures that excessive temperatures do not occur which may degrade the containment and lead to the escape of radioactive material.
- **Containment** of the radiation or radioactive material is done by shielding with concrete walls, which stop or absorb radiation, and with robust vessels, cells and flasks to stop radioactive material escaping.

In non-power-generating nuclear facilities, some of the most significant hazards arises from heat-generating radioactive materials in facilities dealing with used nuclear fuel. Here, cooling will be a key feature and where there is the potential for release of radioactivity, there is always the need to ensure containment.

The unit of radiation exposure is the sievert (Sv). One Sv represents a large dose and in an adult equates to increased chance of getting cancer of about 1 in 20 (for comparison, the normal chance of dying from cancer is about 1 in 4). Most exposures will be measured in millisieverts (mSv) which is one thousandth of a sievert.

The annual legal limits for normal radiation exposure from nuclear facilities are 20 mSv for radiation workers on plants, and 1 mSv for members of the public who may be exposed by discharges and direct radiation from the facility. The legal requirement to take all necessary steps to restrict exposures, so far as is reasonably practicable exposure means that radiation workers in the UK are exposed, on average in a year, to around 1 mSv. This is in addition to the average 2.7 mSv per year we all incur from our normal activities. Exposure to natural radiation varies around the country depending on the local geology. Some areas, such as Cornwall with its high amounts of naturally radioactive granite, give rise to annual background exposures around four times the average (i.e.10 mSv). We also incur increased cosmic radiation doses when we fly, as well as radiation doses when we eat certain naturally radioactive foods, or when we are exposed to certain medical procedures such as X-rays.

The annual legal limits for normal radiation exposure from nuclear power plants are 20 mSv for radiation workers on plants, and 1 mSv for members of the public.

Ensuring safety

The safety of a nuclear facility depends on controlling the risk of exposure to radiation from both routine operational activities and from potential accidents. On site, ONR regulates both of these aspects, while various environment regulators (in England, Wales and Scotland) regulate permitted discharges of radioactive materials into the environment. A number of factors combine to ensure the safety of a nuclear site:

- a robust design with appropriate limits and conditions for operation;
- a rigorous operating regime with peer checking, self-assessment, training accreditation and internal oversight;
- an experienced regulatory group within the licensee's organisation;
- external peer review of the licensee from organisations such as the World Association of Nuclear Operators (WANO) and the International Atomic Energy Agency (IAEA)
- oversight by a strong independent external regulator (ONR) staffed by highly trained, qualified professionals undertaking site inspection and technical assessment work. As well as a rigorous internal assurance process, ONR is also subject to international peer review by the IAEA.

The internationally accepted approach for nuclear safety is to use the concept of 'defence in depth'. This is an approach which puts in place layers of protective systems which, in the event of an accident, will contain and delay the release of radiation and so limit the risk of harm. Defence in depth is embedded in ONR's Safety Assessment Principles (SAPs) which are used to judge the adequacy of licensees' safety cases.

The aim is to ensure that:

- faults do not occur;
- if faults do occur they are controlled; and
- if the protection fails, systems are in place to mitigate the consequences.

Conservative design, good operating practice and proper maintenance and testing should minimise the likelihood of faults. Nevertheless, the design of nuclear facilities must be shown to be capable of tolerating a wide range of possible faults.

The principle of 'defence in depth' also requires licensees to analyse fault sequences leading to severe accidents in order to identify any additional equipment that may be needed and to ensure that realistic guidance on the actions to be taken is available.

The worldwide consensus strategy for nuclear safety is to use a 'defence in depth' approach.

Safety legislation

The legal framework for the nuclear industry is based around the Health and Safety at Work etc. Act 1974 (HSWA), the Energy Act 2013 and the Nuclear Installations Act 1965.

HSWA places duties on all employers, including those in the nuclear industry, to look after the health and safety of both their employees and the public. However, because of the particular hazards associated with the nuclear industry, including the potential for accidents to cause widespread harm and social disruption, further legislation is also in place, specifically the Nuclear Installations Act 1965. Additionally, there are provisions for nuclear regulations to be made under the Energy Act 2013, as well as specific regulations under HSWA such as the Ionising Radiations Regulations 1999 (IRR99) and Radiation (Emergency Preparedness and Public Information) Regulations 2001 (REPPIR).

The legal framework for the nuclear industry is based around the Health and Safety at Work etc. Act 1974, the Energy Act 2013 and the Nuclear Installations Act 1965.

A key principle of the UK's approach is that nuclear licensees are required to build, operate and decommission nuclear sites in a way that ensures that risks are kept as low as reasonably practicable. This is referred to as the ALARP principle and requires licensees to demonstrate that they have done everything 'reasonably practicable' to reduce risks. This requires them to balance the level of risk posed by their activities against the measures needed to control that risk in terms of money, time or trouble. However, they do not have to take action if those measures would be grossly disproportionate to the level of risk averted.

Ensuring overall safety

In addition to nuclear safety ONR is also responsible for regulating non-nuclear, or conventional, health and safety on nuclear licensed sites. The aim of regulation is to ensure that the site has reduced risks to employees and other persons so far as is reasonably practicable. This includes fire safety.

Torness power station (courtesy of EDF Energy)

How ONR regulates nuclear safety

Although ONR regulates nuclear sites in the UK, the legal responsibility for ensuring nuclear safety rests with the dutyholder. The Government is responsible for establishing nuclear policy through a legislative regulatory framework. It does not set regulatory standards or make regulatory decisions. These matters are the responsibility of ONR.

The UK generally operates a goal-setting regime rather than the more prescriptive, standards-based regimes applied in some other countries. This means that ONR sets out its broad regulatory requirements, and it is for licensees to determine and justify how best to achieve them. This approach allows an operator to be innovative and to achieve the required high levels of nuclear safety by adopting practices that meet its particular circumstances. It also encourages continuous improvement and the adoption of relevant good practices.

ONR has attached 36 conditions to each nuclear site licence within which the licensees are required to operate, Table 5 lists these licence conditions. These set requirements for the licensee to make and implement 'adequate arrangements' for compliance with the licence condition, as well as some more prescriptive requirements. Adequacy, in this context, means ONR's evidence-based judgement that the licensee's arrangements for the management of nuclear safety meet the high standards expected of the nuclear industry in both the UK and internationally.

A combination of ONR's assessment and inspection functions allows ONR to judge whether licensees are operating with risks reduced to as low as reasonably practicable.

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In coming to a judgement on whether an acceptable level of safety is being achieved, a significant body of information is typically considered, for example:

- safety cases;
- reports on the licensees' periodic reviews of safety;
- results of on-site compliance inspections, including joint inspections with the licensees' own regulatory compliance teams;
- annual reviews of safety at each site, and information from start-up meetings at the end of each reactor statutory outage;
- the findings from investigations of incidents and events;
- insights and intelligence gained from the licensees' senior management and internal regulator; and
- the annual demonstration of emergency exercises at each site.

A combination of ONR's assessment and inspection functions allows ONR to judge whether licensees are operating with risks reduced to as low as reasonably practicable.

An important part of ONR's safety assurance is its monitoring of the performance of the licensee's internal regulator or internal assurance function, which can provide useful information and help inform the development of site inspection plans and assessments.

Assessment is the process ONR applies to reach an independent and informed judgement on the adequacy of a nuclear safety case and underpins our application of the regulatory regime. For any operation that may affect safety, licensees are required to produce an adequate safety case to demonstrate the safety of that operation. The overriding regulatory requirement is that the safety case shows that the licensee has reduced risks to as low as reasonably practicable.

ONR's assessment resources are organised around a number of specialist technical disciplines, such as structural integrity, fault studies, electrical engineering and human factors. Assessors, who are appointed as nuclear inspectors, are recruited on the basis of their high technical qualifications and extensive experience in nuclear or other high-hazard industries. In reaching decisions on the adequacy of a licensee's safety case, assessors will use ONR's Safety Assessment Principles as guidance. They may also visit sites to check the veracity of what is said in the safety cases and to resolve technical issues with the licensee's staff. In order to ensure that regulatory assessment

Table 5: Licence conditions

1	Interpretation
2	Marking of the site boundary
3	Control of property transactions
4	Restrictions on nuclear matter on the site
5	Consignment of nuclear matter
6	Documents, records, authorities and certificates
7	Incidents on the site
8	Warning notices
9	Instructions to persons on the site
10	Training
11	Emergency arrangements
12	Duly authorised and other suitably qualified and experienced persons
13	Nuclear safety committee
14	Safety documentation
15	Periodic review
16	Site plans, designs and specifications
17	Management systems
18	Radiological protection
19	Construction or installation of new plant
20	Modification to design of plant under construction
21	Commissioning
22	Modification or experiment on existing plant
23	Operating rules
24	Operating instructions
25	Operational records
26	Control and supervision of operations
27	Safety mechanisms, devices and circuits
28	Examination, inspection, maintenance and testing
29	Duty to carry out tests, inspections and examinations
30	Periodic shutdown
31	Shutdown of specified operations
32	Accumulation of radioactive waste
33	Disposal of radioactive waste
34	Leakage and escape of radioactive material and radioactive waste
35	Decommissioning
36	Organisational capability

An important part of ONR's safety assurance is its monitoring of the performance of the licensee's internal regulator.

decisions are robust and consistent, assessment reports are peer reviewed internally and authorised by a senior inspector.

Inspection is the structured gathering of intelligence about nuclear licensees' safety and security performance, through direct first-hand observation of plant, procedures and work activities and the questioning of staff on the site. Safety inspection activities focus on checking licensee compliance with the nuclear site licence conditions and enforcing other safety legislation for which ONR is the statutory regulator.

ONR targets its attention on sites and facilities which hold the highest hazard and pose the greatest risk. Where an operator's safety standards fall short of what is required by law, ONR will implement an enforcement response which is proportionate to the degree of shortfall. ONR generally seeks to bring about safety improvements through a persuasive and influencing approach, but it will increase the severity of its enforcement action as necessary, including taking criminal prosecutions where appropriate.

Regulatory intelligence

Nuclear sites may experience unplanned events that can be described as anomalies, incidents or accidents depending on their severity. In general, the more significant the event the more that could be learned from it. In order to prevent the recurrence of incidents and accidents, ONR encourages licensees and others with legal duties on the site to report events to ensure lessons are being derived. This provides assurance that the dutyholder is taking steps to learn from mistakes and helps ONR focus attention in areas where further investigation or advice might be needed. This contributes towards a culture of continuous improvement in the nuclear industry.

The UK uses the International Nuclear and Radiological Event Scale (INES) to rate reported events. The INES scale is a tool devised and maintained by the International Atomic Energy Agency (IAEA) for use worldwide, to facilitate consistent communication and understanding between the technical community, the media and the public of the safety significance of events associated with sources of radiation.

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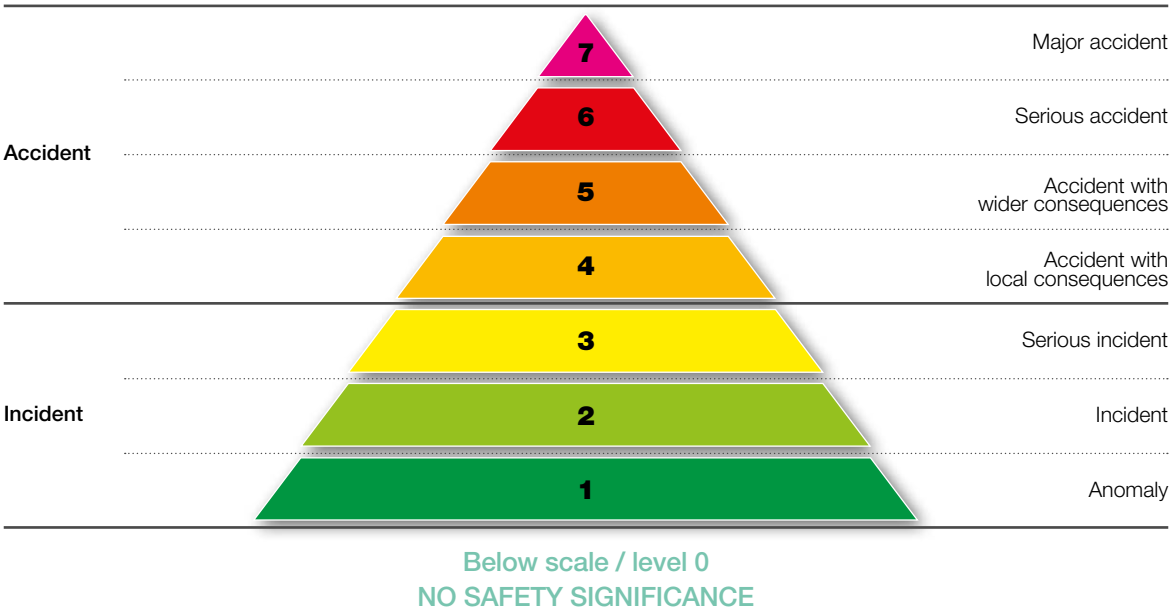
In reporting events to ONR, nuclear sites provide an initial INES rating for the event. ONR employs a nuclear safety inspector as the UK INES National Officer to verify the ratings given by the site.

Events are classified on the scale at seven levels:

- Levels 1-3 are in the incident category.
- Levels 4-7 are in the accident category.
- Events without safety significance are classified as “Below Scale / Level 0”.

The Fukushima accident in 2011 and Chernobyl in 1986 were classified as Level 7. In the UK there has only been one event that was rated as a nuclear accident, ie Level 4 or above; this was the Windscale fire in 1957, which was retrospectively classified as a Level 5 event. This event was instrumental in the Government setting up the Nuclear Installations Inspectorate, since incorporated into ONR, to provide independent regulation of the civil nuclear power programme which was then being embarked upon.

The IAEA International Nuclear and Radiological Event Scale (INES)



Regulatory Assurance

In line with recognised good practice and international guidelines, ONR has a range of internal assurance mechanisms to ensure the robustness of its processes, decision-making and other activities.

The Regulatory Assurance Directorate is independent from ONR's operational programmes and aims to secure the confidence of stakeholders including Government and the ONR Board and Executive. It is headed by the Director of Regulatory Assurance who is also a member of ONR's senior executive team.

The Regulatory Assurance Directorate aims to complement the specialist knowledge and experience of ONR inspectors and the management processes that are followed to routinely assure regulatory decisions and activities. The Directorate is divided in to five separate functions:

- **Regulatory Training** ensures that ONR's people have the necessary skills and knowledge to perform their regulatory duties. Beginning with effective and timely staff induction, and backed by a busy portfolio of both legal core training and specialist technical courses, the team delivers a professional capability development and refresher programme to all ONR inspectors. The ONR Learning and Development team ensures that ONR embeds the ethos of a learning organisation and promotes a consistent approach to regulatory and technical challenges.

- The **Knowledge Management** function ensures that regulatory and technical knowledge is passed on and shared between ONR's experienced regulators and newer inspectors. Embedding effective knowledge management processes throughout the organisation is recognised as vital in ensuring consistent, proportionate and robust regulatory decision-making.

- The **Technical Standards** function maintains ONR's Safety Assessment Principles (SAPs), Technical Inspection Guides (TIGs) and Technical Assessment Guides (TAGs) so that ONR inspectors have up to date, relevant and consistent guidance to help regulate the nuclear industry. To be fully transparent, the SAPs, TIGs and TAGs standards are also published to ensure that all stakeholders, including dutyholders in the industry, are fully aware of ONR's expectations.

ONR has a range of internal assurance mechanisms to ensure the robustness of its processes, decision-making and other activities

- The **Regulatory Research** function ensures that ONR has continued access to the latest independent scientific and technical expertise, to support its goal of being an exemplary regulator. The objectives of this research include supporting independent regulatory decision-making by helping ONR to test claims made in safety cases, identifying potential risks from new technologies, and securing access to scarce technical expertise.

- **Regulatory Assurance Review and Oversight** ensures that ONR follows appropriate standards, guidance and processes across the entire regulatory body. The team carries out internal reviews, both planned and reactive, in addition to general oversight activities across all of ONR's operational programmes. The Review and Oversight team aims to highlight learning and continuous improvement opportunities throughout the organisation, and provides assurance reports to ONR's Board, Executive Management Team, and the Government.

Security of the civil nuclear estate

Effective security arrangements in the nuclear industry are essential to prevent the theft of nuclear or other radioactive materials, the sabotage of nuclear facilities and to protect sensitive nuclear information. ONR plays an important role in setting out requirements for nuclear security outcomes for the civil nuclear sector thereby enabling it to put in place protective security measures commensurate with the threat. Doing this requires collaboration between a number of national and international bodies.

(Courtesy of Civil Nuclear Police Authority)

Effective security arrangements in the nuclear industry are essential.

Security legislation

The Nuclear Industries Security Regulations 2003 (as amended) (NISR) place significant obligations on the operators of civil licensed nuclear sites with regard to physical security measures for facilities, nuclear material and the security of Sensitive Nuclear Information (SNI). NISR also covers the vetting of permanent staff and contractors, the movement of nuclear material by road and rail within the UK and globally in UK-flagged vessels. This legislation requires all civil nuclear operators to produce and implement robust Nuclear Site Security Plans (NSSP).

Strict requirements exist for the reporting of security incidents, and developers of civil nuclear sites have obligations during the design and construction process.

ONR regulates:

- civil licensed nuclear sites, each with an NSSP, as well as tenants at some of these sites who are required to maintain their own security plans;

- one unlicensed nuclear site holding nuclear material;
- companies approved by ONR to transport nuclear material within the UK and globally in UK-flagged vessels;
- locations where SNI and technology is held – ONR regulates the security of SNI whether on or off nuclear licensed sites;
- the vetting of permanent staff and contractors involved with nuclear materials or SNI.

ONR does not regulate the security of radioactive sources held outside nuclear licensed sites; these are regulated by the environment agencies and supported by police counter-terrorist security advisors. Security at nuclear premises operated primarily or exclusively by MoD or its contractors is also outside of ONR's regulatory remit.

ONR has the power to compel plant operators, carriers of nuclear material and those holding sensitive information and technology to make improvements to their security arrangements if necessary.

How ONR regulates nuclear security

ONR's regulation of nuclear security prioritises areas that involve the greatest hazard and present the greatest risk. As with safety, security in the nuclear industry is based on the principle of defence in depth where there are multiple layers of protection so that if one is breached, further barriers exist. Our enforcement of security legislation is conducted in accordance with the same policies and procedures as those governing the enforcement of safety legislation. ONR has the power and duty to compel plant operators, carriers of nuclear material and those holding sensitive information and technology to make improvements to their security arrangements, if necessary.

Currently, security regulation is underpinned by ONR's National Objectives, Requirements and Model Standards (NORMS). This provides guidance on how the industry can meet the duties placed on it by security legislation and has moved the regulation of civil nuclear security towards a more goal-setting, outcome-based approach, with onus on dutyholders to propose and justify security arrangements that meet ONR's defined security objectives. In 2017, the evolution of outcome focused security will continue as NORMS is replaced by Security Assessment Principles (SyAPs) providing more mature guidance.

A programme of planned and no-notice inspections (including in-depth multi-disciplinary inspections) is carried out by teams of security inspectors, to ensure compliance with the approved arrangements. Regular site security exercises are also observed to assess the performance of security systems against a range of scenarios.

Emergency planning and preparedness

Responding to an emergency

Although the design, operation and maintenance of nuclear installations makes the risk of accidents involving the release of radiation extremely low, regulations are in place to ensure there are adequate arrangements for responding to a nuclear or radiological emergency. These regulations are enforced by ONR.

The Department of Energy and Climate Change (DECC) is the Lead Government Department in the event of any emergency resulting from off-site radiological consequences from a licensed civil nuclear site in England and Wales. In Scotland, the main national coordinating role would fall to the Scottish Government. DECC has established national governance arrangements where representatives from nuclear operators, police, fire service, local authority emergency planning officers, nuclear regulators and government departments and agencies come together to consider measures required to respond to a nuclear emergency.

All nuclear operators and relevant local authorities prepare, in consultation with the emergency services and other bodies, emergency plans for the protection of the public and their workforce in a nuclear emergency. These emergency plans are subject to regular tests under three categories:

- **Level 1 exercises** are held at each nuclear site generally once a year and concentrate primarily on the operator's actions on and off the site.
- **Level 2 exercises** are usually held triennially and are aimed primarily at demonstrating the adequacy of the arrangements made by the local authority to deal with the off-site aspects of the emergency.
- **Level 3 exercises** are held annually to rehearse the wider involvement of central government.

All nuclear operators and relevant local authorities prepare, in consultation with the emergency services and other bodies, emergency plans for the protection of the public.

The police, working in conjunction with other emergency services, expert bodies, and local and national agencies, are responsible for coordinating response effort locally. The lead government department coordinates the response at a national level, briefing ministers and the UK's international partners, and acting as the main source of information to the public and the media at national level.

ONR works closely with Public Health England's Centre for Radiation, Chemical and Environmental Hazards which provides guidance on public protection countermeasures. Such countermeasures include sheltering, evacuation and the taking of potassium iodate tablets to reduce the uptake of radiation to the public in the early stages of some types of nuclear emergency.

ONR determines the size of the local authority off-site emergency planning area in accordance with the Radiation (Emergency Preparedness and Public Information) Regulations 2001 (REPPIR). In determining the size, consideration is given to the level of risk presented by the site, local and practical considerations relevant to the implementation of the plan itself, and any other relevant factors that ONR judges to be necessary in the interests of public safety. The off-site emergency planning area is based on the effects of a reasonably foreseeable radiation emergency, and whilst not currently a statutory requirement, it is good practice that local authorities consider the means by which the area might be extended in the highly unlikely event of a larger accident.

Emergency exercise

Transport of radioactive materials

ONR regulates the movement of all radioactive material in Great Britain (with the exception of some material related to defence). This includes flasks carrying spent nuclear fuel from operating and decommissioning nuclear reactors, radio-pharmaceuticals needed for hospitals, and sealed radiocative sources needed, for instance in the construction industry, or for the non-destructive testing of North Sea oil rigs.

The regulations for the transport of radioactive materials are prescriptive to meet international requirements that enable transport of packages across international borders. The UK regulations are based on those of the IAEA, which are applied internationally. ONR engages with UK industry and interested parties regarding proposed changes to the regulations, and represents the interests of the UK at the Transport Safety Standards Committee at the IAEA. The UK regulations also reference other international regulations for radioactive materials transported by land, sea and air.

Although complex, this arrangement has worked successfully for many years.

Significant incidents or accidents must be reported to ONR so that they can be investigated and appropriate lessons learnt and acted on. ONR implements an inspection and audit programme to judge the extent to which the nuclear industry and other duty holders comply with transport regulatory requirements. ONR also reviews the emergency arrangements of consigners and carriers and ensure that these are appropriately tested.

(Courtesy of IAEA)

The regulations for the transport of radioactive materials are prescriptive to meet international requirements that enable transport of packages across international borders.

International Activities

ONR undertakes a broad range of international activities, working to ensure that international law and standards are best placed to further safety and security in the UK and to take advantage of opportunities to increase the quality and efficiency of our regulation through international cooperation.

At the European level a number of European Commission Directives place requirements on the law ONR enforces and the wider regulatory framework- such as the independence of the regulator. ONR supports the Government on the negotiation and implementation of Directives. ONR is a member of the European Nuclear Safety Regulators Group (ENSREG) and alongside other European regulators, advises the Commission on nuclear safety matters and works with other member states on key European safety issues.

The UK is also signatory to two international safety conventions; the Convention on Nuclear Safety and the Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management. ONR ensures that its practices align with the requirements of the conventions and takes part, every 3 years, in international peer review of the UK and other contracting parties' compliance with these Conventions. With respect to nuclear security the UK is signatory to the Convention on the Physical Protection of Nuclear Material.

ONR meeting with Hitachi-GE, the British Embassy and the Nuclear Regulatory Authority (NRA), Japan's nuclear safety regulatory body.

In addition to the legal framework, ONR contributes to safety and security standards set by the International Atomic Energy Agency (IAEA) and safety reference levels agreed by the Western European Nuclear Regulators Association (WENRA). These standards directly inform ONR's own standards and policies used in regulation.

The IAEA's Integrated Regulatory Review Service (IRRS) conducts reviews of national regulators' policies and practices against IAEA standards. In addition to being reviewed by the IRRS, most recently in 2015, ONR provided experts to take part in reviews of other countries. Similarly the UK hosts and contributes experts to missions by the International Physical Protection Advisory Service (IPPAS), concerning practices and arrangements for nuclear security. The UK hosted an IPPAS mission in 2011 and will receive a follow up mission in 2016. ONR uses these missions to benchmark our regulatory approach and facilitate continuous improvement.

International activities however are not limited to international law, standards and guidelines. ONR undertakes a range of bilateral and multilateral work to progress safety and security in the UK. For example, ONR takes part in the Multinational Design Evaluation Programme (MDEP), which brings together regulators from countries undertaking the assessment of new reactor designs to share learning and agree common positions. This work directly contributes to the Generic Design Assessment work carried out by ONR.

These activities, amongst others, are used by ONR to ensure that strategic objectives can be met through international engagment, contributing to both UK and worldwide safety and security.

ONR meets its strategic international objectives through involvement in a wide variety of international activities.

Nuclear safeguards

Nuclear safeguards are measures put in place to verify that countries comply with their international obligations not to use civil nuclear materials (plutonium, uranium and thorium) for the manufacture of nuclear explosives. Since it is the country itself that is regarded as the potential diverter of nuclear material, confidence about the absence of diversion is provided by international (i.e. third party) verification. Such safeguards are a cornerstone of the international non-proliferation regime, and safeguards obligations in the UK derive from:

- the Euratom Treaty, which requires European Commission application of safeguards to all civil nuclear material in the European Union; and
- the safeguards agreement between the UK, the International Atomic Energy Agency (IAEA) and Euratom in connection with the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), under which the IAEA can choose to inspect civil nuclear material at any facility in the UK, and the additional protocol to that agreement.

The primary safeguards 'regulators' are the international safeguards inspectorates of the IAEA and the European Commission (Euratom), not the ONR. This means ONR's safeguards role differs from what it does in regulating nuclear safety, security and transport. ONR's safeguards team works with the Euratom and IAEA safeguards inspectorates and UK organisations subject to safeguards requirements so that safeguards obligations for the UK are met in a proportionate manner. ONR also fulfils safeguards-related reporting obligations on behalf of the UK Government and provides advice and support to DECC, who are responsible to Parliament for the UK's international safeguards obligations, and elsewhere in Government on safeguards implementation in the UK.

Nuclear safeguards are measures put in place to verify that countries comply with their international obligations not to use nuclear materials (plutonium, uranium and thorium) for the manufacture of nuclear explosives.

List of abbreviations

AGR	Advanced gas-cooled reactor
ALARP	As low as reasonably practicable
AWE	Atomic Weapons Establishment
CCSWG	Centrifuge Collaboration Security Working Group
CNI	Chief Nuclear Inspector
DECC	Department of Energy and Climate Change
DNSR	Defence Nuclear Safety Regulator
EC	European Commission
ENSRA	European Nuclear Security Regulator Association
ENSREG	European Nuclear Safety Regulator's Group
EPA	Emergency Planning Area
GTRP	Global Threat Reduction Programme
HSE	Health and Safety Executive
HSWA	Health and Safety at Work etc. Act 1974
IAEA	International Atomic Energy Agency
INES	International Nuclear and Radiological Event Scale
IPPAS	International Physical Protection Advisory Service
IRR99	Ionising Radiations Regulations 1999
IRRS	Integrated Regulatory Review Service
MoD	Ministry of Defence
mSv	millisievert
NDA	Nuclear Decommissioning Authority
NEA	Nuclear Energy Agency
NEPDC	Nuclear Emergency Planning Delivery Committee
NISR	Nuclear Industries Security Regulations 2003
NORMS	National Objectives, Requirements and Model Standards
NSSG	Nuclear Safety and Security Group
NSSP	Nuclear Site Security Plan
ONR	Office for Nuclear Regulation
PWR	Pressurised water reactor
REPPIR	Radiation (Emergency Preparedness and Public Information) Regulations 2001
SAPs	Safety Assessment Principle(s)
SNI	Sensitive Nuclear Information
Sv	Sievert
WANO	World Association of Nuclear Operators
WENRA	Western European Nuclear Regulators Association

Further reading

The ONR website contains the latest reports, information and details of the standards and guides used in its work, as well as summaries of how it has arrived at regulatory decisions.

www.onr.org.uk

To get regular updates on ONR's work sign up for ONR's ebulletin via the website.

ONR

- Strategy
- Annual plan
- Annual report
- Safety Assessment Principles
- CNI Summary Programme Plan

HSE

- Reducing Risks, Protecting People www.hse.gov.uk/risk/theory/r2p2.pdf
- www.hse.gov.uk/risk/theory/ alarpglance.htm

Useful websites

Department of Energy and Climate Change:

- www.decc.gov.uk Nuclear Emergency Planning Liaison Group Consolidated Guidance
- www.gov.uk/government/ publications/ nuclear-emergency-planningconsolidated-guidance

Environment Agency

- www.environment-agency.gov.uk

Scottish Environment Protection Agency

- www.sepa.org.uk

Defence Nuclear Safety Regulator Public Health England

- www.gov.uk/government/ organisations/ public-health-england

International Atomic Energy Agency

- www.iaea.org
- Preparedness and Response for a Nuclear or Radiological Emergency, GS-R-2

Nuclear Safety and Security

- http://www-ns.iaea.org/security
- Publication: The Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Rev5)

Acts and regulations

- The Energy Act 2013
- Ionising Radiations Regulations 1999
- Nuclear Industries Security Regulations 2003
- Nuclear Installations Act 1965 (as amended)
- Radiation (Emergency Preparedness and Public Information) Regulations 2001
- The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009

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Further information about ONR is available at www.onr.org.uk