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THE ENERGY WHITE PAPER 2020 AND NEW NUCLEAR: DECOMMISSIONING AND WASTE IMPLICATIONS

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1. Introduction

In 2008 the UK Government committed to the development of a new generation of nuclear power stations in the UK[1]. All of the potential sites for new nuclear that were identified at that time were existing NDA sites or those hosting operational nuclear stations.

The energy landscape changed significantly in December 2020 when the UK Government published a **White Paper[2]**, setting out how it intends to deliver Net Zero Carbon by the target date of 2050. It proposes at least one more large new nuclear station, but also the development of alternative forms of nuclear generation: **Small Modular Reactors (SMRs**), **Advanced Modular Reactors (AMRs)** and **fusion** power. Government also commits to a vast expansion of renewable energy, large-scale energy storage and the development of the hydrogen economy.

While it is not within Nuleaf's remit to form a view on whether new nuclear power stations should be built, the proposals in the White Paper will impact on nuclear legacy management and the waste inventory. Proposals for new nuclear generation are likely to be identified as the 'next planned use' for a number of legacy sites. NDA sites may also host new renewable energy capacity along with hydrogen and energy storage facilities.

This Briefing Paper explains:

- Current policy for new nuclear in England and Wales
- The key points of the 2020 Energy White Paper and the UK's framework for moving towards Net Zero Carbon.

[1] UK government commits to 16GW of new nuclear
[2] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/945899/201216_BEIS_EWP_Command_Paper_Accessible.pdf

- The implications, in terms of decommissioning and waste management, of alternative forms of nuclear generation, along with the scope for NDA sites to be used to promote renewable energy technologies.

Policy and proposals for individual new nuclear developments are moving forward at a significant pace and this paper will be updated to reflect these.

2. Current UK policy on new nuclear power, decommissioning and legacy waste management

The Government legislated in the **Energy Act 2008** to ensure that operators of new nuclear power stations have secure financing arrangements in place to meet the costs of decommissioning and their full share of waste management and disposal costs. The Act is supported by the UK Government's **Long term Nuclear Energy Strategy**[3] which was published in 2013.

Policy for the delivery of major energy developments in England and Wales is set out in a series of National Policy Statements (NPS). The **National Policy Statement (NPS) for Nuclear Power Generation (EN-6)**[4] provides the primary basis for decision taken by the Infrastructure Planning Commission (IPC) on applications it receives. It is used by local planning authorities in preparing local impact reports and sets out a range of information on the decommissioning and legacy waste aspects of new nuclear. EN-6 was published in 2011 and sits under the primary NPS on **Energy (EN-1**).

The end point of Higher Activity Waste (HAW) from any new nuclear stations, as with that of former and current plants, is envisaged to be a **Geological Disposal Facility (GDF).** Waste should be placed in safe and secure interim storage facilities prior to a geological repository becoming available.

Government launched a new siting process for a GDF in 2018. Current policy is set out in:

- **Working with Communities: long term management of higher activity radioactive waste**, published in December 2018 (England[5]) and January 2019 (Wales[6]).
- The **National Policy Statement (NPS) for Geological Disposal Infrastructure**[7], which establishes a Geological Disposal Facility (GDF) as a Nationally Significant Infrastructure Project (NSIP). The NPS only

[3] Long-term Nuclear Energy Strategy (publishing.service.gov.uk)
[4] https://www.gov.uk/government/publications/national-policy-statements-for-energy-infrastructure
[5] https://www.gov.uk/government/publications/implementing-geological-disposal-working-with-communities-long-term-management-of-higher-activity-radioactive-waste
[6] https://gov.wales/written-statement-geological-disposal-radioactive-waste-working-potential-host-communities-0
[7] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/814491/national-policy-statement-geological-disposal-infrastructure.pdf

applies to England – separate planning process will be applicable if communities in Wales enter the siting process.

Given the uncertainty about the exact scale of any new nuclear development there is the potential for it to exceed the 16GW programme included in current inventory projections. The Working with Communities policy (para 6.55) recognises that any increase in Spent Fuel and Intermediate Level Waste (ILW) resulting from a new nuclear programme that exceeds current expectations would have to be discussed and agreed with communities engaged in the siting process. The policy (para 6.54) emphases that dialogue around the inventory should be undertaken with potential host communities.

Upcoming policy developments

On the 6th September 2021 the UK Government announced that it would be undertaking a review of the energy National Policy Statements[8], starting with EN-1. In due course a new NPS on Nuclear, which will address the issues arising from SMR/AMRs will be developed, as will a NPS on Fusion.

The UK and Devolved Governments are due to consult on a new **Nuclear Decommissioning and Radioactive Substances Policy**. This will set out the framework for site remediation and the management of waste from new nuclear power stations.

3. The 2020 White Paper: a new energy landscape

The UK Government has set a legally binding target to achieve **Net Zero Carbon** by 2050[9] and has committed delivering 78% emission reductions by 2035[10]. The **Welsh Government** has committed to Net Zero carbon by 2050 and has set interim targets of a 63% cut by 2030 and an 89% reduction by 2040[11].

The **Energy White Paper** was launched by the UK Government on the 18th December 2020. The primary objective is to drive moves towards a 'net zero' energy system through action across energy generation, industry, transport and the domestic sector.

It sets targets for 2030 of:

- 40GW of offshore wind, representing a quadrupling of current capacity.
- 5GW of low carbon hydrogen.

[8] https://www.gov.uk/government/consultations/planning-for-new-energy-infrastructure-review-of-energy-national-policy-statements
[9] https://www.gov.uk/government/news/uk-becomes-first-major-economy-to-pass-net-zero-emissions-law
[10] https://www.gov.uk/government/news/uk-enshrines-new-target-in-law-to-slash-emissions-by-78-by-2035
[11] https://gov.wales/climate-change-targets-and-carbon-budgets

- Ending the sale of petrol and diesel engine cars and vans.
- The Capture, Usage and Storage (CCUS) of 10Mt of carbon in four industrial clusters.
- Development of at least one more large nuclear power station.

The White Paper also identifies new and advanced nuclear technologies, which are explained in more detail in Section 4 below. Government is committed to:

- Consideration of Small Modular Reactors (SMRs) and Advanced Modular Reactors (AMRs).
- The construction of a commercially viable fusion power plant by 2040.

The White Paper is supported by a **10 Point Plan for a Green Industrial Revolution**[12], published at the end of 2020. **A Clean Growth Strategy**[13] was launched in 2017 and an **Industrial Decarbonisation Strategy** was released in March 2021[14].

4. Evolution of energy policy: Implications for legacy waste management

The White Paper envisages that electricity demand could double by 2050 as heat and transport are decarbonised. Two scenarios of the future energy mix are offered. Both require a huge increase in renewable generation but also at least a doubling of nuclear capacity.

No information is provided in the White Paper on the decommissioning and waste implications of this proposed nuclear expansion. It is hard to quantify these impacts at present as the scale and mix of different types of new nuclear generation is not clear. The White Paper states that the UK Government *'are not targeting a particular generation mix by 2050…the electricity market should determine the best solutions…'* (p42).

Despite this it is possible to offer a range of comments on the current proposals for large conventional nuclear power, SMRs/AMRs and fusion in relation to nuclear legacy issues. Proposals for the expansion of renewable generation, hydrogen and energy storage also have potential implications for existing nuclear sites.

i. Conventional nuclear generation

When the 2008 Energy White Paper was launched, the stated intention of Government was to deliver 16 Gigawatts (GW) of new nuclear power through the development or at least 12 new large scale nuclear reactors. These reactors

[12] https://www.gov.uk/government/publications/the-ten-point-plan-for-a-green-industrial-revolution/title#point-3-delivering-new-and-advanced-nuclear-power
[13] Clean Growth Strategy (publishing.service.gov.uk)
[14] https://www.gov.uk/government/publications/industrial-decarbonisation-strategy

were to be constructed at 5 locations across England and Wales, each of which was on, or adjacent to, an existing NDA decommissioning site.

One such station, Hinkley Point C[15], is already under construction, with the current estimate being that it will begin generation in 2026. Discussions are also underway around the possible construction of two other stations, Hinkley Point C[16], in Suffolk and Bradwell B in Essex[17]. Renewed interest in the Wylfa site emerged in autumn 2021, with Government in discussion with developers interested in either a new large nuclear plant or a smaller reactor and wind farm on the site [18].

Challenges have arisen in advancing new nuclear developments related to the make-up of the international development consortia and issues over finance and funding.

a. Regulation and Planning

New nuclear plants are regulated under the same framework as existing stations, by the **Office for Nuclear Regulation (ONR)** and the **Environment Agency/Natural Resource Wales**. The Office for Nuclear Regulation (ONR) and Environment Agency published their guidance on the **Modernised Generic Design Assessment (GDA)** process in October 2019[19].

While such developments are classed as NSIPs, Local Planning Authorities (LPAs) play a significant part in the process as has been shown in relation to Hinkley Point C. Councils also have a wider role in managing the socio-economic and environmental impacts that such large-scale developments have during construction, operation and decommissioning.

b. Decommissioning and waste implications

Under the Energy Act, operators of new nuclear power stations are required to have a **Funded Decommissioning Programme (FDP)** in place and approved by Government before construction of a new nuclear power station begins, and to comply with this FDP thereafter. Failure by the operator or an associated company which has obligations under the FDP, to comply with the FDP will be a criminal offence under section 57 of the Energy Act. Guidance on the Funded Decommissioning Programme was published in 2011[20].

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[15] Hinkley Point C | EDF (edfenergy.com)
[16] Sizewell C | EDF (edfenergy.com)
[17] Homepage - Bradwell B Project Site
[18] https://www.bbc.co.uk/news/uk-wales-politics-58668704
[19] https://www.gov.uk/government/publications/advanced-nuclear-technologies/advanced-nuclear-technologies
[20] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/70214/guidance-funded-decommissioning-programme-consult.pdf

The **Long-term Nuclear Energy Strategy**[21] requires that:

- Any nuclear programme to 2050 and beyond will need to ensure the minimisation and management of any waste arisings and spent fuel, through planning for decommissioning and waste routes early in the design process.
- Operators must have secure financial arrangements to meet the full costs of decommissioning and their full share of waste management and disposal costs, in other words a Funded Decommissioning Programme, as defined by the Energy Act 2008. In particular, operators have to demonstrate a credible plan for the long-term management of their wastes, especially Higher Activity Wastes (HAW).

Section 2.11 of EN-6 deals with radioactive waste. This states that:

- There is an assumption that there will be no reprocessing of spent fuel.
- That Higher Activity Waste (HAW) from new nuclear stations will consist of spent fuel and Intermediate Level Waste (ILW). The intention is that this material should be disposed of in a Geological Disposal Facility (GDF), preceded by 'safe and secure interim storage.'
- Solid low-level waste (LLW), liquid and gaseous discharges and non-radioactive wastes will be managed in line with the arrangements that already exist for dealing with legacy wastes of this type.

Proposals for waste management facilities that either form part of the development itself, or which are classed as associated development should be considered by the **Planning Inspectorate – National Infrastructure Planning** using the principles and policies set out in EN-1.

c. Socio-economics

Decommissioning, as well as construction and operation, of any energy infrastructure will have socio-economic impacts.

In accordance with EN-1, the developer is required to identify at local and regional levels any socio-economic impacts associated with the decommissioning of the proposed new nuclear power station. This assessment should demonstrate that the applicant has taken account of, amongst other things, potential pressures on local and regional resources, demographic change and economic benefits.

[21] Long-term Nuclear Energy Strategy (publishing.service.gov.uk)

ii. SMRs and AMRs

The Energy White Paper, and the Ten Point Plan for a Green Industrial Revolution, both identify **Advanced Nuclear Technologies**[22] as having an important role to play in the transition to a low carbon economy.

Advanced Nuclear Technologies encompass a wide range of nuclear reactor technologies under development. The technologies share common attributes in that they are:

- smaller than conventional nuclear power station reactors
- designed so that much of the plant can be fabricated in a factory environment and transported to site, reducing construction risk and, it is claimed, reducing costs. A number of such modular reactors could be developed on a single site.

Advanced nuclear technologies generally fall into one of 2 groups:

- Third generation water-cooled **Small Modular Reactors (SMRs),** similar to existing nuclear power station reactors but on a smaller scale. SMRs are usually defined as reactors that produce less than 300 MWe—compared to the more than 1,600 MWe that a modern nuclear power plant can produce.
- Fourth generation and beyond **Advanced Modular Reactors (AMRs**), which use novel cooling systems or fuels. It is suggested that these offer the potential for a step change reduction in costs. AMRs may also offer new functionalities – for example through operating at over 800C they could unlock the efficient production of hydrogen and synthetic fuels.

A £385 million Advanced Nuclear Fund has been announced. This will see £215 million allocated to develop a domestic SMR design and up to £170 million to a research and development programme on AMRs. A further £40 million will be provided to develop regulatory frameworks and support the UK's supply chain.

On the 9th November 2021 it was announced that a consortia led by **Rolls Royce** had secured around £400 million from the UK Government and private investors. The funding will go towards developing Rolls-Royce's SMR design and take it through regulatory processes to assess whether it is suitable to be deployed in the UK. It will also identify sites which will manufacture the reactors' parts.

In parallel, **NuScale** and **Shearwater Energy** are working to develop a SMR/renewables/hydrogen hybrid system. Both the Rolls Royce and NuScale/Shearwater plans have identified existing NDA sites as prime locations for their development, although there is also potential for SMRs to be constructed in locations away from existing nuclear licensed sites. Developers have been in discussion with host local authorities and the aim is for the first SMRs to be operational around 2030.

[22] https://www.gov.uk/government/publications/advanced-nuclear-technologies/advanced-nuclear-technologies

The **Nuclear Free Local Authorities (NFLA)** oppose the development of SMRs and AMRs and have prepared a briefing setting out their views[23].

a. Regulation and Planning

SMRs and AMRs would be regulated in the same way as larger nuclear plants[24], that is by the Office for Nuclear Regulation (ONR) and by the Environment Agency/Natural Resource Wales. ONR has been considering how it can develop its capability and capacity to regulate these advanced nuclear technologies[25].

b. Decommissioning and waste implications

The decommissioning and waste management aspects of SMR and AMR development are governed by the same framework as for conventional nuclear stations. It is likely that the decommissioning process and waste generation from SMRs will be broadly equivalent to that of a conventional nuclear station of equivalent energy output, though information is limited.

Potential AMR technologies are diverse in character and could use new types of fuel and coolant, and even potentially reuse spent nuclear materials as new fuel. It is too early to give any estimate on type and quantity of waste arisings.

c. Socio-economics

The claimed benefits of SMRs over conventional nuclear station are largely related to construction costs, based on economies of scale for a large SMR programme. As with any energy scheme, these developments will create employment and support supply chains through construction, operation and decommissioning.

iii. Nuclear fusion

Nuclear fusion is fundamentally different from conventional (fission) power generation. In fusion two lighter atomic nuclei, such as isotopes of Hydrogen (Deuterium and Tritium) form a heavier nucleus while releasing energy[26].

Fusion power has not so far been developed as a source of commercial energy generation anywhere in the world. However there is significant interest in it, with a number of large national and international research programmes. The UK Atomic Energy Agency (UKAEA) undertakes research on fusion at its Culham site in Oxfordshire.

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[23] http://www.nuclearpolicy.info/wp/wp-content/uploads/2021/04/NFLA_New_Nuclear_Monitor_No65_SMR_in_the_UK.pdf
[24] https://www.gov.uk/government/publications/advanced-nuclear-technologies/advanced-nuclear-technologies
[25] https://www.onr.org.uk/advanced-nuclear-technologies/index.htm
[26] https://ccfe.ukaea.uk/

In 2020 a siting process for a **STEP (Spherical Tokomak for Energy Production)** fusion reactor was launched by UKAEA[27]. This is a prototype reactor and while it will generate some net energy (around 50MW) it is not intended to operate as a commercial power station.

Following engagement with local authorities and other stakeholders a total of 15 potential sites for STEP have been identified. These are spread across England, Scotland and Wales and include a number of NDA sites[28].

UKAEA is currently assessing the sites based on their technical and operational suitability; alignment with STEP's socio-economic and community benefit principles; and support for the commercial progress of the project. Once this is completed a recommendation will be made to the Secretary of State for Business, Energy and Industrial Strategy (BEIS) with a final decision anticipated around the end of 2022. The reactor itself is expected to begin operation by 2040.

In addition to the STEP proposal, a new large scale fusion demonstration plant is planned for the Culham site[29], with backing from General Fusion, a Canadian company. UKAEA is also developing a fusion technology facility in South Yorkshire[30].

The **Nuclear Free Local Authorities (NFLA)** oppose fusion due to the generation of waste, the cost and the fact that commercial generation is still some decades away[31].

a. Regulation and Planning

In October 2021 the UK Government launched a consultation on the regulatory framework for fusion[32]. It proposes that future fusion plants are regulated by the **Health and Safety Executive (HSE)** and the relevant **Environment Agency** in different parts of the UK, as is the case with current fusion research and development activity in England.

It is likely that the STEP fusion plan will be designated as a Nationally Significant Infrastructure Project. The current consultation proposes that a Fusion NPS will be prepared, setting out the development consent framework.

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[27] https://step.ukaea.uk/
[28] https://step.ukaea.uk/host-step-in-your-community/
[29] https://www.bbc.co.uk/news/science-environment-57512229
[30] https://ccfe.ukaea.uk/construction-milestone-at-new-fusion-technology-site-in-yorkshire/
[31] https://www.nuclearpolicy.info/news/nfla-analysis-nuclear-fusion-english-councils-should-decline-host-experimental-reactor/
[32] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1022286/towards-fusion-energy-uk-government-proposals-regulatory-framework-fusion-energy.pdf

b. Decommissioning and waste implications

Fusion reactors create far less radioactive material, with a shorter half-life, than fission reactors but do generate radioactive waste. The recent Government consultation states:

- No High-Level Waste will be generated from fusion during normal operations
- The quantity of Low-Level Waste (LLW) produced is comparable to the quantities produced by a fission reactor producing equivalent power, namely thousands of tonnes of LLW which does not require specialist storage or disposal.
- A fusion power plant could potentially produce thousands of tonnes of what is currently defined as Intermediate Level Waste (ILW) if that waste were sent for disposal immediately after operations (e.g. without decay storage). This would be less than 1% of the UK's total ILW inventory.
- A significant proportion of this ILW is expected to be classed as LLW after a period of decay storage of around 100 years and then disposed of accordingly. However, impurities within the activated materials could result in much longer-lived radioisotopes, meaning that some fusion waste may be classed as ILW for thousands of years.
- Waste reduction, handling and mitigation strategies are already established in the nuclear sector and would be applied to fusion reactor waste.

The STEP programme is a small scale, prototype facility and the waste arisings are expected to be limited. UKAEA has committed to provide more information on radioactive waste generation and management. Waste arisings would be stored on site pending final disposal.

c. Socio-economics

UKAEA has been engaging with local authorities around the STEP process and has committed to delivering a range of direct and indirect socio-economic benefits as part of the development[33].

iv. Renewables and integrated Net Zero Planning

The Energy White Paper also supports a large expansion of renewable energy capacity, as well as of storage and hydrogen generation. There is scope for all these technologies to be developed on NDA land, either on an interim basis or as the next planned use. They therefore offer an alternative to new nuclear development on NDA sites, as do other uses that promote biodiversity, economic development and recreational projects.

The use of nuclear licensed sites for new energy developments, whether based on nuclear, renewables, storage or hydrogen, can be integrated into wider

[33] https://step.ukaea.uk/step-siting/

strategic energy and net zero plans as has already been done in Cumbria, North Wales, Southwest England and East Anglia.

5. Conclusions and recommendations

New nuclear build will impact on nuclear legacy management in a number of ways. These include:

- the requirements for the number and location of interim storage facilities, particularly for Intermediate Level Waste and spent fuel;
- requirements for the number, location and capacity of Low-Level Waste disposal facilities, either at existing nuclear sites, or new regional or national disposal facilities;
- impact on site end states or the time period within which the end state might be reached, given that many new nuclear developments are likely to be on or adjacent to current NDA sites; and
- the impact on the inventory of wastes for emplacement in a geological repository and implications for repository size and cost.

The 2020 Energy White Paper sets out broad aspirations only. The scale and timetable for new energy developments, their location, and the balance between different technologies, remains unclear. More information is required on:

- How much new nuclear capacity Government wishes to develop and whether this will be in the form of conventional large scale nuclear plant or other developments such as SMRs.
- What the likely impact on the UK Radioactive Waste Inventory will be in terms of (a) types of waste arising (b) when wastes are likely to arise and (c) the timeframe for their decay.
- The storage of wastes, the management options and their impact on current plans for waste disposal including the Geological Disposal Facility and Near Surface Disposal.
- The socio-economic implications of developments including on direct and indirect employment, skills and the supply chain. Nuleaf will continue to press for the maximisation of local socio-economic benefits and for community benefits to be paid to host communities. While agreement has already been reached on community benefits and mitigation around Hinkley Point C, there is less clarity on what is proposed around SMRs/AMRs and in relation to fusion.

At a local level, any developer of new nuclear facilities must engage properly with local authorities and communities and ensure that what they propose aligns with and helps facilitate the NDA/Magnox plans for decommissioning of current nuclear legacy sites. This should include the following:

- The developer should ensure that it identifies the requirements for on and off-site facilities for radioactive waste management and decommissioning, and the implications for existing or planned facilities for managing the nuclear legacy on or adjacent to the site concerned and for any regional or national facilities;
- The developer should engage with the local planning authority on those requirements and implications throughout the application process;
- The developer should publish the above information and engage with the host community in an open and transparent way;
- In liaison with the NDA, and taking into account the views of local authorities and the communities they represent, the developer must ensure that its proposals for radioactive waste management and decommissioning do not prejudice effective management of the nuclear legacy; and
- That the recruitment of staff into any new build programme does not leave nuclear legacy management short of staff and skills.