EDF Energy Nuclear Generation

Our Journey Towards Zero Harm

A summary of our nuclear safety and waste policy and associated management systems

This report is produced on an annual basis. This report covers the period January 2016 to December 2016 unless specifically stated.

June 2017

Registered Company Details:

EDF Energy plc. Registered number 02366852
EDF Energy Customers plc. Registered number 02228297
Registered office: 40 Grosvenor Place, Victoria, London SW1X 7EN

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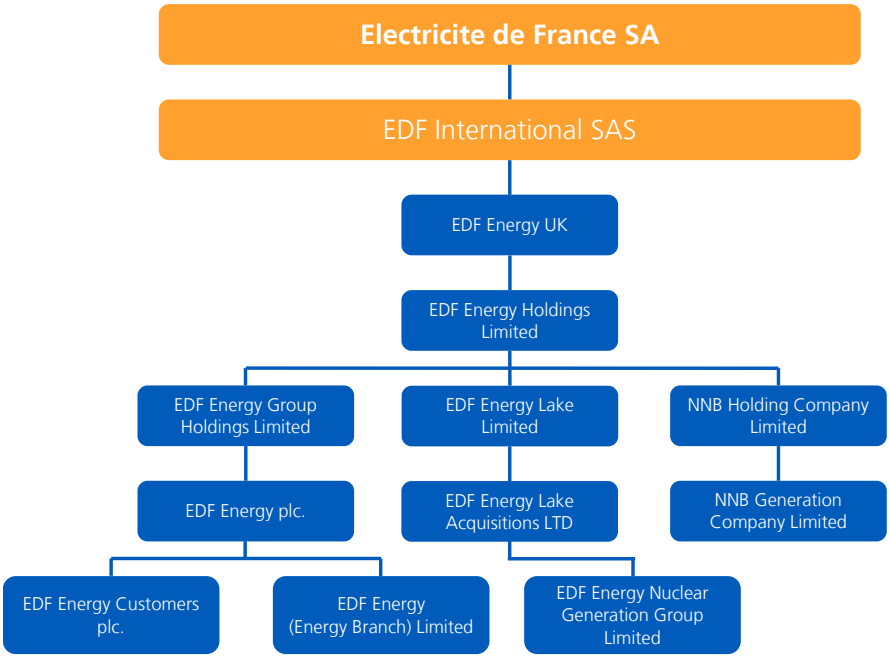
About EDF Energy

EDF Energy is one of the UK's largest energy companies and the largest producer of low-carbon electricity. We produce around one-fifth of the nation's electricity from our nuclear power stations, wind farms, coal and gas power stations and combined heat and power plants. EDF Energy supplies gas and electricity to over 5 million customer accounts and is the biggest supplier of electricity by volume in Great Britain.

EDF Energy is a part of EDF Group which has around 159,000 employees worldwide and produces in the region of 620 terra-watt hours (TWh) of electricity every year.

EDF Group has around 38 million customers worldwide and an annual revenue of 75 billion euros. EDF Energy encompasses all the UK operations of EDF Group. This primarily includes our electricity generating assets, customers business and nuclear new build.

We are the UK's leading generator and supplier of low carbon energy, producing around 20% of the nation's electricity and employing more than 13,500 people. We operate nuclear, coal and gas power stations, wind farms, and combined heat and power plants. We have a focus on safe, dependable energy generation and an ethos of service excellence.



The company in which our eight UK nuclear stations and their supporting central functions sit is Lake Acquisitions Limited. EDF Energy has held 80% of Lake Acquisitions Limited and since 2009 Centrica has owned 20%. This document reports on the performance of EDF Energy Nuclear Generation Group Limited. This report covers the period from January 2016 to December 2016 unless specifically stated.

Our Business Units

Generation

Encompasses all of our electricity generation activities – Nuclear, Coal, Gas and Renewables.

Nuclear New Build

Tasked with the delivery of the new generation of nuclear plants to produce safe, affordable, reliable, low carbon electricity.

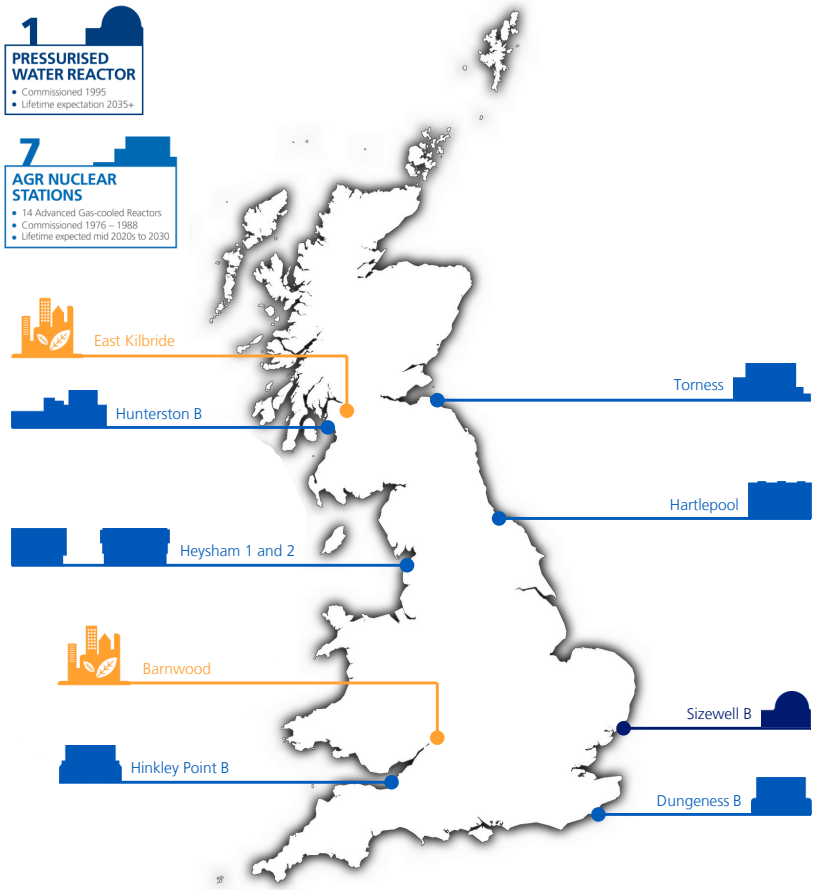
Customers

Responsible for supplying energy to our business and residential customers in the UK.

About EDF Energy Nuclear Generation

Nuclear generation encompasses all EDF Energy's nuclear power stations and nuclear specific central support functions located in Barnwood in Gloucester and East Kilbride in Glasgow.

Safe, reliable generation over extended life.



Since 2015, EDF Energy has been the sole operator of all generating nuclear power stations in the UK. These eight existing nuclear sites have a combined capacity of c.9,000 megawatts and operate 24 hours a day, seven days a week. Electricity generation through these 15 reactors avoids emissions of over 40m tonnes of carbon dioxide compared to the equivalent fossil fuel generation. That's the equivalent of taking about 60% of cars off our roads.

The map opposite shows the location of our eight nuclear power stations around the UK as well as our central support offices at East Kilbride and Barnwood.

Station	Reactors	Commissioned	Scheduled closure date	Net capacity /MW(e)
Hunterston B	2 x AGR	1976	2023	965
Hinkley Point B	2 x AGR	1976	2023	955
Hartlepool	2 x AGR	1983	2024	1180
Heysham 1	2 x AGR	1983	2024	1155
Dungeness B	2 x AGR	1983	2028	1050
Heysham 2	2 x AGR	1988	2030	1230
Torness	2 x AGR	1988	2030	1185
Sizewell B	1 x PWR	1995	2035	1198

Capacities are stated net of all power consumed for the stations' own use, including power imported from the National Grid. Capacities are subject to review each year end. The capacities quoted reflect expectations for the reference energy generation from the units from 1 January 2016. In particular, Hinkley Point B and Hunterston B have been adjusted to reflect planned operation at reduced load due to boiler temperature restrictions.

* Advanced Gas-cooled Reactor, Pressurised Water Reactor.

** The AGRs were designed with a nominal 25 year lifetime and Sizewell B with a nominal 40 year lifetime. Prior to EDF Energy ownership, the AGRs had their lives extended by an average of 10 years. During EDF Energy ownership, the AGRs have had their lives further extended by an average of 8 years.

Better Energy Ambitions

Our better energy ambitions puts sustainable and responsible business practices at the heart of how we act today and how we plan for the future. This mission sits under EDF Energy's overarching ambitions called our Better Energy Ambitions. These build on our progress so far to embed sustainability into our business operations, planning and behaviours. They are our framework for sustainability.

Zero harm

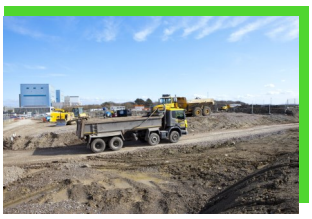
We believe all harm is preventable. This ambition means making sure our workplaces are safe and healthy for everyone: our employees and anyone working on our behalf.

Zero Harm is major part of our organisational culture and drives the way we operate. We take a rigorous approach to risk and have introduced innovative programmes. We are now industry-leading when it comes to our safety performance.

Better for customers

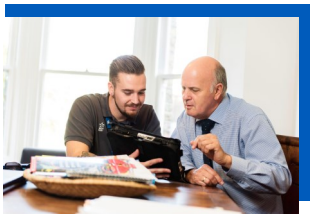
The fundamental need for energy won't disappear, but traditional ways of working with our customers will change. We are embracing this future and taking action to ensure we are able to meet the demands of modern consumers

. We are seizing opportunities in digital energy efficiency solutions and services, to enable customers to manage their energy better. As a responsible business, caring for all of our customers is something we have always considered our duty especially for the most vulnerable in our society.



Leading decarbonisation

At the Paris Conference in 2015, the international community reiterated the crucial aim of limiting carbon emissions to keep the rise in global temperatures to below 2 °C. To support this, EDF Group has undertaken to produce increasingly low-carbon electricity. We are the UK's largest producer of low-carbon electricity. Our Environment Policy sets out our approach to achieve our environment ambition, leading the decarbonisation of UK electricity whilst seeking to achieve a net zero environmental impact across our operations regarding air, land and water.



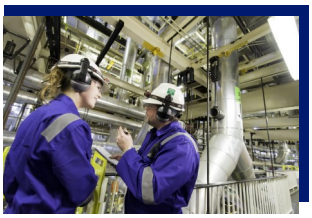
People as a force for good

Our major investments are not just about new infrastructure or technologies; they are about training and jobs, skills and education. There is no industrial strategy without a people strategy.

Through education we are inspiring the next generation, so the UK can continue the journey to a stronger, low-carbon future. Investing in people will make sure the future of our company is a bright one.

Strong finance and ethics

We are working to give back to society, share the value we create and help to grow the economy we all depend on. We provide an essential service to society and it's important that we do this in a responsible way. That is why our ambition is to achieve a strong financial and ethical performance. All our people work to our guiding principles for ethical behaviour and our business values. We give our people the tools to work in an honest and ethical way and the confidence and processes to report any instances where we suspect we have not.



Excellence in nuclear

We believe nuclear has a key part to play in the future energy mix and therefore we are working to build Hinkley Point C, the UK's first in a new generation of nuclear power stations. Nuclear safety is our overriding priority. The UK's nuclear industry has an excellent safety record going back more than 50 years. Our nuclear power stations are built to the highest and most exacting international standards, with due consideration of external hazards including earthquakes, floods and fires. Independently regulated by the Office of Nuclear Regulation, we comply with some of the toughest nuclear regulations in the world.

Statement on modern slavery

Doing business in an ethical way is one of our most important values. Through our Better Energy Ambitions, we are working to ensure sustainable, ethical practices across our supply chain, and we will not tolerate any fraud, corruption or abuse of human rights. At EDF Energy, we recognise that modern slavery is a growing global concern, and we are working to ensure that our own operations, and those of our supply chains, are appropriately evaluating the risks of modern slavery. We are working to mitigate these risks as far as possible by putting plans in place to demonstrate our commitment to ethical business. We report our sustainability performance annually through our Better Energy Ambitions, and are signatories to the United Nations Global Compact (UNGC). We strive to improve our standards of ethical behaviour continuously; our commitment to ethical business practice is outlined in our ethics and business conduct policy.

UN GLOBAL COMPACT
United Nations Global Compact

At EDF Energy we have a set of minimum standards that suppliers are required to abide by. These include a requirement for suppliers to complete a risk-based self-assessment, aligned to the ten Principles of the UNGC. This provides us with an opportunity to assess and mitigate the risks associated with modern slavery. We ask our tier one and tier two suppliers (covering nearly 90% of our supply chain expenditure) to obtain Chartered Institute of Procurement and Supply's Sustainability Index accreditation. This covers economic, environmental, and social aspects of their supply chains and includes evidence to support payment of legal wage, entitlement to work and compliance with regards to modern slavery act. Our tier one suppliers (covering approximately 40% of our supply chain expenditure) are subject to additional reviews which include topics designed to identify the risks of modern slavery. Supplier relationship management activities and supplier compliance reviews allow in depth and ongoing checks throughout contract delivery, to ensure ethical behaviours and industry codes of practice are followed.

Nuclear Safety

The nuclear safety policy is the overarching document which ensures nuclear safety is at the forefront of any activity undertaken within EDF Energy Nuclear Generation.

EDF Group nuclear safety policy

All organisations within EDF Group share the same vision that nuclear safety is the overriding priority for the sustainable use of nuclear energy, recognising that nuclear energy also needs to be efficient, affordable and environmentally friendly. It is an indispensable prerequisite when providing energy to humanity.

Nuclear Generation (NG) complies with the EDF Group nuclear safety policy through a combination of the NG nuclear safety policy and the supporting NG management system. A copy of the EDF Group nuclear safety policy is provided within the Nuclear Generation Nuclear Safety Policy in Appendix B.

Nuclear Generation nuclear safety policy

The EDF Energy Nuclear Generation nuclear safety policy (Appendix B) represents our corporate commitment to nuclear safety and is implemented through our management processes. It requires all leaders to support and demonstrate specific values, and the commitment of all individuals to maintain positive control of nuclear safety via deliberate and considered actions.

We are responsible for the safe operation of our nuclear facilities, and understand our greatest responsibility is to protect the public, the environment and ourselves from the any adverse effects of nuclear technology. This is achieved by maintaining nuclear safety at all times. The nuclear safety policy is implemented through the Nuclear Generation management system.

Our obligation as a nuclear operator, is to protect the people of this country and the population worldwide by maintaining nuclear safety at all times. We take that obligation very seriously at all levels throughout the organisation. The importance of maintaining nuclear safety cannot be overstated and this policy requires that everyone is aware of their obligations. Fission products, decay heat and vast amounts of stored nuclear energy can have an adverse impact on our wider society if released in an uncontrolled manner.

Our primary focus is to ensure nuclear safety through positive control of reactivity, core cooling and containment of the contents of the core and all by-products of nuclear power plant operations whether in reactor, during movement, disposal or storage. We are committed to keeping the balance of risks as low as reasonably practicable.

Nuclear safety culture

We have adopted the standard International Atomic Energy Agency (IAEA) definition of nuclear safety culture:

> *"That assembly of characteristics and attitudes in organisations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance."*
>
> 2007 IAEA glossary

This means that in working together, we should all recognise our individual and collective impact on nuclear safety such that as nuclear professionals, we all do the right thing at all times.

A positive nuclear safety culture is continually fostered within the organisation and characterised by communications founded upon openness, mutual trust, and shared values. This includes promoting a safety conscious work environment in which we all openly report and pursue safety issues or concerns without experiencing a negative reaction. In addition to normal processes such as raising concerns through supervisors and use of the corrective action programme, we also have a confidential reporting line for any outstanding safety concerns, Safecall.

Our nuclear safety culture has been built on the three principles of plant, process and people.

A **learning organisation** striving for excellence through continuous improvement.

Plant is well designed, operated and maintained within established safety cases to ensure they operate at a risk level that is as low as reasonably practicable (ALARP).

Processes are robust and focused on preventing events and identifying and resolving problems.

People are well trained, follow procedures, demonstrate a questioning attitude, uphold the highest standards and coach each other to continually improve those standards.

Our nuclear safety culture is also supported through the adoption of the following ten traits of a healthy nuclear safety culture from the World Association of Nuclear Operators (WANO).

The health of our nuclear safety performance and culture is routinely assessed to ensure that the objectives of this policy and the ten traits are being achieved.

Ten traits of a healthy nuclear safety culture

Personal accountability
All individuals take personal responsibility for safety.

Questioning attitude
Individuals avoid complacency and continuously challenge existing conditions and activities in order to identify discrepancies that might result in error or inappropriate action.

Effective safety communication
Communications maintain a focus on safety.

Leadership safety values and actions
Leaders demonstrate a commitment to safety in their decisions and behaviours.

Decision making
Decisions that support or affect nuclear safety are systematic, rigorous and thorough.

Respectful work environment
Trust and respect permeate the organisation.

Continuous learning
Opportunities to learn about ways to ensure safety are sought out and implemented.

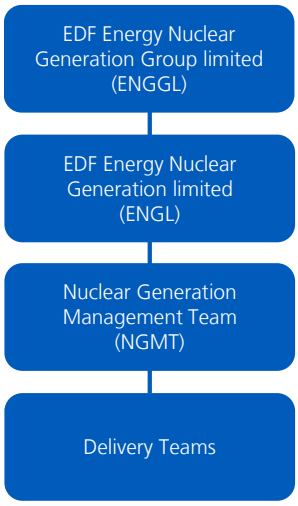
Problem identification and resolution
Issues potentially impacting safety are promptly identified, fully evaluated, and promptly addressed and corrected commensurate with their significance.

Environment for raising concerns
A safety conscious work environment is maintained where personnel feel free to raise safety concerns without fear of retaliation, intimidation, harassment, or discrimination.

Work processes
The process of planning and controlling work activities is implemented so that safety is maintained.

Corporate governance

Under UK law, a Nuclear Site Licence must be held by a corporate body (a company). In the case of Nuclear Generation, the Nuclear Site Licence is held with EDF Energy Nuclear Generation Limited Board (ENGL) (the licensee board). The Licensee must be the controlling mind with respect to Licensee issues.



The purpose of the EDF Energy Nuclear Generation Group Limited Board (ENGGL) is to provide oversight of the safety and operational performance and nuclear governance of the licensee board, advising it and the EDF Energy Executive on the findings resulting from its oversight role. It ensures that the Licensee is properly resourced and supported as required by nuclear site licence conditions. Some senior representatives of NG are members of the Group board. Within NG, nuclear safety committees are constituted in compliance with the nuclear site licences. These committees are consulted regularly for their consideration and advice on matters of nuclear safety.

Management of Nuclear Generation is the responsibility of the Nuclear Generation Management Team (NGMT) who are responsible for overseeing the operation of all our nuclear power stations. Delivery teams have delegated authority from the NGMT to monitor performance in the areas of operations, safety, people, investment, engineering governance, and financial performance.

Nuclear Generation management system

NG operates in accordance with a single unified management system that integrates safety, health, environmental, security, quality and economic objectives. The management system defines the responsibilities of key post holders, the line management organisation and the main interfaces between the company and other organisations. This overarching management system applies to all policies and performance areas outlined in this document.

Operating within a safety critical industry, it is paramount that Nuclear Generation is able to describe clearly how key activities are managed, performed and assessed. It must be able to show how the organisation is governed and describe how functional responsibilities, levels of authority and interfaces between different groups are controlled and managed such that the overall objectives are achieved in a safe, efficient and effective manner.

The management system has been developed in line with industry best practice and has also been designed to ensure that the requirements of our nuclear site licences are fulfilled.

NG covers 10 locations in total (eight nuclear power stations and two support locations) that are all certified by the following standards:

- LRQA for ISO9001 (quality) and ISO14001 (environment)
- OHSAS18001 (occupational health and safety)
- ISO45001 (asset management)

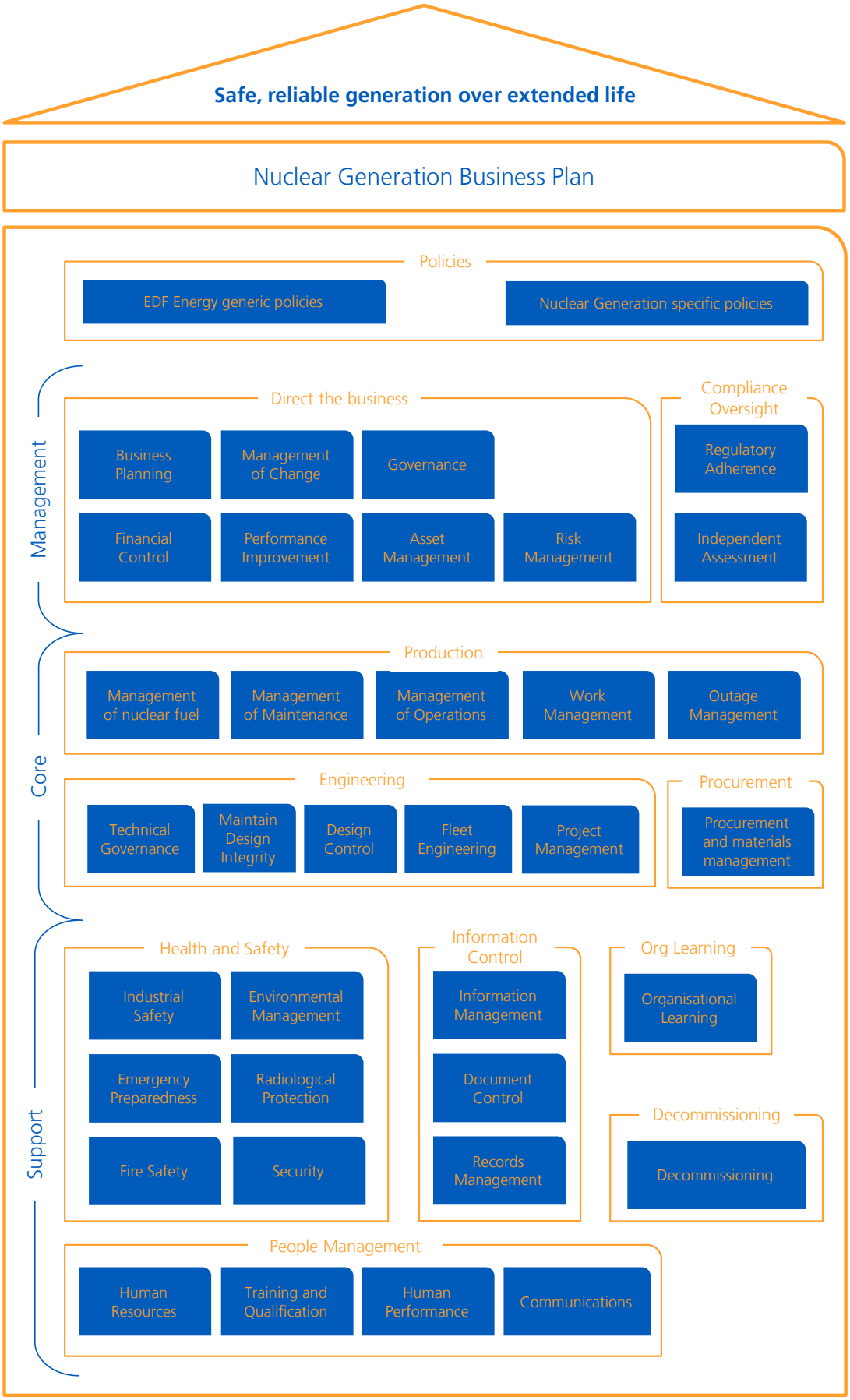
The management system supports the achievement of the two general aims of a management system, as stated by the International Nuclear Safety Group in Management of Operational Safety in Nuclear Power Plants, INSAG-13:

- To improve the safety performance of the organisation through the planning, control and supervision of safety related activities in normal, transient and emergency situations
- To foster and support a strong safety culture through the development and reinforcement of good safety attitudes, values and behaviour in individuals and teams so as to allow them to carry out their tasks safely.

The structure of the system is summarised opposite and shows how our company vision and associated strategic objectives are implemented through a defined organisational structure and 36 interlocking processes which are directed by EDF Energy and Nuclear Generation specific policies.

Processes are arranged into management, core and support processes. For each process there is an identified lead in the business that owns the process definition and documentation, and is charged with its continuous improvement.

The whole system is underpinned by the values, standards and expectations that should qualify, inform and permeate all activities throughout the company.



The fleet approach

NG operates and manages all the remaining generating nuclear power stations in the UK. It has established an operational model based on a fleet approach to all company processes within the management system. This ensures that all processes with the potential to impact safety are managed centrally, ensuring alignment across all stations. This approach also facilitates a platform through which to share best practice throughout the fleet, and provides a mechanism and resources to offer enhanced support to individual stations if required.

The fleet approach to our operations is aligned to the GOSP model. The model is built on the fundamental principle of collective responsibility for the performance of the NG entity as a whole. This principle is enshrined in the roles and fiduciary responsibilities of the Licensee Board, where each Executive Team member is jointly and severally responsible for the performance of the licensed entity.

Governance

Establishing the controlling processes and performance standards.

Governance of a core process is provided by the fleet function, lead by the fleet manager. They maintain accountability to set the requirements and rules to ensure the process outcomes are in line with Nuclear Generation's core ambitions and business plans. Strong governance provides broad boundaries that guide the development of methods, procedures, and practices to achieve the necessary outcomes assigned to that function.

Oversight

Analysing performance against process deployment and assessing results.

In-process, or functional oversight is provided by fleet management who, as well as ensuring adequate governance is in place, are also responsible for measuring and monitoring the performance of the process. As a minimum NG is required to demonstrate compliance against the requirements of regulators and legislation relevant to the process. Oversight is also provided independently through our internal regulator to provide additional challenge and ensure that any drifts in performance is identified and analysed.

Support

Assisting line to deploy best practice and to assure delivery of results.

The fleet model enables support to be provided to local sites through peer groups to facilitate the sharing of best practice. These take place on a frequent and regular basis and will be attended by process representatives from each site. The accountability for support is provided through fleet management.

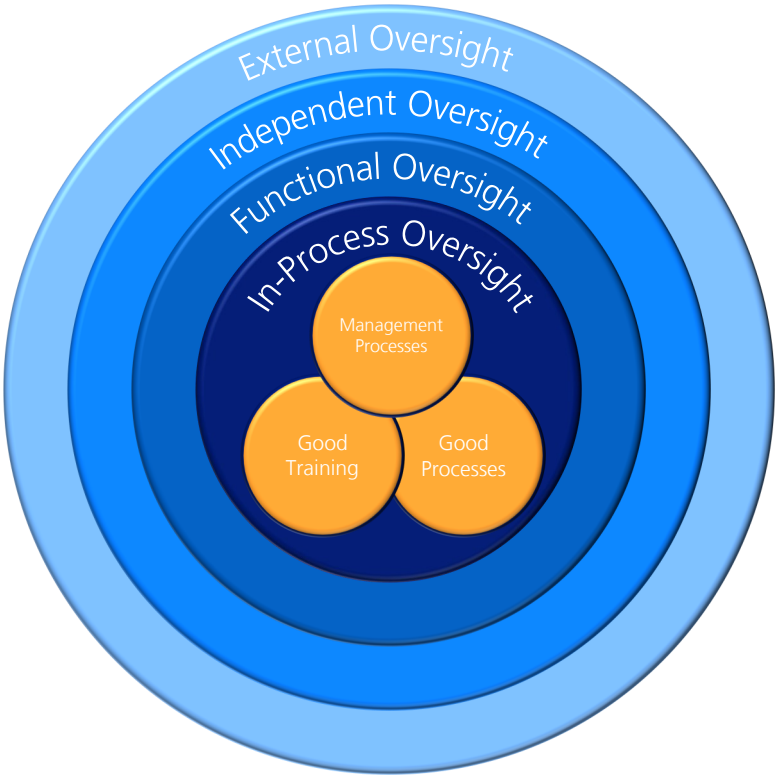
Perform

Deployment of processes with a view to producing the required outcomes

Station line management provides accountability to ensure that all procedures, tasks, and actions required for the safe, reliable generation of electricity from our nuclear power stations is undertaken in line with the expectations of the process and within requirements of the process governance. Performance measurements against criteria and targets set by fleet management are reported through line and fleet management to determine areas for improvement in each of the GOSP areas.

Oversight

As is expected for a highly complex and potentially hazardous industry, there is a particular emphasis on strong oversight to monitor performance and conformity to both our internal standards and external regulations. We operate a multi-layer model with increasingly independent oversight being exercised through various channels.



EDF Energy operates its nuclear power stations to the highest possible safety standards meeting the stringent requirements of the World Association of Nuclear Operators (WANO). These standards are based on years of experience in nuclear operations worldwide and provide a solid basis for safely and reliably operating nuclear power stations. WANO's standards are integrated into our processes and business plan.

Nuclear Generation uses multiple layers of oversight to ensure all processes and actions are undertaken in line with NG's policies and international best practice.

The diagram opposite shows the varying levels of oversight which are employed to support our core business processes. This 'onion model' demonstrates how each layer of oversight provides additional safeguards, creating multiple barriers to protect against process failure.

In-process oversight

In-process oversight is provided through line management and provides assurance that tasks are being performed to the expected standards. Personal accountability is ensured through expectations set through the organisational leadership:

Safety	Safety is paramount in all that we do. Our future as a company will depend on our ability to demonstrate a consistent and unrelenting commitment to safety
Environmental stewardship	This is a fundamental obligation that we have to our country, our customers and the communities in which we live and work.
Leadership behaviour	To act as role models demonstrating excellent leadership at every level of our business.
Individual behaviour	To take responsibility for our actions and are committed to improving our performance.
Training and development	All personnel will receive appropriate training and development to equip them with the skills and knowledge required to carry out their role correctly and safely.
Communications	Clear and simple communication forms a vital part of an effective working environment.
Operational focus	is a culture in which the organisation is aligned to common goals and priorities that achieves safe and reliable operation.
Procedural use and adherence	are written to ensure we all consistently follow approved processes and standards in line with all statutory, mandatory and good practice requirements.
Conservative decision making	is making high quality, safe decisions when faced with uncertain operating conditions.

Functional oversight

Reliable plant tends to be safe plant, and processes are in place to continually identify, address and monitor plant irregularities and non-conformities as early as possible to prevent them from escalating. These processes are based on the best international standards and include all elements necessary to manage and control nuclear power stations safely and efficiently.

Alongside processes for specific technical activities, there are processes for securing sufficient suitably qualified and experienced personnel (SQEP) including training for:

- Developing, implementing and monitoring governance procedures.
- Ensuring adherence to regulations.
- Securing independent assessment of our activities.
- Investigating departures from expected plant and personnel behaviour and preventing their recurrence.
- Reporting issues.
- Driving continuous improvement in all aspects of performance.

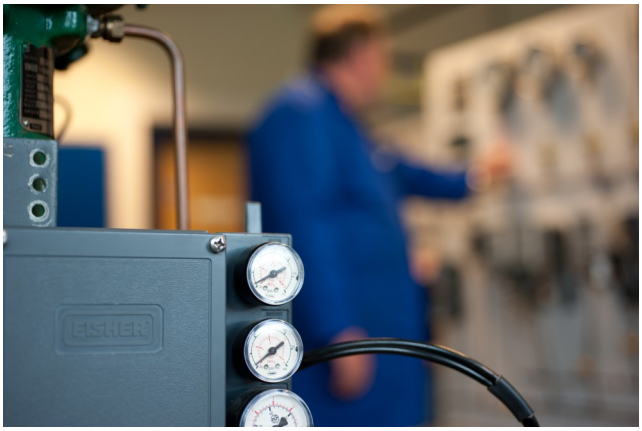
Various groups undertake this work, including a nuclear safety review board; fire and industrial safety functions; a maintenance, inspection, testing and surveillance function; an equipment reliability function and an emergency preparedness department.

Performance on nuclear safety, radiological protection and operations is reported monthly to governance bodies within NG including the safety and oversight delivery team; the operations performance delivery team; the Generation executive team and the Licensee Board. Routine reports on the safety state of the plant and processes through use of results, analysis, insights and oversight are presented to the Licensee Board and the EDF Energy Nuclear Generation Group Limited Board.

Independent oversight

EDF Energy's independent nuclear assurance (INA) function is responsible for providing effective internal but independent regulation of the company for the areas of nuclear, radiological, environmental, and industrial safety; along with nuclear security. It reports to the Licensee Board independently of the operating arm of the company.

The department comprises individuals with diverse experience in the civil nuclear industry.



External oversight

The industry is subject to exacting requirements and oversight from independent regulators and assurance bodies. Numerous organisations provide external oversight to the nuclear industry. All civil nuclear operators worldwide recognise that the future success of the industry is dependent upon continued safe operation.

As an operator of nuclear facilities in the UK, Nuclear Generation is subject to requirements prescribed by the Office for Nuclear Regulation (ONR). The oversight arrangements require us to report any deviations from our safety standards, however small, so they can be prioritised and addressed. Open reporting in this way is an important element of our nuclear safety culture and is positively encouraged throughout the organisation.

As part of our reporting arrangements we inform the ONR of incidents and events that occur on our sites; of these the vast majority were rated at INES Level 1 or below.

There have not been any events rated greater than INES 1 within EDF Energy for over eight years. None of these events have had an impact on public safety or the environment.

The Inspector General for Nuclear Safety and Radiation Protection provides annual reports to the Chief Executive Officer of EDF Group and to the Nuclear Safety Council. This report provides high level oversight of nuclear activities across EDF Group, allowing NG to benchmark its performance against the wider organisation.

WANO peer reviews are held at each of NG's power plants every four years with an interim follow-up visit to review progress. Nuclear Generation therefore typically receives two or three peer reviews per year, with a similar number of follow-up visits. Corporate peer reviews are also held periodically.

Each peer review has two primary outputs:

- A report which identifies areas for improvements (AFIs) which describe gaps between current performance and excellence. These are supported by factual evidence and an analysis of the causes which underlie performance gaps.
- Since 2010, a separate report which reviews station progress in addressing WANO significant operating experience reports recommendations.

During follow up visits, WANO assesses progress made by plants in addressing AFIs identified during the previous peer review.

In conjunction with WANO, the International Atomic Energy Agency (IAEA) and the Office for Nuclear Regulation (ONR), EDF Energy also provides support to, and is supported by, technical support missions, self-assessments, operating experience feedback, benchmarking, workshops seminars, performance indicators and international secondments.

ONR Office for Nuclear Regulation

WANO

INPO®

IAEA International Atomic Energy Agency Atoms for Peace

Security

EDF Energy Nuclear Generation recognises the value of the people, physical assets, information and systems that it utilises to undertake its business and the necessity to protect them from unlawful acts.

Security policy and approach

Security is about protecting our physical assets, information (both commercial and sensitive nuclear information), the public, and our staff from any malicious act which could adversely affect the integrity of our assets and/or availability of information. Our security arrangements also ensure that the right systems, processes and procedures are in place to deliver electricity safely and securely. The risk of theft or non-civil misuse of nuclear fuel is fully taken into consideration by EDF Group companies, in strict compliance with the requirements of international organisations such as IAEA, European Atomic Energy Community (EURATOM), and national legislation and regulations.

NG's approach to security is risk-based and designed to ensure that appropriate and proportionate controls are implemented and maintained. Identified security risks are assessed and subjected to regular internal and external review. The risk profile covers all identified security threats to the business ranging from petty crime, malicious behaviour through to protestor disruption, cyber-attacks and terrorism.

Management of security

A management system has been established through NG's nuclear security function which encompasses all operational, physical, information and personnel security controls. This security management system is supported by processes, standards and guidelines that meet our policy and regulatory requirements. All staff are made aware of security requirements and trained appropriately. In particular they are made aware of their individual security responsibilities, regulatory compliance and event reporting. The system also demonstrates how NG achieves compliance with nuclear site licence conditions and applicable security, regulatory and legal requirements as well as meeting the prime security requirements of the business.

There are a series of safety and security measures in place at each of our nuclear power stations in addition to the inherent physical security provided by the robust design of the nuclear reactors. Access to nuclear power stations is strictly controlled, and across the nuclear fleet and EDF operates an enhanced vetting and aftercare regime. Armed police are deployed at all the UK's nuclear sites to complement the company's security measures. The Civil Nuclear Constabulary (CNC) is a specialised armed police force whose role is the protection of civil nuclear sites and nuclear materials. The mission of the CNC is to deliver an effective armed response to deter and if required, defeat the UK's defined threat.

As part of the process of continuous improvement, our security regime has been developed in the light of operational experience in the UK and abroad, and appropriate use is made of developing technologies, capabilities and processes. Frequent internal security assessments and external regulatory security inspections provide the basis for effective oversight and compliance to the required standards. The overall state of security in the civil nuclear industry in the UK is graded by the ONR (CNS) in its annual report 'The state of security in the civil nuclear industry and the effectiveness of security regulation'. The report provides an independent view on security performance.

Incidents and Events

Our plant is designed to be operated without significant impact on the health and safety of its operating personnel or of the public living around the stations. The most harmful potential consequences arising from nuclear facilities originate from the loss of control over nuclear reactor core cooling, the nuclear chain reaction, or uncontrolled radioactive discharges. These constitute the three most important safety functions that are secured and verified on a permanent basis.

The nuclear safety case

Our plants are designed to be operated with no adverse impact on the health, safety and environment of the local community and of people working at our power stations. All sites are subject to an extensive routine programme of inspection, maintenance and testing.

Plant behaviour in normal operation and a wide range of abnormal circumstances has been analysed, and limits of operation are specified in the nuclear safety case for each station. The nuclear safety case is a document which outlines the safe limits of operation of the plant, demonstrating for a wide range of circumstances that the station will either be able to continue operating safely or be brought to a safe shutdown condition.

The operational limits contained within the nuclear safety case, including the availability requirements of backup systems are incorporated into operating instructions. These control all aspects of operation and incorporate appropriate safety margins to ensure that all parameters the plant is controlled to are within conservative limits. These operating instructions direct the action to be taken if these limits are approached so that the plant can be returned to a steady and safe state should any deviations occur.

Staff are trained in the requirements of the nuclear safety case and operators in control are subject to a rigorous training regime, individually mentored and fully examined in simulator exercises before becoming authorised to undertake the role.

The adequacy of the nuclear safety case, the monitoring and maintenance regime, and the control of operations is continually evaluated and is formally assessed in comparison to the latest standards every ten years through periodic safety reviews. To give early warning of any deterioration, whether in plant or operating standards, and to facilitate our goal of continuous improvement every deviation from the expected plant status or the management system procedures must be reported as described later in this document.

Management of incidents and events

We rarely have any significant incidents or events. EDF Group and NG aim to reduce the likelihood of such losses of control to the lowest possible level and take all necessary measures in order to:

- Prevent the occurrence of failures or abnormal conditions that could lead to such a loss of control.
- Prevent the escalation of any failures or abnormal conditions that do occur and mitigate their consequences
- Prevent the loss of confinement or the discharge of radioactive substances outside the facilities.
- Mitigate the impacts of any event by implementing one or more established emergency response measures.

In line with IAEA principles and local regulations, EDF Group and NG have local processes in place to prevent and detect both technical, process and security failures. As well as prevention and mitigation, these processes leverage experience to prevent the reoccurrence of similar events. All NG corporate, station and contractor personnel understand their responsibilities to:

- Identify conditions having an undesirable effect on performance of equipment, programmes or organisations.
- Ensure necessary immediate actions are implemented to place the plant/situation in a safe and stable condition.
- Report the condition to a supervisor or the control room, including immediate corrective actions taken.
- Promptly initiate a condition report.
- Provide sufficient information so that the condition can be properly evaluated for operability, reportability, significance and disposition.

Emergency response

Nuclear site licence condition 11 requires Nuclear Generation to make and implement adequate arrangements for dealing with any accident or emergency arising on site. A dedicated emergency planning department is present at each of our sites which are responsible for maintaining and supporting the site's emergency arrangements. In line with NG's fleet approach, each site's emergency planning group is supported by the fleet central emergency preparedness function.

The emergency preparedness programme includes arrangements for working with local and national emergency services and associated government bodies to provide countermeasure advice and action to protect the public and environment as a consequence of any significant radioactive material from any of our power stations.

Symptom-based emergency response guidelines and accident management guidance is available to control any accident, and mitigate the consequences in the unlikely event of failure of any of the required engineered protective features.

In addition to these routine processes, the company has detailed plans for the action to be taken in any event with the potential to impact people or the environment. We perform regular emergency exercises to test procedures, facilities, systems and equipment, and enable everyone to practise their role. We also demonstrate the effectiveness of our emergency arrangements to external agencies and the public. These arrangements have been further strengthened following the events at Fukushima in March 2011. Emergency exercises are also required to satisfy the nuclear security regulations and the transport of radioactive material.

In addition to the regulatory exercises, sites have tested various aspects of the emergency plans during shift exercises and training drills. The lessons from all exercises have been shared across the fleet and used in revising emergency plans and future exercise programmes. Examples of some additional key activities in the emergency preparedness area since Fukushima include:

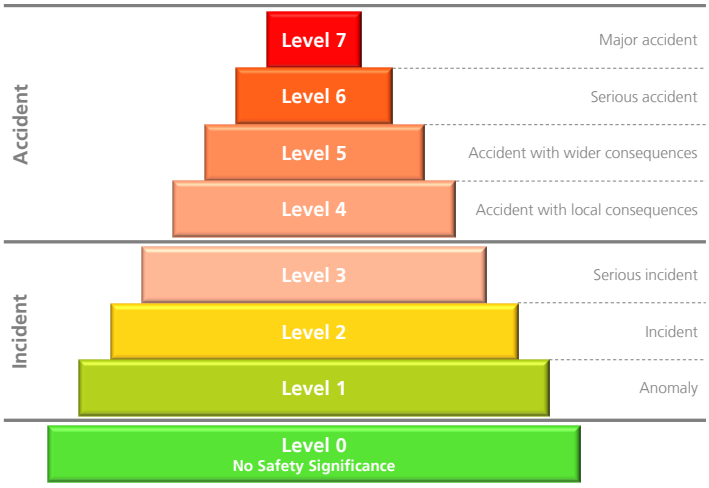
- Provision of further detailed emergency arrangements to support beyond design-base accidents and integration of the post Fukushima recommendations. Proof of concept exercises have been held to test the new extended arrangements, including deployment of back up equipment.
- Increased alignment of the safety and security response arrangements for the industry and the fleet.
- National forums such as Nuclear Emergency Planning Liaison Group and Nuclear Emergency Arrangements Forum have made significant changes to structure and governance. NG has consistently attended the Energy and Climate Change National Strategic Framework; this is the governance framework for the national emergency response capability.
- Review by IAEA and ONR on increased extendibility planning and potential increases in the Detailed Emergency Planning Zone.
- Following the decision to include emergency preparedness in peer reviews there has been increased focus on WANO internal and external activities.

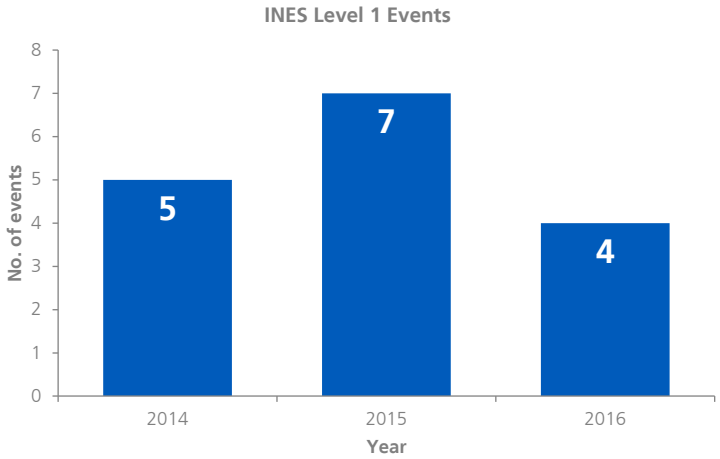
Central emergency support centre is prepared at all times to assist in providing emergency response to any nuclear power station in the event of an emergency.

Public	Staff	Environment	Plant	Security

The key priorities of the emergency response team when dealing with an event.

Nuclear safety events





To provide a consistent approach to the way events are reported across the world, the international nuclear events scale (INES) was introduced by the International Atomic Energy Agency in 1990. It the worldwide standard for the categorisation of nuclear events and a tool for communicating to the public the safety significance of nuclear and radiological events.

INES applies to any event associated with the transport, storage and use of radioactive material and radiation sources, whether or not the event occurs at a facility. These are categorised between level 1, which is an anomaly with no impact on the safety of the general public or workforce, and Level 7 which represents a major accident.

Nuclear Generation has had no events rated higher than INES Level 1 in the last eight years.

Figure 1 shows how many INES Level 1 (anomaly) events we have had in the previous three years.

Top - IAEA classification of INES events

Left - Figure 1. INES Level 1 events in the Nuclear Generation fleet for 2014, 2015 and 2016.

Nuclear reportable events

Within NG, an open reporting culture is positively encouraged. As a result, a large number of adverse conditions are reported each year. Each of these reports is categorised and allocated either to immediate action, to further investigation or for data trending. A very small number of events are identified as requiring formal reports to the ONR under our nuclear site licence compliance arrangements or the reporting requirements of applicable government departments. The large number of condition reports that are raised within NG is a good indication of the open reporting culture that exists within the business.

The most significant events are known as immediately reportable nuclear reportable events (NRE). The only NRE in the past three years was in 2014, following the discovery of a legacy defect in a boiler spine at Heysham 1. A significant programme of work was launched in response to this which involved boiler modifications, further detailed inspections, and adjustments to the safety case and operational documentation.

The number of NREs over the previous three years is shown in figure 2.

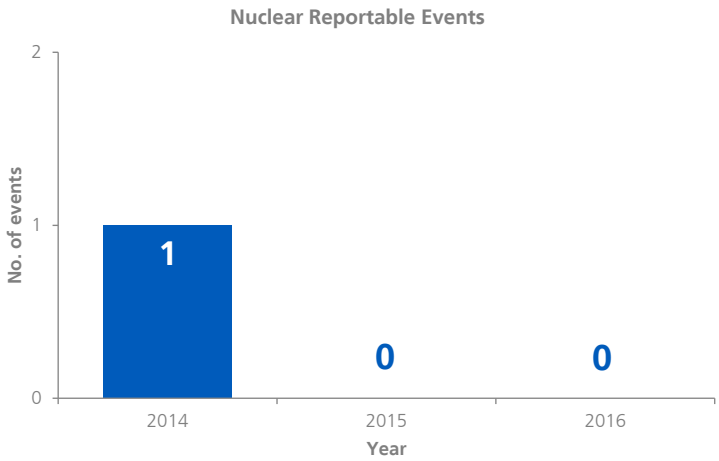


Figure 2. Nuclear reportable events in the Nuclear Generation fleet for 2014, 2015 and 2016.

Unplanned Shutdowns

Unplanned shutdowns have the potential to challenge the operational safety of a power plant. NG is therefore committed to safe, reliable generation through the reduction and eventual elimination of unplanned shutdowns. Reduced plant availability due to unplanned shutdowns also has an adverse economic impact in terms of lost revenue and additional costs.

Work management

NG has implemented work management best practices following the INPO guideline AP-928. This process gives assurance that defence in depth is maintained for nuclear safety related equipment during routine and emergent maintenance activities. This ensures that operators are always able to make use of multiple safety systems which will, through carefully planned release schedules, have high availability factors both in normal operation and outage execution.

The guiding principles of an effective work management process are:

- To ensure nuclear safety and non-nuclear safety by providing timely identification, selection, planning, coordination, and execution of work necessary to maximise the availability and reliability of station equipment and systems.
- To manage the risk associated with conducting work.
- To identify the impact of work to the station and work groups and to protect the station from unanticipated transients due to the conduct of work.
- To maximise the efficiency and effectiveness of station staff and material resources.

Each reactor is required to be shut down for a statutory outage approximately every three years to undertake extensive maintenance which would not be possible during operation. The NG long-term outage planning process has been developed to give enhanced clarity with respect to the future outage programmes at each site. The aim of the outage management programme is to support the site delivery of the medium term plan commitments and to identify opportunities to optimise outage durations and costs. Since a significant proportion of the maintenance and maintenance-related activities are carried out during these outages, the quality of the outage planning and execution has a significant effect on the safety and reliability of the nuclear power plant, and consequently on the occurrence of unplanned shutdowns.

Equipment reliability

To ensure safety, nuclear significant equipment must be reliable. This is true for all components within a power station from large items of plant, through to valves and gauges. Therefore minimising the unplanned unavailability of equipment through poor reliability also minimises the instance of unplanned reactor shutdowns.

The nuclear industry has established a documented standardised best practice in the area of equipment reliability based upon reliability-centred maintenance. This equipment reliability process represents the integration and coordination of a broad range of equipment reliability activities into one process for plant personnel to evaluate important station equipment, develop and implement long-term equipment health plans to manage their health, monitor equipment performance and condition and make continuing adjustments to preventive maintenance tasks and frequencies based on local, fleet-wide and industry-wide equipment operating experience. All of which is focused on the principal goal of underpinning nuclear safety.

Through the equipment reliability process, the equipment that is critical for safe, reliable operation is systematically identified and its performance meticulously tracked. Risk based maintenance techniques are selected and used to define the preventive maintenance programmes and the life cycle management strategies to be adopted in order to maximise reliability and availability. This is done at both system and component levels, and is used to anticipate and prevent ageing and degradation effects impacting on nuclear safety and reliability. The process focuses on improving equipment reliability and availability, resulting in increased nuclear safety margins.

Organisational learning

NG is committed to improving organisational learning which encompasses human performance, nuclear safety culture, the corrective action programme. Organisational learning focuses on minimising the frequency and consequences of human errors through training, effective use of human error prevention tools, effective supervision, performance coaching and the identification and reduction of organisational weaknesses through investigations into events, incidents, near misses and performance trending of sub-standard conditions.

Human performance

Events leading to an unplanned shutdown derive directly or indirectly from organisational weaknesses. The objective of the human performance programme is to prevent safety and reliability related events and incidents and maximise nuclear safety margins. This is done by systematically identifying and addressing organisational weaknesses which lead to error-likely situations, promoting fundamental behaviours that reduce human error and by developing a nuclear safety culture which instils a defence-in-depth philosophy, supplementing and reinforcing the human performance of individuals through strong leadership.

The following principles have been used to inform the development of our human performance programme:

- Error-likely situations are predictable, manageable and preventable.
- Individual behavior is influenced by organisational processes and values.
- People achieve high levels of performance based largely on the encouragement and reinforcement received from leaders, peers and subordinates.
- Events can be avoided by understanding the reasons why mistakes occur and applying the lessons learned from the past events, not from apportioning blame.
- Even the best people make mistakes.

Our programme also encompasses the ten traits of a healthy nuclear safety culture as previously discussed.

Corrective action programme

The corrective action programme (CAP) is a cornerstone of continuous improvement and organisational learning. An effective CAP is fundamental to improving the resilience, safety and reliability of the plant. The objective of CAP is to identify low level issues before they become a significant problem, and provide early mitigations. If we do have an event we use the tools and techniques within the organisational learning toolkit to understand the root causes, eliminating these from the affected site and throughout the fleet. Promoting cross fleet learning is a powerful tool to ensure we learn from each other. By using CAP and the organisational learning toolkit we preserve plant reliability, which underpins a strong nuclear safety culture.

Unplanned plant shutdowns

A reactor trip describes when a reactor has to be shut down unexpectedly. Trips can be initiated automatically by the plant's own safety systems or manually by operations personnel. One of WANO's key performance indicators is the number of unplanned trips per 7,000 hours of reactor operation, which is approximately one year. Figure 3 shows the unplanned manual trip rate per 7,000 hours of reactor operation for 2014, 2015 and 2016. A low figure indicates that the reactor and turbine are operating safely and reliably.

Increased focus has been given to equipment reliability to ensure that learning from unplanned automatic trips is embedded across the fleet. As figure 3 shows, the unplanned automatic trip rate (UATR) for all our nuclear stations at the end of the 2016 calendar year was 0.3. This demonstrates a strong improving trend over the past three years.

In September 2016 Heysham 2 power station broke the world record for continuous operation, running for 940 days before shutting down for a statutory outage. The previous record was held by Ontario Power Generation's Pickering plant which ran continuously for 894 days from 1992 to 1994.

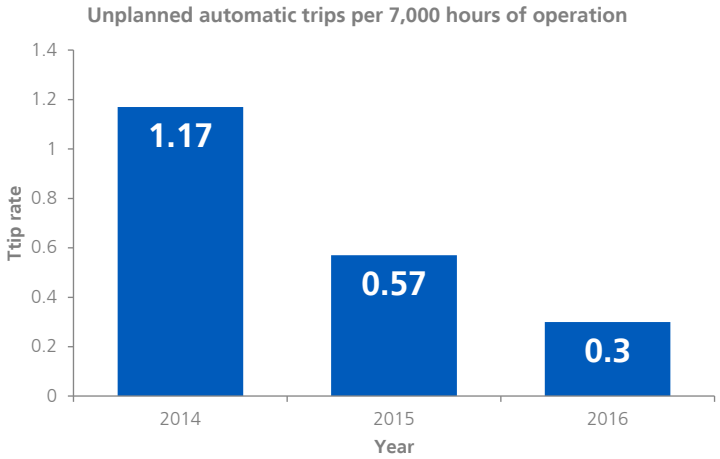


Figure 3. Unplanned automatic trip rate in the Nuclear Generation fleet for 2014, 2015 and 2016.

Operating experience

Effective sharing and use of our own operating experience is an important process established by the nuclear industry following the Three Mile Island accident in 1979. OPEX requires the review and dissemination of internal and external event notices to relevant stakeholders both within NG and the wider EDF business. As a contributor to the global nuclear knowledge base, NG communicates events from within the organisation to the broader worldwide nuclear community through WANO.

At the global level, WANO maintains a database of events reported to their event reporting system from every nuclear power plant on the secure WANO members' website. WANO has established specific reporting information categories, including causes, corrective actions and learning points. Members are encouraged to report events promptly, so that others can benefit from their experience. From this dataset and other significant events, WANO produce significant operating experience reports (SOERs) based on information submitted to WANO from the global community. Implementing the recommendations within the SOERs enhances our plant resilience and underpins improvements in nuclear safety. Nuclear Generation is systematically implementing all of the SOER recommendations across the nuclear fleet.

Nuclear Generation has implemented an organisational learning portal on the company intranet. This is a repository where over 30,000 operating experience reports from EDF Energy Generation nuclear and non-nuclear sites, other nuclear operators and other industries are stored. It also acts business networking tool, enabling staff to share knowledge across the fleet. Users can subscribe to areas of interest and also declare skills against a list of different categories of knowledge. In addition to being able to view event information and event documents, users can comment on items as well as raise and answer questions to other members of staff. All EDF Energy staff and contractors are expected to search for relevant operating experience in a proactive way before undertaking work to prevent repeat events.

Safety Assessments

There is a fundamental legal requirement for risks to be as low as reasonably practicable (ALARP). This responsibility is fully recognised by the company and leads it to continuously improve the maintenance of nuclear safety standards in its nuclear power plants. The safety cases for plant-based faults, internal hazards and external hazards all minimise consequences and drive risks ALARP.

Safety assessment principles

As previously mentioned, the company as an owner and operator of commercial nuclear power plant is responsible for the safety of its employees and the public. It aims to minimise risks arising from normal operation and from any nuclear accident arising from its installations and from events: to an acceptable level in line with national and international standards and industry best practice. The nuclear safety case therefore includes risk assessments of:

Plant-based faults Including loss of coolant events, loss of power, and equipment unavailability.

Internal hazards Including steam release, human error and fires.

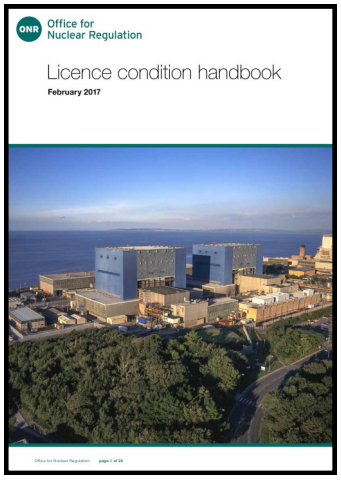
External hazards Including flooding, earthquakes, and extreme weather events.

Our primary focus is to ensure nuclear safety through positive control of reactivity, core cooling and containment. This includes containment of contents of the core, and all by-products of nuclear power plant operations whether in the reactor, during movement, disposal or storage.

The safety of the our nuclear power stations was determined prior to construction through use of agreed contemporary advice, including national and international standards and guidelines, and is also assessed as specific issues arise against the company's deterministic and probabilistic nuclear safety principles.

The company's nuclear safety principles have been defined taking into account the document issued by the Health and Safety Executive entitled The Tolerability of Risk from nuclear power stations (TOR) and subsequently developed further in guidance called Reducing Risks, Protecting People (R2P2) which reflects current thinking on tolerable levels of risk, both to individuals and to society as a whole. In common with TOR and R2P2, the concept of reasonable practicability is also an important feature of the nuclear safety principles.

Regulatory assessments


ONR Office for Nuclear Regulation

Licence condition handbook

February 2017

Each nuclear power station is subject to a nuclear site licence, which is issued by the ONR. The licence has 36 conditions, which govern all aspects of safe operation of the station and form the basis of our safety assessments. The ONR monitors the performance of the power station operator and appoints a site inspector for each station. All significant changes to the plant or to its operating procedures are subject to approval by the ONR.

Although subject to monitoring by the ONR, NG is self-regulating through our independent nuclear assurance function. All significant proposals for changes to plant or operating conditions are referred to these departments for independent nuclear safety assessment before they are put into effect.

Each station has a nuclear safety committee that advises on safety matters and is required to advise on all significant proposed changes to the safety case before they are submitted to the ONR. The membership of the nuclear safety committee consists of the station director, senior safety officers of the company and independent safety experts.

Design philosophy

Nuclear power stations are designed so that failures and malfunctions can be tolerated without the risk of a release of radioactivity. The objective of the safety case is to assess risks and demonstrate that, in the event of any credible accident; the reactor can be shut down and cooled so as to avoid radioactive releases. The reliability of safety systems is secured by the design principles of diversity, redundancy, independence, failsafe, testability and segregation.

These principles ensure that plant is protected from both common mode and common cause failure mechanisms:

Diversity	Equipment diversity describes having more than one type of equipment or system capable of performing a particular task. Having a diverse suite of equipment able to undertake a process protects against a failure mode that could occur across multiple pieces of similar plant. All the nuclear power stations have diverse trip, shutdown and post trip cooling systems.
Redundancy	The provision of duplicate plant items in excess of the number that can be foreseen as necessary enables safety systems to perform satisfactorily even if individual plant items fail to perform on demand. It also allows items to be taken out of service for maintenance.
Independence	Systems in place to maintain safety are designed to be fully independent from control and operational systems. For example, multiple and independent reactor cooling systems are installed at each station.
Failsafe	A piece of equipment must be designed such that in the event of a fault or failure, it produces the safest response. An example of this is the reactor control rods, which are designed to fully insert into the reactor core under gravity if external power supplies are lost. This ensures that the failure results in the safe shutdown of the reactor.
Testability	It must be possible to test the functionality of all safety critical equipment whilst the reactor is operating at power. It is also fundamental that the integrity of the system is not compromised by performing tests.
Segregation	Redundant and diverse systems located within the same area may still be subject to a common form of mechanical damage, for instance fire or flooding. The final stage in securing reliability is therefore segregation. Diverse systems are kept apart, or if this is not possible, are separated by suitable barriers.

Detailed consideration has been given to hazards which might damage the plant. Appropriate protective measures have been incorporated such that the worst damage that might potentially be inflicted by each hazard would not prevent safe reactor trip, shutdown and post trip cooling. The more significant hazards originating from outside the station include flooding, earthquakes and extreme winds. Aircraft impact is treated differently because it is not practicable to consider all possible effects in detail; a probabilistic argument is therefore used instead. It is shown that the likelihood of a crash causing damage leading to a release is acceptably low, and is within guidelines drawn up by the ONR. The more significant hazards originating from within the plant include fire, steam release, hot gas release, and loads dropped from cranes.

Maintain design integrity

The maintain design integrity process ensures that the design intent is met and that, where changes are made to the design, this is done in a controlled manner and rigorous configuration control is maintained over the reference plant documentation.

Plant changes may result for a number of reasons, including: obsolescence, operating experience, periodic reviews or enhancements.

Design changes may arise through various company processes, including: asset management; risk management; outage management; emergency preparedness; procurement and materials management; waste management; environmental management; operational experience; security; radiation protection; human performance; industrial safety and corrective action.

Most plant design changes are identified and scheduled in advance whereas some result from plant breakdown. Irrespective of the motivation for the work, any change to plant or the safety case will be subject to the maintain design integrity process.

Periodic safety review

Nuclear power stations generally have an operational life of around forty years or more; yet nuclear site licences are only valid for ten years. In order to get its site licence renewed, each nuclear site must undergo a periodic safety review. This is because over the operational life of the station, safety standards and reactor designs evolve. The purpose of the periodic safety review is to assess the station's performance against current standards, identifying gaps and addressing any issues according to ALARP principles. The review also assesses the risk of any potential faults arising within the reactor and reactor support systems and compare the results against the company's nuclear safety principles in order to:

- Confirm that the installation is adequately safe for continued operation within the current safety case.
- Identify and evaluate any factors which may limit the safe operation of the plant in the foreseeable future.
- Identify any safety enhancements that are reasonably practicable.

The assessment encompasses not only all radiological risks from the reactor but also considerations of:

- Criticality safety.
- The fuel route and radioactive waste treatment plant.
- Plant-based faults and internal hazards such as steam release.
- External hazards such as seismic, high winds, climate change leading to rising sea levels and flooding.
- National and international standards which set industry best practices.
- Operating experience gained within the company, the global nuclear industry, and through global high hazard industry events.

Nuclear safety reviews use:

Expert assessment of the design and system of operation including all relevant scientific, technical and human factors, plus good engineering practice. They also take into consideration accepted precedents and recognised codes and standards.

Structured safety arguments demonstrating the acceptability of the topic under review by assessment against deterministic principles and, where relevant, against the probabilistic principles, the doses to workers principle and methods for supporting safety case claims.

Appropriate quality assurance arrangements for the design, procurement, construction, installation, commissioning and operation of structures, systems and components. Similarly, appropriate arrangements are required for the production of nuclear safety documentation of adequate quality.

Beyond design basis fault analysis

It is recognised that there are certain highly improbable extreme fault conditions for which there is no specific design provision. These are called beyond design basis events. These could in principle arise either from extremely unlikely initiating events which are inherently severe enough to cause extensive plant damage, or from extremely unlikely sequences of events in which the many levels of designed-in defence in depth fail following a more minor initiating event.

Our safety management arrangements seek to mitigate risks from beyond design basis events through:

- Demonstrating plant resilience to beyond design basis initiating events, in particular an absence of cliff-edges just beyond the design basis so as to provide confidence in the existence of a healthy safety margin
- Maintaining the reliability of the plant required to provide the designed defence in depth, so that the sequential failure of that plant is avoided with high confidence
- Providing advice to the operators on how to regain control of the plant should there be challenges to the above
- Providing remotely stored deployable back up equipment and arrangements/instructions to use it, so as to increase the levels of defence using supplementary means of delivering the essential safety functions should some or all of the installed plant fail
- Providing advice about the objectives/actions to mitigate the risk to the public should this be required.

If an event at any station is, or threatens to become a significant challenge to the operators, we activate a highly developed, exercised and tested set of company emergency preparedness processes to support the affected station(s). These arrangements involve bringing all the relevant company resource to bear in managing the event. This would always be activated if a beyond design basis event were to occur.

Radiological Protection

EDF Energy is committed to maintaining a comprehensive radiological protection programme to safeguard staff, contractors, visitors and the general public against the hazards of ionising radiation arising from its operations. Our approach is to ensure compliance with all applicable regulations, emulate best nuclear industry practices and to work to a common fleet standard. We will strive to ensure that any exposure to ionising radiation is kept ALARP.

Protecting workers

Radiation dose is measured in units of milli Sieverts (mSv). The UK legal dose limit for an individual is 20 mSv per year. EDF Energy is committed to a robust radiological protection programme to safeguard staff and as such sets a company dose limit of 10 mSv per year. NG plants routinely have the lowest radiation dose of all plants worldwide. This is a result of AGR technology, excellent standards and practices. Sizewell B PWR is also within the worldwide top quartile performance band.

Radiological protection standards

1	Radiological protection of workers is paramount in the planning and execution of work involving ionising radiation. Work must be fully justified in terms of its net benefit.
2	Work activities are planned, specified and implemented in such a manner as to ensure that individual and collective radiation doses are maintained ALARP.
3	Whenever practicable, engineered and physical control measures are employed to minimise radiological risks in the workplace.
4	Radiological protection infrastructure is provided to ensure that the radiological protection programme is sufficiently implemented and maintained.
5	Adequate radiological protection monitoring instrumentation and personal protective equipment is provided to ensure the safety of workers.
6	Corporate and station ALARP committees periodically review radiological performance with a view to improving radiological protection standards and reducing radiation dose to workers.
7	Best nuclear industry practices are systematically be deployed to improve overall radiological protection programme standards. Common radiological practices and processes are deployed wherever possible.
8	Radiological protection control measures and performance are routinely reviewed and corrective actions implemented when required.
9	Training and instruction are provided to equip workers with the knowledge required to work safely in radiation controlled areas (RCAs).
10	Controls and supervision are provided to oversee the safety of persons required to enter RCAs.
11	Coaching is encouraged in RCAs to reinforce good practices and behaviours and correct sub-standard practices and behaviours.
12	Workers are expected to obey radiological protection rules, minimise the dose they accrue, limit the generation of radioactive waste and to correctly use personal protective equipment and monitoring instrumentation.
13	Any workers who purposely disregard radiological protection rules or instructions will be barred from entering RCAs until their management has instituted remedial action to prevent a recurrence; this is in the interest of their own and other workers' safety.
14	Counselling and reassurance monitoring are made available when appropriate to workers in instances where an individual has radiological concerns.

Monitoring individual exposure

The dose received by any worker required to enter a radiological controlled area is measured by an electronic personal dosimeter. While the legal dose limit for an individual is 20 mSv per year, we operate to a lower company dose restriction level of 10 mSv.

Figure 4 shows the highest individual dose received on our sites in 2016 was 5.188 mSv, well within our internal limit. The levels rose between 2014 and 2015 due to increased frequency of vessel entries and maintenance work. Overall radiological protection performance on NG sites has continued to exhibit year on year improvement with respect to radiation exposure due to enhanced governance, plus investment in training and equipment.

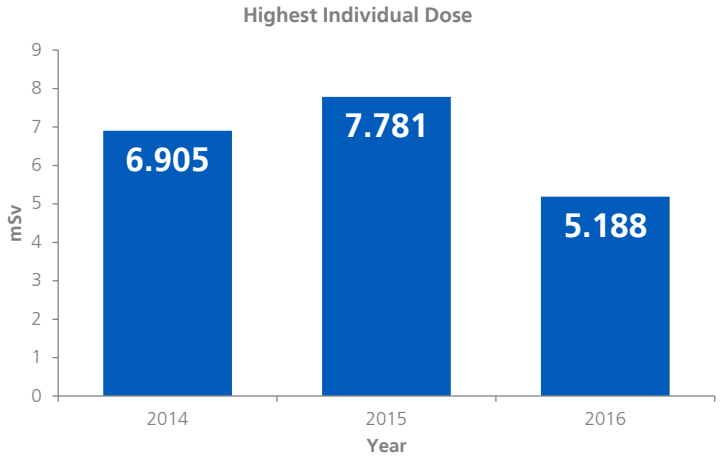


Figure 4. The highest individual annual dose to a member of staff for 2014, 2015 and 2016.

Collective radiation exposure

Collective radiation dose is the term given to the collective amount of radiation registered on dosimeters worn by employees and contractors at our nuclear stations. Low figures indicate low radiological exposure. This collective amount is expressed using the unit man Sieverts per reactor, or manSv/reactor.

As shown in figure 5, the three year average collective radiation exposure for NG at the end of 2016 as defined by WANO was 0.007 manSv/reactor. To put this into context, at the end of 2015 the CRE dose for the best performing quartile of stations worldwide was 0.33 manSv/reactor (source: WANO.org, all WANO centres).

NG CRE performance is five times better than the upper quartile level. NG stations are routinely the world's best performers for CRE according to WANO. This is the result of AGR technology and excellent radiological protection standards and practices. Sizewell B PWR is also routinely in the upper quartile performance band over its full operating cycle.

The three year collective CRE provides a good measure of performance as it smooths out the variations due to the cyclical outage programme. By comparison with other nuclear operators the radiation dose received by workers at NG is low; primarily due to the design of the AGRs, good PWR dose performance at Sizewell B and excellent control of all high dose work performed across the company. NG applies stringent procedures to reduce dose to a minimum and check the radiation doses received by staff and contractors.

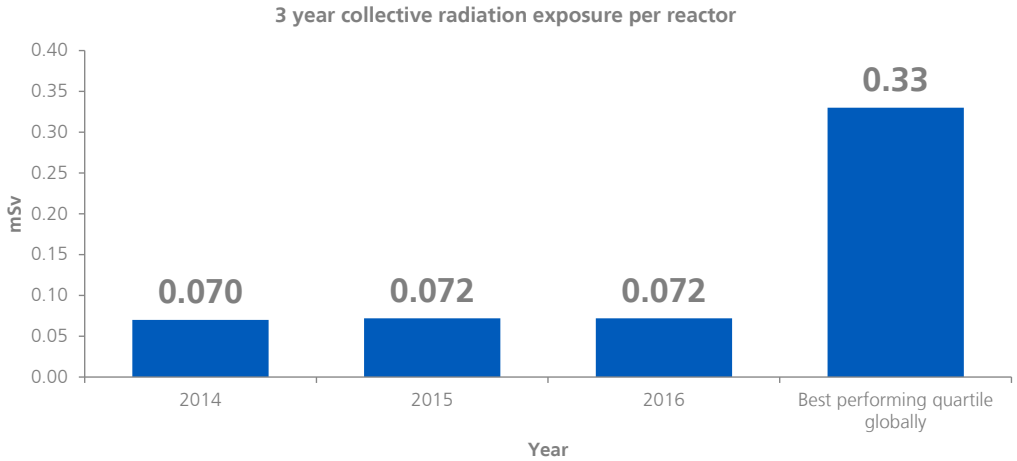


Figure 5. Three year collective radiation exposure per reactor for 2014, 2015 and 2016, compared to the WANO global best performing quartile.

Protecting the public and the environment

The main potential source of radiation dose to the public from our operations is associated with the potential impact of small amounts of radioactive material discharged to the environment.

Recognising the duty of care for the environment placed upon us by society, we have a special obligation to ensure our nuclear power stations are operated in a way that safeguards the public and the environment.

We operate our power stations to strict UK and EU laws on environmental protection. We report all events and emissions to the Environment Agency in England, and the Scottish Environmental Protection Agency in Scotland.

Nuclear Generation environmental policy

EDF Energy's environmental policy describes our requirement to ensure every job is done safely to protect the environment, employees, contractors and the communities that could be impacted by our operations. The policy commits us to continually improve our environmental and radiological protection performance and comply with all applicable legal and other requirements by:

- Reducing the environmental effect of our activities, products and services to a practicable minimum by the prevention of pollution, reduction of waste and the efficient use of resources.
- Demonstrating and promoting the efficient use of energy.
- Continuing to develop a sense of environmental responsibility among staff and contractors.
- Openly reporting performance against environmental targets.
- Assessing the impact of our operations on biodiversity and implementing opportunities for enhancement.

Environmental management system

In NG's environmental management system (EMS) we identify, plan and mitigate the risks associated with any operations with the potential to adversely affect the environment. This is achieved through:

- Establishing, implementing and maintaining documented procedures to control situations where their absence could lead to deviations from the environmental policy, objectives and targets.
- Stipulating operating criteria in the procedures.
- Establishing, implementing and maintaining procedures related to the identified significant environmental aspects of goods and services used by NG and communicating applicable procedures and requirements to suppliers, including contractors.

Broadly, there are two types of environmental documents that make up the EMS. The first type describes specific environmental processes that are generally applicable to all environmental regimes such as maintenance and operation of equipment and training of staff. The second type specifies how the company complies with particular major environmental legislation.

Each operational site has environmental specifications that are the mechanism for satisfying the above requirements from the central control room. These cover both radiological and non-radiological environmental processes.

NG's approach to environmental management is informed by the following standards:

- Clear compliance criteria are defined for all environmental permits, authorisations and consents that, if met, ensure we remain within the strict requirements of the regulations.
- Best available techniques (BAT) or best practicable means (BPM) is used where required.
- Clear and documented support is obtained from the environmental regulatory bodies for our interpretation of their environmental permits, authorisations and consents.

- We work with the environmental regulators to ensure our permits, authorisations and consents are based on sound science and are documented to avoid uncertainty in scope or interpretation.
- Activities are planned, specified and implemented in a manner that achieves environmental excellence.
- Plant is operated within the bounds of permits, authorisations, consents and other applicable environmental regulations.
- Plant design and operating margins are recognised and carefully guarded at all times by investigating and resolving problems promptly.
- Equipment is maintained so that it can perform fully as required in permits, authorisations and consents and other applicable environmental regulations.
- Operational decisions and actions are based upon the need to maintain margins of compliance to environmental limits.
- Decisions are made, based on the fullest information available, toward a long-term view of operation.
- Fostering a positive culture that is characterised by communications founded upon mutual trust and by shared values that recognise the importance of excellent environmental performance.

Dose to the most exposed members of the public

We are required to assess the radiation dose to the most exposed members of the public in the vicinity of our sites using the results of environmental monitoring. This does not however distinguish between the impact of our discharges and those of neighbouring operators. Discharge modelling is used to make a conservative assessment of the impact of our discharges on the local population. This is used to assess the hypothetical maximum dose to the potentially most exposed member of the public. The assessment for the three years 2014 to 2016 is shown in figure 6.

Doses to the public are a very small fraction of the legal limit and the average radiation dose due to natural background in the UK. The maximum hypothetical assessed dose received over this period is equivalent to the natural background radiation dose received during a normal day in the UK.

The consistent level of very low public dose from 2014 to 2016 is evidence of the company's successful efforts to employ best practicable means to minimise the impact of its discharges on the public (a formal requirement of our discharge permits).

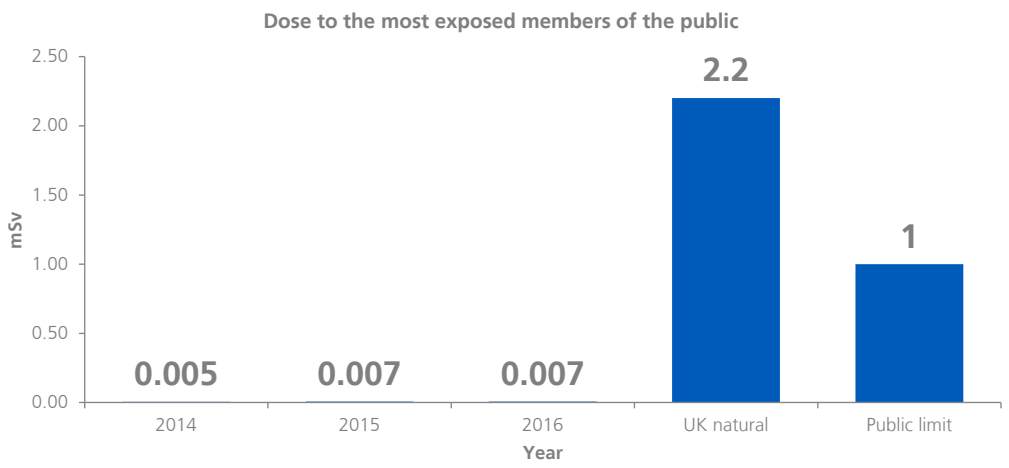


Figure 6. Annual assessed dose to the most exposed members of the public for 2014, 2015 and 2016, compared to the UK natural background radiation and UK public limit.

Nuclear Waste

Our zero harm ambition also applies to how we manage our waste. We consider it a minimum requirement to comply with all relevant environmental regulations, standards and other codes of practice. We strive to continuously improve our waste management performance from reductions in waste generated, through to our disposal arrangements.

Waste management principles

In order to achieve our goals we have a suite of governance arrangements to manage conventional and radioactive waste across the fleet. Figure 7 illustrates our overarching approach to waste management.

In the context of radioactive waste and spent fuel management, which we work to on an ALARP basis, we have the following aims:

- Reducing generated radioactive waste and optimising spent fuel.
- Effectively using the waste management hierarchy.
- Using reprocessed uranium in our existing fleet of power stations where appropriate.

NG is committed to working on future improvements in spent nuclear fuel and radioactive waste management and as such, we work together with the wider EDF Group to identify synergies.

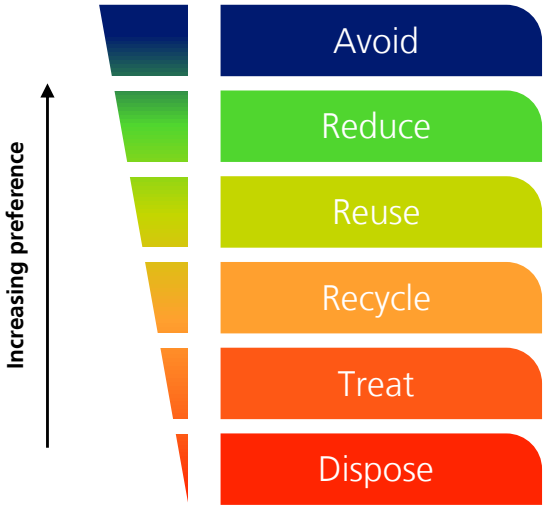


Figure 7. Nuclear Generation's waste management hierarchy.

Currently two key areas of interest are the reprocessing and/or long term storage options for spent fuel and the potential for optimising waste management options. As technologies and capabilities develop, these areas are reviewed. NG continues to explore the options for and fund research in reusing spent fuel material in future reactor designs. NG also continues to optimise end of life fuel usage for older AGRs.

The responsibility for radioactive waste management belongs with each site, as required by the nuclear site licence conditions. The safe management of radioactive waste on nuclear licensed sites in the UK is regulated by the ONR under the Nuclear Installations Act 1965 (as amended).

The following principles underpin how we manage radioactive waste:

- Radioactive waste will, at all times, be adequately controlled and/or contained so that it cannot leak or escape
- Radioactive waste will be accumulated and stored in a safe manner
- Radioactive waste will be characterised in terms of the rate of arising, the chemical, physical and radiochemical composition
- Radioactive waste with different chemical, physical and radiochemical properties will be segregated where practicable
- Radioactive waste volume reduction and decontamination techniques will be employed where practicable
- Radioactive waste for which there is no available disposal route will be safely stored pending the availability of a disposal route
- The condition of radioactive waste stored on site will be monitored in accordance with site licence requirements
- For each radioactive waste stream, the optimum method and timing for the retrieval, processing and packaging will be determined, taking account of safety, costs, the availability of a disposal route, the decommissioning strategy and non-foreclosure of future options
- Our governance arrangements ensure that our systems for processing and packaging radioactive wastes meet the requirements of future final disposal facilities.

Nuclear waste management system

The responsibility for spent fuel on NG's nuclear licensed sites rests with EDF Energy Nuclear Generation Limited as Licensee. The safe management of spent fuel is a primary focus in delivering safe operation and our zero harm ambition.

Spent fuel is handled under carefully controlled conditions and the process is managed and operated by suitably qualified and experienced persons (SQEP) individuals. The spent fuel management on station includes dismantling, cooling, temporary storage, containment, loading for transport and finally, despatch off-site. The operation and maintenance of the transport flask is set and controlled via the package operations and maintenance manual, the requirements of which are incorporated into station working documentation.

All of these processes are carried out under controlled procedures to ensure safety and compliance at all times. The processes are constantly reviewed by the SQEP individuals carrying out the tasks and any improvements are identified via the CAP system.

Changes to the management system for spent fuel can often have an impact on other companies and organisations. Therefore any changes are coordinated, managed and communicated to other organisations. Our staff are highly trained and we also support the training of our key contract partners and other supporting organisations.

All processes for loading, cleaning, monitoring and transporting the flasks are thoroughly verified to ensure that they are radiologically compliant. All activities are carefully carried out and documented to ensure that safety, security and compliance is maintained at all times.

NG also participates in nuclear industry working groups to investigate and address industry opportunities for improvement in both the management of spent fuel and its transportation. NG monitors performance of the systems described above and the performance and progress is reported both internally and externally.

We have a process called sustainable approach to waste management (SAWM), which aims to improve our performance whilst integrating with existing related company processes. A new fleet strategy for waste, radioactive waste improvement plan and technical baseline and underpinning research and development documents have been issued which will be implemented across the fleet. Through the fleet strategy, SAWM will develop and manage the use of performance indicators. Fleet strategy and waste management practices are defined through a suite of company specifications for all waste types, for which compliance and BAT are routinely reviewed. Consideration of the waste management hierarchy underpins these company specifications to ensure that waste disposal to land is always the final option. The waste management hierarchy provides a framework for preventing, minimising, treating and disposing of waste.

Our arrangements for the management of radioactive waste ensure:

- Radiation doses to the workforce and the general public from radioactive waste management operations, including disposal, are within legal limits and are ALARP.
- BPM and BAT are applied to ensure the generation of radioactive wastes is minimised as far as practicable.
- We dispose of all wastes as soon as practicable where a safe and economic route has been established.
- We maintain safety cases for all waste management activities including handling, accumulation and storage of wastes.
- We develop the technology and processes in conjunction with our supply chain, required for the safe retrieval, treatment, packaging and interim storage of wastes.
- We co-operate with other UK waste producers on radioactive waste policy and strategy issues, and manage major stakeholder relationships effectively.
- We maintain an inventory and records of radioactive waste arising, accumulations and disposals.

Waste disposal routes

Radioactive waste disposal is regulated by the Environment Agency in England and Wales and by the Scottish Environment Protection Agency in Scotland. In the UK, solid radioactive waste is defined by the following categories, requiring specific disposal routes.

Category		Disposal route
Very low level waste	(VLLW)	Consigned for landfill or on-site incineration
Low level waste	(LLW)	Sent for treatment and/or disposal to the national low level waste repository (LLWR)
Intermediate level waste	(ILW)	Sent for storage at specialist facilities.
High level waste	(HLW)	Sent to Sellafield for treatment and storage.

Examples of low level waste include redundant equipment, waste from maintenance activities; plastic, rubble, old protective clothing from our nuclear power stations, used filters and resins.

Spent fuel

Spent nuclear fuel is not currently classified as waste since it can be reprocessed to extract uranium and plutonium for re-use. HLW results from the reprocessing of AGR fuel at Sellafield. It contains high levels of radioactivity which generates heat. No HLW is stored on any EDF Energy power station.

Under historic contractual arrangements, spent fuel from our AGRs is transported to Sellafield in specially designed flasks for reprocessing or storage. Once processed, HLW exists in the form of glass contained within stainless steel canisters for long term storage at Sellafield.

The spent fuel from our AGRs can be temporarily stored in cooling ponds on site. Figure 8 shows the total amount of spent fuel stored in our cooling ponds across the nuclear fleet. Under our contracts, the NDA determine whether spent fuel is reprocessed to separate uranium and plutonium for possible future use, or stored for the longer term. In either case safety and protection of the environment are paramount.

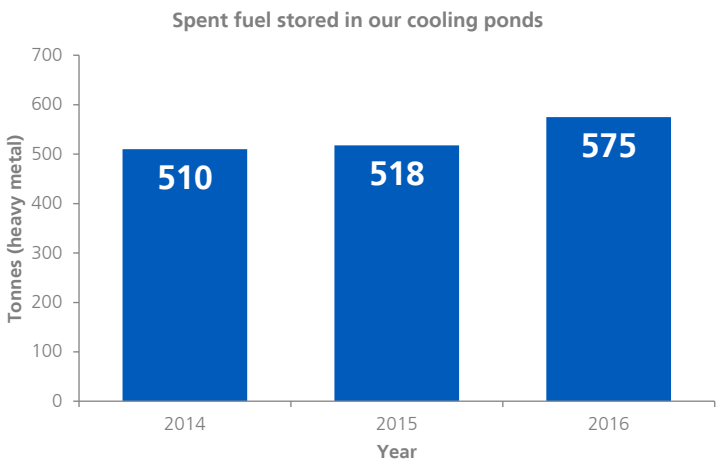


Figure 8. Total amount of spent fuel stored in our on-site cooling ponds in 2014, 2015 and 2016.

At Sizewell B PWR station, spent fuel is stored on site until a final decision is determined on its long term disposal route. We have built a new facility in which the station's spent fuel can be stored until the end of its operational life. Currently, the government's policy for the management of spent fuel from Sizewell B is that it will be directly consigned from on-site storage to a national disposal repository. Disposal of spent fuel from Sizewell B will not occur for a number of decades.

ILW is stored in purpose built facilities for radioactive decay and/or pending packaging for disposal. Where the volume produced exceeds the capacity of plant storage facilities, the excess is packaged to the anticipated requirements of a future national repository (for English stations). They are then placed in on-site interim storage. Scottish national policy differs in so far as ILW will be packaged in preparation for long term storage in Scotland.

Spent fuel poses potential risks to people and the environment, so we have a suite of policies and processes in place to ensure it is dealt with safely. Within NG we apply this in the context of nuclear spent fuel by:

- Prioritising safety and the protection of people and the environment above all else and playing a leading role in the drive for continuous improvement in these areas across the worldwide nuclear industry.
- Maintaining responsibility for managing our wastes including working with key external stakeholders to demonstrate progress towards implementing a long term UK radioactive waste solution for the industry.
- Ensuring that funding and knowledge are available to future generations to deal with the decommissioning and waste management needs of our stations .
- Practising openness and transparency in these businesses and demonstrating we can be trusted to act to the highest professional standards in relation to nuclear security issues.
- Not allowing nuclear materials from our business to be used for non-peaceful purposes. This is a legal requirement in the UK and under international treaties.
- Supporting development within the UK of the skills necessary to sustain these nuclear businesses through our work with schools, universities and other bodies.

NG is demonstrating the above through numerous programmes of work and control systems, these include:

- Nuclear material accountancy, which ensures that all of NG's nuclear material is accounted for at all times.
- Continuous learning though the active engagement in CAP, OPEX, self-assessment and benchmarking programmes to support our continuous improvement across our entire nuclear business.
- Research and development of new fuel types and designs to improve efficiencies and fuel use to minimise spent fuel arisings.
- Investment in post irradiation examination of fuel and components to ensure our plants are operated as safely and efficiently as possible.

Supporting Campus (EDF Energy's online learning portal for employees) by providing expert knowledge for training of our staff, contract partners and other organisations who are involved in the handling, transportation, storage and management of spent fuel and waste.

Waste performance

Low level waste (LLW)

Higher volumes of LLW disposed off-site indicates better management of radioactive waste on stations. Stations are encouraged to address the backlog of LLW accumulated on site. The greater the volume consigned for disposal in a year, the greater the reduction in accumulations.

Radioactive waste production depends on operating and maintenance patterns, so longer term trends are a better indicator than year to year comparisons. Annual values depend largely on the amount of maintenance carried out on the plant within the year. Higher volumes of waste are loosely correlated to increased levels of maintenance or are indicative of a particular waste management project that may have been undertaken in addition to routine waste arising.

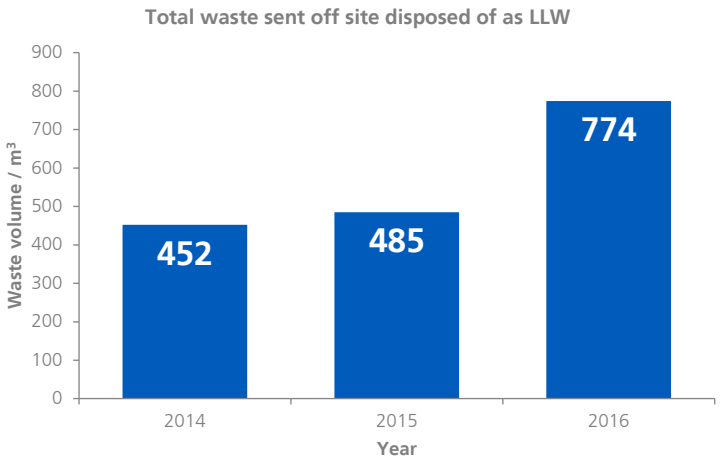


Figure 9. Total amount of low level waste sent off site in 2014, 2015 and 2016.

Intermediate level waste (ILW)

The ILW indicator is derived from the UK's 2013 Radioactive Waste and Materials Inventory (UK RWMI) issued by DECC (now the Department of Business, Energy and Industrial Strategy), and the National Decommissioning Authority (NDA).

This provides an estimate of the annual arising volume of waste disposed of as ILW at the end of the site's life. The waste volume is given as a packaged waste volume based on currently proposed waste processing techniques and package types. Figure 10 shows levels of ILW produced in 2014, 2015 and 2016.

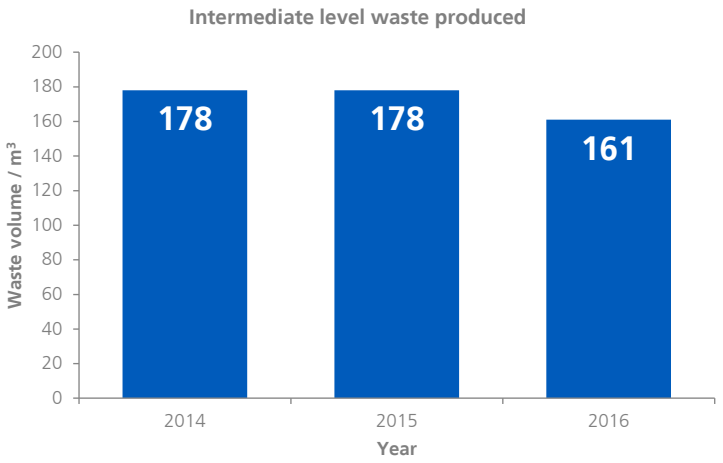


Figure 10. Total amount of intermediate level waste produced from 2014 - 2016

High level waste (HLW)

We have contracts with the NDA for the management of our spent AGR fuel and we monitor the performance and progress of the management by the NDA and its subcontractor, Sellafield Ltd, of materials created from our fuel. Spent fuel sent off site will vary from year to year due to numerous factors which include cooling times, optimising transport arrangements and operation capabilities within the UK nuclear industry. Spent fuel stored in our cooling ponds is a function of electricity generation and will generally show an increasing trend as PWR spent fuel remains stored on site.

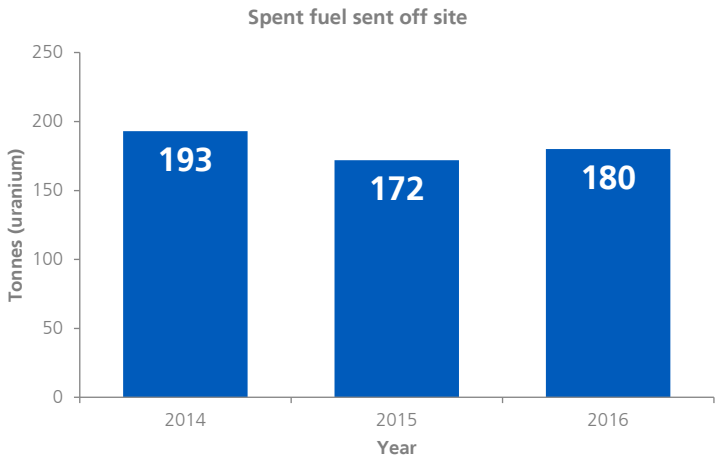


Figure 11. Total amount of high level waste sent off site in from 2014 - 2016

Decommissioning

Nuclear Generation is responsible for ensuring the safe decommissioning of all of its nuclear sites. A deconstruction and decommissioning organisation was established in 2015 to start these preparations.

Defueling and decommissioning plans for Hinkley Point B, Hunterston B, Hartlepool and Heysham 1 are underway. Once plants cease operation and move into the decommissioning phase, we will report on the progress of their decommissioning plans and the wastes arising from decommissioning activities. During the enactment of decommissioning, regular review and reporting of the actual waste inventory will include a comparison of the estimates used in planning the activities.

Decommissioning principles

The company decommissioning policy, strategy and plans have evolved over a number of years and have been developed using multi-attribute decision analysis to ensure that the best practicable environmental options are being pursued. The strategy and plans take due consideration of the nuclear, industrial and environmental safety implications. The company objective for decommissioning is to return the power station sites to a state suitable for unrestricted alternative use.

Nuclear Generation remains responsible for discharging all aspects of decommissioning works and the management of associated wastes for all its power stations. The role of the NDA, as agent for the UK Government and Secretary of State, is to administer the Liabilities Management Agreements, including the approval of Nuclear Liabilities Fund (NLF) payments for decommissioning and waste management.

The funding for NG power station decommissioning and waste management comes primarily from the Nuclear Liabilities Fund (NLF), into which we and other Licensees have been paying for a number of years.

The decommissioning strategy, policy and plans are subject to regular review. At minimum, a five yearly review of the plans is undertaken. This commitment to review ensures the plans reflect best practice, take advantage of OPEX from ongoing decommissioning projects and remain consistent with national and international policy and legislation. In developing our decommissioning plans and strategy, NG has worked with experienced contractors involved in the Magnox fleet decommissioning and international decommissioning projects. We actively participate in a range of related industry fora including those focussed on associated research and development into decommissioning and waste management.

Although no decommissioning activity has yet commenced at any of our stations, transition activities have commenced. Detailed baseline decommissioning plans (BDPs) for each site are in place and have been formally approved by our regulators and the NDA. The BDPs include site-specific detail on individual decommissioning activities and processes, including the requirements to transition an operational site to a decommissioning site, and includes consideration of the associated resourcing and training requirements.

The BDPs include detailed decommissioning work scope, schedules, and costs and include a comprehensive decommissioning radioactive waste inventory. The inventory of decommissioning waste is reported in the UK Radioactive Waste Inventory. The Inventory produces a statement every three years. The last statement was published in December 2016.

The estimates of decommissioning waste inventory are robust and based on comprehensive evaluation to ascertain its content and qualities. The decommissioning waste inventory will be maintained and formally reported throughout the decommissioning period to reflect the actual waste inventory as it arises. This OPEX will be used to refine any subsequent decommissioning waste estimates.

Any potential impacts of our operational activities on the agreed decommissioning plans are assessed and summarised in an annual review and formally reported to the NDA within the Annual Liabilities Report: Part 1 (ALR1). This provides a formal route for recording changes in our NG decommissioning and waste liabilities which may have occurred over the previous financial year.

We are focused on ensuring that there are no breaches in minimum performance standards which would potentially result in a detrimental impact to decommissioning.

Managing spent fuel

Radioactive wastes that arise during decommissioning will either be stored or disposed of depending on the availability of appropriate disposal routes, in accordance with UK Government and Scottish Government policies, noting that radioactive wastes will be disposed of where a disposal route exists.

The low level waste repository site near Drigg in Cumbria is currently available for the disposal of operational and decommissioning LLW within the constraints of its acceptance criteria and is expected to remain operational until at least 2050. It is Government intent that a national repository or geological disposal facility (GDF) for ILW will be constructed, although it is not expected to be available before 2040.

NG's decommissioning plans detail the sequence for dismantling the stations and calculate the amounts of radioactive and non-radioactive material that will be created. These plans use sustainability and recycling principles to ensure materials created are stored, recycled and disposed of in a manner consistent with safety and environmental legislation.

In this context, the term 'disposed of' reflects the strategic end point assumption for the waste when the waste has been conditioned/packaged, placed within the GDF and the GDF facility closed. For the waste strategic end point, waste disposed of to GDF, there are no alternative strategic options, this is the end state.

The inventory of materials projected for NG during decommissioning periods is contained in the latest publication of the National Inventory Statement.

Decommissioning management system

NG has a document that specifies the arrangements by which decommissioning of our power stations will be controlled to ensure compliance with all statutory and mandatory requirements. It describes the regulatory compliance (Site Licence), interface requirements and arrangements necessary for managing decommissioning at NG's power stations.

Radioactive wastes will be managed in accordance with the corporate radioactive waste management strategy and the integrated company practice for environmental compliance and management.

In addition to our ISO 14001 accreditation, the Sizewell B plant has attained registration to the European Eco-Management and Audit Scheme, demonstrating that environmental concerns are fully integrated in our business. There are site and central teams and specialists whose role it is to investigate and define environmental policies, strategy, standards and procedures, monitor compliance and provide advice on best practices.

Nuclear Generation's environmental policy will continue to apply to its decommissioning sites.

Training

The nuclear site licence requires NG to only use suitably qualified and experienced personnel to perform safety related work. Our training mission is to provide the right training to the right people at the right time.

Training policy

The requirement to only use suitably qualified and experienced personnel (SQEP) has been achieved through the implementation of a systematic approach to training which:

- Ensures qualified staff can work independently.
- Encourages line ownership.
- Ensures training is targeted at maintaining and improving performance.
- Includes development of a human performance and nuclear safety culture programme.
- Establishes an independent training standards accreditation board to oversee the process.

Our training policy statement sets the direction and approach. This policy lays the foundations for using training for performance improvement, the implementation of the systematic approach to training, line ownership, establishment of training committees and accreditation against internationally recognised training objectives and criteria by an independent accreditation board.

The nuclear power academy at the central support offices in Barnwood.

Nuclear Generation recognises the importance that well trained people have in maintaining nuclear safety. As such significant investment in the company's training and development infrastructure; such as EDF Energy's Campus, the nuclear power academy at Barnwood, training buildings, departments, and new and enhanced reactor simulators at each power station.

Training standards

Training is a leading indicator to succession management and the long term health of the organisation. Line managers are responsible for the effective training and qualification of their personnel. Monitoring how their staff are performing enables line managers to ensure that training contributes to safe and reliable plant operation and to identify training opportunities and solutions. Training is developed and conducted following consistent, rigorous processes to ensure effectiveness. Personnel that are assigned training responsibilities are the organisation's best, and can influence others to a higher level of performance. Other functions of training include:

- Providing the knowledge and skills needed for independent job performance.
- Incorporating operating experience from previous internal and external events.
- Ensuring the current and future needs of the organisation are met.
- Helping to reinforce management standards, expectations and key messages to embed future and expected behaviour.

Training processes, programmes and content are standardised across the fleet where possible and practical. INPO ACAD 02-001, Revision 0, The Objectives and Criteria for Accreditation of Training in the Nuclear Power Industry, provide the standards to which training aspires. Satisfactorily achieving these objectives, as determined by independent evaluation, is the measure of long-term progress.

Within NG the systematic approach to training is used to ensure that:

- Training needs are accurately identified through job and task analysis.
- Training objectives are defined according to job performance requirements.
- Training materials, methods and instructor lesson plans are developed to address learning objectives.
- Training is effectively delivered to the right audience and line managers are integrally involved.
- Training is evaluated using the Kirkpatrick Model which includes trainee feedback, assessments at end of training sessions to determine objectives of training have been met, post training in the field evaluations to ensure knowledge and skills have been transferred to the workplace and performance evaluations to confirm business improvements have occurred.
- While the training organisation owns this process, line managers and supervisors have a responsibility to be involved and to support all phases of this process in order to achieve quality training for their workforce.

Training organisation

Both the Campus training organisation and the Nuclear Power Academy provide a focus for company-wide improvements, with the role of:

- Setting the fleet training standards.
- Developing and delivering the initial technical training programmes for engineering, maintenance and operations.
- Developing and delivering a fleet certified instructor programme.
- Coordinating the fleet accreditation programme.
- Coordinating the fleet training improvement programme and providing governance.
- Maintaining a central apprentice programme for the fleet.

Each power station and central support has an established training department and training facilities, including classrooms, workshops with simulators and rigs. Line management leads training committees to drive the training improvement programmes based on operational needs.

Management of training

NG has adopted a hierarchy of committees at each of its locations to guide and monitor the training function, and to maintain appropriate oversight of training.

Strategic training committees involve the highest level of leadership at the station and in central technical and support functions. They concentrate on strategic issues such as ensuring that training is improving staff and plant performance, and promoting ownership and stewardship of training by line management. Training advisory committees focus on one particular training programme and include the training programme owner and curriculum review committee (CRC) chairs as members. It is the committee's responsibility to promote excellence in training and to evaluate the programme's effectiveness.

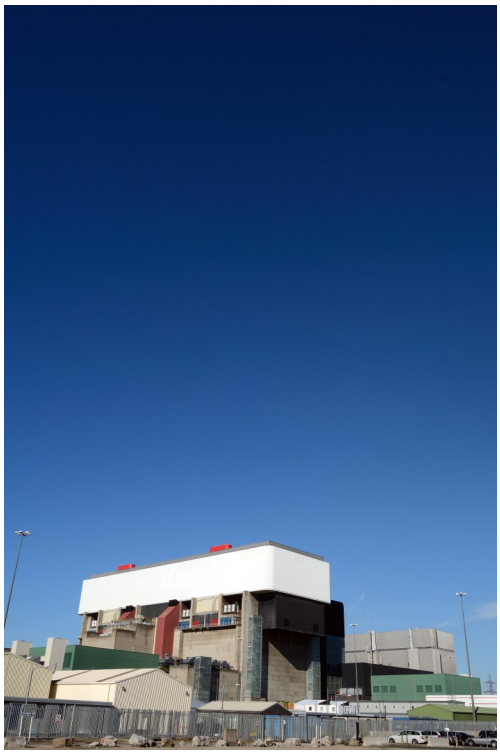
The CRC establishes and reviews training plans, approves learning objectives, reviews course feedback and determines the details of content, scheduling, delivery and evaluation of training programme events.

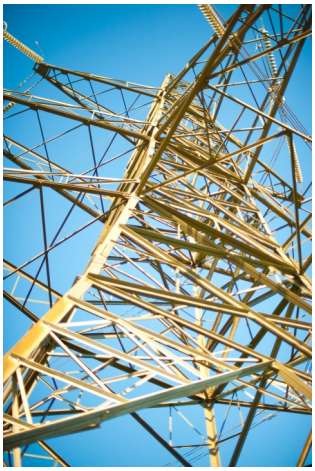
Self-assessments are used by the organisation to identify areas for improvement or opportunities for replication of good practices. A programme of training self-assessments is undertaken by each area of the business to determine alignment with the training objectives and criteria. The output from these assessments forms a key input to the training committees.

Accreditation process

There are three key phases to the accreditation process; a comprehensive self-assessment, accreditation team visit (ATV) followed by attendance and discussion at the training standards and accreditation board (TSAB).

The purpose of an ATV is to ascertain how plant training and personnel qualification programmes implement the systematic approach to training and address the accreditation objectives. The team comprises independent experts who provide an objective view of the conduct of training. The TSAB makes accreditation decisions on training programmes based on evidence provided via the stations' self-assessment, the ATV report and TSAB questioning of site representatives. TSAB members judge the capability of the line and training organisations to ensure nuclear personnel are being trained and qualified to perform their assigned activities safely, reliably and efficiently. By granting or renewing accreditation, the TSAB judges that the site is able to carry out effective training for the next four years.





Appendix A

Acronyms

AFIs	Areas for improvement
AGR	Advanced gas-cooled reactor
ALARP	As low as reasonably practicable
ALR1	Annual liabilities report: part 1
ATV	Accreditation team visit
BAT	Best available techniques
BDPs	Baseline decommissioning plans
BPM	Best practicable means
CAP	Corrective action programme
CNC	Civil Nuclear Constabulary
CNS	Civil nuclear security
CRC	Curriculum review committee
CRE	Collective radiation exposure
EMS	Environmental management system
GDF	Geological disposal facility
GWe	Gigawatts (electrical)
HAW	Higher activity radioactive waste
HLW	High level radioactive waste
INES	International nuclear event scale
INPO	Institute of Nuclear Power Operators
IAEA	International Atomic Energy Agency
ILW	Intermediate level radioactive waste
LLW	Low level waste
LLWR	Low level waste repository
mSv	milli Sieverts
ManSv	Man Sieverts
MWe	Megawatts (electrical)
NDA	Nuclear Decommissioning Authority
NG	Nuclear Generation
NISR	Nuclear industries security regulations
NLF	Nuclear liabilities fund
NNB	Nuclear New Build
NRE	Nuclear reportable events
ONR	Office for Nuclear Regulation
OPEX	Operating experience
PWR	Pressurised water reactor
R2P2	Reducing risks, protecting people
RCA	Radiological controlled area
SAWM	Sustainable approach to waste management
SOER	Significant operating experience report
SQEP	Suitably qualified and experienced personnel
TOR	Tolerability of risk (from nuclear power stations)
TSAB	Training standards and accreditation board
TWh	Terrawatt hours
UATR	Unplanned automatic trip rate
UK RWMI	Radioactive waste and materials inventory
UNGC	United Nations Global Compact
WANO	World Association of Nuclear Operators
VLLW	Very low level waste

Appendix B

EDF Energy Nuclear Generation Nuclear Safety Policy

Nuclear Generation
Nuclear Safety Policy

Executive Sponsor	Mike Harrison
Lead Policy Owner	Teresa Mullen
Policy Reference Number	BEG/POL/006
Version Number	012
Date of Effect	09/02/2017

2 Nuclear Generation Nuclear Safety Policy

Policy Statement

Nuclear safety is our overriding priority. Every one of us has a direct or indirect impact on nuclear safety and it must be in the forefront of what we do. Additionally we must ensure that radiological, environmental, industrial and fire safety are adequately controlled in support of our ambition to achieve a zero harm safety record.

This policy represents our corporate commitment to nuclear safety and is implemented via our management processes. It requires the commitment of all leaders to support and demonstrate the values outlined in this policy and the commitment of all individuals to maintain positive control of nuclear safety via our deliberate, considered actions.

In operating our nuclear facilities, we have no greater responsibility than to protect the public, the environment and ourselves from the potentially adverse effects of our technology. We are responsible for the safe operation of these facilities. Our obligation, as a nuclear operator, is to protect the people of this country and the population worldwide by maintaining nuclear safety at all times. We need to take that obligation very seriously throughout the organisation. The importance of maintaining nuclear safety cannot be overstated and this policy requires that everyone is aware of their obligations. Fission products, decay heat and vast amounts of stored nuclear energy can have an adverse impact on our wider society if released in an uncontrolled manner.

Our primary focus is to ensure nuclear safety through positive control of reactivity, core cooling and containment of the contents of the core and all by-products of nuclear power plant operations whether in reactor, during movement, disposal or storage (referred to as 3Cs). We are committed to keeping the overall balance of risks As Low As Reasonably Practicable (ALARP).

We have adopted the following definition of Nuclear Safety Culture:

"That assembly of characteristics and attitudes in organisations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance." (From IAEA Safety Series No75-INSAG-4 "Safety Culture".)

This means that, in working together, we should all recognise our individual and collective impact on nuclear safety such that we all do the right thing at all times, that is:

"Nuclear Professionals, doing the right things."

Stuart Crooks, Managing Director
For and on behalf of the Generation Executive Team

3 Nuclear Generation Nuclear Safety Policy

Policy Standards

Safe nuclear operation is achieved by:

Nuclear Safety Culture

1. A positive Nuclear Safety Culture that is continually fostered within the organisation, characterised by communications founded upon openness, mutual trust and shared values. This includes fostering a Safety Conscious Work Environment (SCWE) in which we all openly report and pursue safety issues or concerns without experiencing a negative reaction;

Plant

2. Plant that is well designed, operated and maintained within established safety cases to ensure they operate at a tolerable risk;

Process

3. Processes that are robust and focused on prevention of events, problem identification and resolution;

People

4. People who are well trained, follow procedures, demonstrate a questioning attitude, uphold the highest standards and coach each other to improve those standards;

Learning Organisation

5. A learning organisation that strives for excellence by continuous improvement;

Underpinning Principles

This policy is also supported by the adoption of the following ten traits (from WANO / INPO):

Personal Accountability: all individuals take personal responsibility for safety.
Questioning Attitude: individuals avoid complacency and continuously challenge existing conditions and activities in order to identify discrepancies that might result in error or inappropriate action.
Effective Safety Communication: communications maintain a focus on safety.
Leadership Safety Values and Actions: leaders demonstrate a commitment to safety in their decisions and behaviours.
Decision Making: decisions that support or affect nuclear safety are systematic, rigorous, and thorough.
Respectful Work Environment: trust and respect permeate the organisation.
Continuous Learning: opportunities to learn about ways to ensure safety are sought out and implemented.
Problem Identification and Resolution: issues potentially impacting safety are promptly identified, fully evaluated, and promptly addressed and corrected commensurate with their significance.
Environment for Raising Concerns: a safety-conscious work environment (SCWE) is maintained where personnel feel free to raise safety concerns without fear of retaliation, intimidation, harassment, or discrimination.
Work Processes: the process of planning and controlling work activities is implemented so that safety is maintained.

Periodic Assessment

The health of our Nuclear Safety performance and culture will be periodically assessed to ensure that the objectives of this policy and the ten traits above are being achieved.

Relationship With EDF Group Nuclear Safety Policy

Nuclear Generation Limited (NGL) complies with the attached EDF Group Nuclear Safety Policy (Appendix A) through a combination of the NGL Nuclear Safety Policy and the supporting NGL Management System.

References

Bibliographical References

- IAEA Safety Series No75-INSAG-4 "Safety Culture"
- INPO / WANO – Traits of a Healthy Nuclear Safety Culture

Implementing References

- GMS/REP/17/004 – Nuclear Safety Policy Route Map

Definitions

Word or Phrase	Definition
ALARP	As Low As Reasonably Practicable
IAEA	International Atomic Energy Agency
INPO	Institute of Nuclear Power Operations
INSAG	International Nuclear Safety Advisory Group
WANO	World Association of Nuclear Operators

5 Nuclear Generation Nuclear Safety Policy

Change History

Version	Date	Changes Made
009	01/09/2014	Change to reflect the transition from Principles for a Strong Nuclear Safety Culture to Traits of a Healthy Nuclear Safety Culture
010	22/07/2015	Cancelled revision
011	22/07/2015	Change of Lead Policy Owner
012	09/02/2017	Change to replace the signed letter with Jean-Bernard Levy letter dated 18th January 2017

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Appendix A EDF Group Nuclear Safety Policy

Le Président-Directeur Général

EDF Group Nuclear Safety Policy

We all, within EDF Group, share the same vision that nuclear safety is the overriding priority in the sustainable use of nuclear energy, recognising that nuclear energy needs also to be efficient, affordable and environmentally friendly. It is an indispensable precondition when providing energy to humanity.

Nuclear safety inside the Group rests on the principle of clarity of responsibility and control.

- Each nuclear operating company inside the group acts under the framework of legal obligations and regulations specific to its country and must comply with them. Each guarantees and continuously improves its safety performances with its own methods, skills and values.
- EDF respects national differences, across the Group, whilst developing common principles to deliver the highest level of incident prevention and protection of the public, workers, and the environment. This policy covers all aspects of nuclear – for example, new build, architecture, design and construction – and all aspects of the existing stations – operation, maintenance, waste management, decommissioning and off-site support. The Group works closely with its industrial partners to deliver this.
- Each company is responsible for, and assigns adequate delegation at each level of management or operation: clear organisation, the required skills and decision-making capacity, access to support and resources. The Group guarantees the allocation of resources needed to ensure nuclear safety.
- An in-house independent nuclear safety assessment function is put in place at power station level, company level and Group level. Each report independently of all line functions and have not only the right, but also the duty, to notify senior management of inappropriate or inadequate line management response.

Common commitments for all nuclear companies of the Group

- An overriding priority is placed on nuclear safety at every stage of the plant lifecycle: design, construction, operation and decommissioning. That priority is the responsibility of all and is demonstrated via the individual commitment of all staff within the Group. Each company ensures that its contractors enforce that requirement, and employ well-trained and professional staff.
- The Group recognises that excellence in everything we do is underpinned by equipment reliability, human performance and efficient work management, as these are the main drivers of nuclear safety and reliability.

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- The Group recognises the importance of establishing a good nuclear safety culture among its staff and contractors. This is characterised by people having a questioning attitude and being free to raise safety concerns, using error prevention techniques, reporting in a timely and transparent way, being conscious of risks and continuously assessing them. The Group values highly, and encourages, independent oversight and challenge.

- Although it is mobilised to minimise the risk of any incident or accident, the Group must respond adequately to such an event with the aim to protect public health and safety. The Group's companies maintain comprehensive emergency plans at a high state of readiness, including carrying out regular emergency drills with local and national authorities. The Group uses these opportunities to reinforce its communication towards the public and to enhance the safety culture of its staff.

- Continuous improvement is promoted and organised using the full range of knowledge and services within the Group and within international organisations. Operational experience is collected, analysed, reported, and acted on.

- International experience enriches continuous improvement and the drive for excellence: the Group's companies commit both to receive regular international peer reviews and provide suitable peers for such reviews in other companies. All recommendations are considered and acted on.

- Openness and transparency: we aim to build openness and trust internally and externally by creating an open culture and actively engaging with our stakeholders and communities through clear and timely communications on nuclear safety issues and incidents. We strive for a constructive, open and trusting, relationship with our Stakeholders, including our staff, our supplier's staff, regulators, trade unions and local communities.

Application

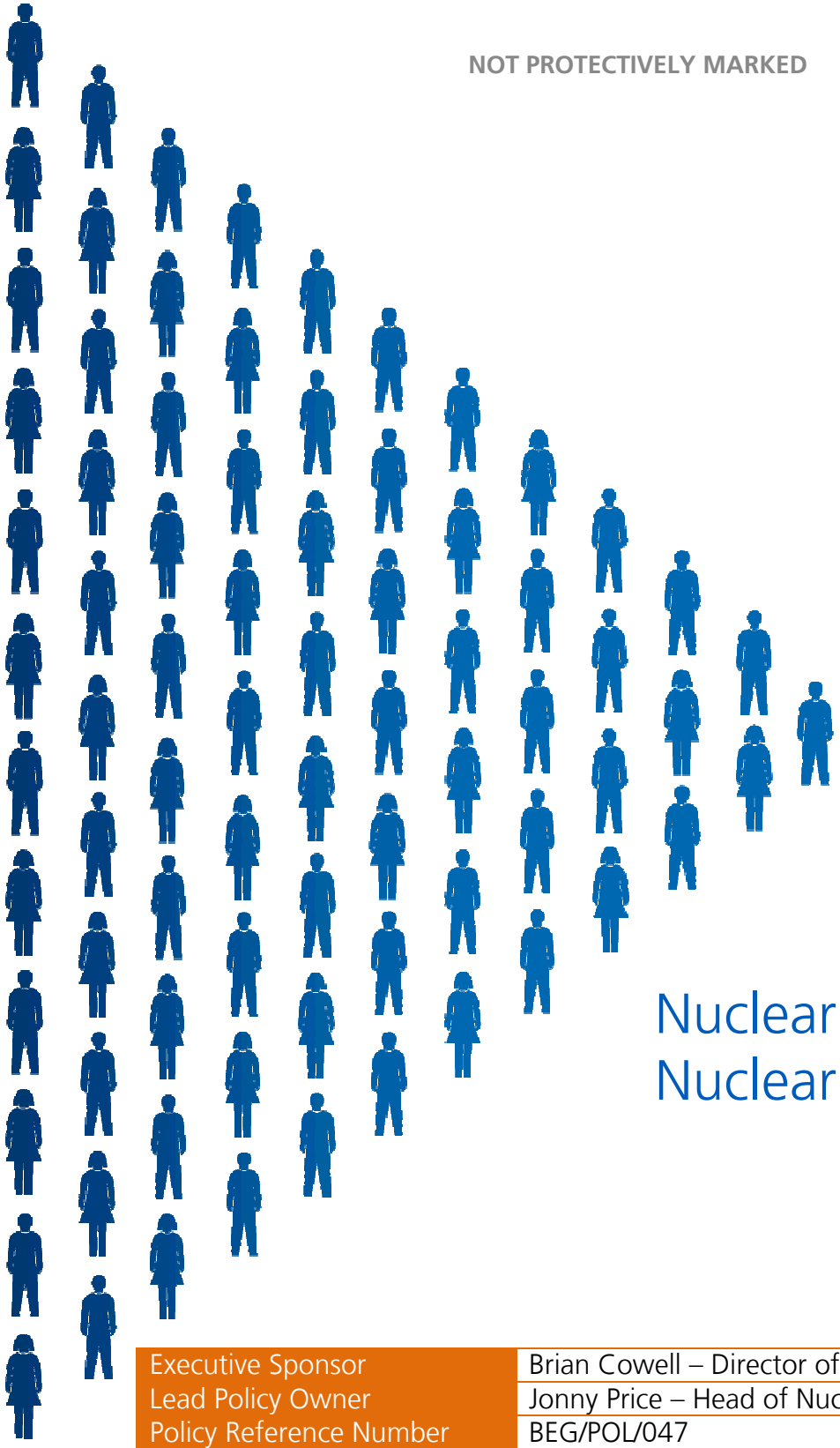
The responsibility for the deployment of this policy, and the overall operation of the business unit, lies unambiguously with the line management. Group is responsible for checking, using appropriate mechanisms, that the policy has been adequately deployed and the standards and quality for the delivery of nuclear safety are being adequately maintained by the line management.

Paris, 18th January 2017

Jean-Bernard Lévy

Appendix C

EDF Energy Nuclear Generation Nuclear Security Policy



Nuclear Generation
Nuclear Security Policy

Executive Sponsor	Brian Cowell – Director of Nuclear Operations
Lead Policy Owner	Jonny Price – Head of Nuclear Security
Policy Reference Number	BEG/POL/047
Version Number	000
Date of Effect	01/05/2017

2 Nuclear Generation Nuclear Security Policy

Policy Statement

Nuclear Security provides an essential foundation block without which Nuclear Safety cannot be assured. As nuclear professionals we have individual and collective responsibility to deliver and support an effective nuclear security regime and a strong nuclear security culture throughout our organisation, recognising that security is not the sole preserve of our dedicated security staff.

Where necessary to ensure nuclear safety, protect radiological material or sensitive nuclear information, security will take precedence over other operational matters.

This policy describes our corporate commitment to nuclear security and is implemented via our management processes. It requires all leaders to support and demonstrate the values outlined in this policy and the commitment of all individuals to consider security as a core part of their day to day business activities. Adherence to our security arrangements will ensure effective mitigation of a range of security threats that pose a risk to nuclear safety and our overall business objectives.

In operating our nuclear facilities we must protect our plant, people, radiological material and sensitive information from sabotage, subversion and theft, by both internal and external malicious actors, thereby protecting the public, the environment and ourselves from the potentially adverse effects of our technology.

Our nuclear security arrangements ensure our facilities are protected from a range of dynamic threats that face the United Kingdom, including terrorist and cyber threats. We take that responsibility very seriously and, throughout the organisation, the importance of maintaining a comprehensive security regime and culture cannot be overstated. This policy requires that everyone is aware of their obligations.

Through the establishment and sustainment of a comprehensive, risk informed, multi-layered and proportionate security regime, we are committed to ensuring all security risks are effectively mitigated. Working together as nuclear professionals, we recognise the security risks we face and understand our individual and collective responsibilities in ensuring the security of our plant, people and information.

Brian Cowell, Director of Nuclear Operations
For and on behalf of the Generation Executive Team

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Policy Standards

Secure nuclear operation is achieved by having:

A Robust Nuclear Security Culture

1. Nuclear Security Culture is described by the International Atomic Energy Agency as "*The assembly of characteristics, attitudes and behaviour of individuals, organisations and institutions which support and enhance nuclear security*". A robust nuclear security culture ensures that the management and implementation of the nuclear security arrangements receives the attention warranted by their significance. In EDF Energy Generation we will ensure that a robust nuclear security culture is fostered, characterised by openness, mutual trust and shared values. Our organisation will be 'security aware' and we will positively encourage the reporting of security concerns.

Risk Informed Security Solutions

2. Based on risk informed analysis and decision making, our security solutions will be appropriate, proportionate to the threat, comprehensive and based on the principles of security 'in-depth' and our established multi-layered approach to risk mitigation and hazard management.

Security Aware People

3. In an effective security environment people feel personally accountable for their behaviour and are motivated to ensure nuclear security standards are understood and maintained. Our people will be well trained, demonstrate an inquisitive attitude, uphold the highest security standards and utilise learning and coaching techniques to continually improve standards, increase security awareness and maintain a robust security culture.

Learning Organisation

4. The organisation will seek continual improvement in nuclear security culture and work to prevent complacency from compromising overall security objectives. A learning organisation will exist that strives for excellence by continuous improvement.

Underpinning Principles

This policy is also supported by the adoption of the following traits (from WANO/ WINS / IPPAS):

Personal Accountability: all individuals take personal responsibility for security.
Questioning Attitude: individuals avoid complacency, challenge existing conditions to identify activities and deviations from security standards that may pose a security risk.
Effective Security Communication: communications highlight security concerns and standards consistent with all other hazards the business needs to manage.
Leadership Security Values and Actions: leaders demonstrate a commitment to security in their decisions and behaviours.
Decision Making: decisions that support or effect nuclear security are systematic, rigorous and risk informed.
Respectful Work Environment: trust and respect permeate the organisation.

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Continuous Learning: opportunities to learn about ways to enhance security mitigations are sought out and implemented.
Problem Identification and Resolution: issues potentially impacting security are identified, evaluated and promptly addressed and corrected commensurate with their significance.
Environment for Raising Concerns: As nuclear professionals a security-aware working environment is maintained where personnel feel free to raise security concerns without fear of retaliation, intimidation, harassment, or discrimination.

Periodic Assessment

The health of our Nuclear Security performance will be periodically assessed to ensure that the objectives of this policy and the traits above are being achieved.

References

Bibliographical References

- Nuclear Industries Security Regulations 2003
- Nuclear Installations Act 1965

Implementing References

- BEG/ICP/SEC/ORG/001 – Management of Security

Definitions

Word or phrase	Definition
WANO	World Association of Nuclear Operations
WINS	World Institute for Nuclear Security
IPPAS	International Physical Protection Advisory Service

Change History

Version	Date	Changes Made
000	01/05/2017	First issue