heart of the south west
local enterprise partnership

NUCLEAR SouthWest

WEST OF ENGLAND Combined Authority

A Review of Nuclear capabilities in the South West

SWMAS

Document Issue Sheet

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Disclaimer

Foreward

The Heart of the South West Local Enterprise Partnership (HotSW LEP), working with the West of England Combined Authority (WECA) and Nuclear South West, have commissioned SWMAS Limited to prepare a report on their behalf. The aim of the report is to identify and review the existing nuclear capability of companies in the South West with experience in the nuclear decommissioning sector.

The report provides a review of our findings, gathered from primary research and information, in the form of a decommissioning capability supplier list, associated detail capability charts and case studies from South West businesses. It details the existing nuclear decommissioning capability, as well as touching upon the opportunities linked to decommissioning in the South West across all nuclear sectors as indicated below:

- **Decommissioning**
- **New Nuclear Construction**
- **Advanced Nuclear Technologies**
- **Defence**
- **Science and Research**

In highlighting the capabilities across the South West, a review was conducted on how these capabilities apply to the wider UK market, the International decommissioning market, and how the existing capabilities of South West-based companies can win work and export their expertise in overseas markets.

The report adds to the work previously commissioned by the Heart of the South West LEP and partners on the potential for nuclear activity such as the DNA (Davies Nuclear Associates) Report, and the Frazer Nash report, both of which have highlighted areas of opportunity for the South West.

The approach for the Report will be to focus on the decommissioning opportunities on the existing nuclear licensed sites at Berkeley, Oldbury, Hinkley, and Winfrith on a primary basis, and bringing in other areas such as future decommissioning of the Advanced Gas-Cooled Reactor Fleet (AGRs), defence, and new nuclear technologies where there could be beneficial synergies and opportunities for South West companies in the wider UK market and into International work.

For the purposes of the Report, the "South West" includes Heart of the South West LEP (Devon and Somerset), Dorset, Gloucestershire, and West of England.

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1 Executive Summary

The South West of England has been part of the UK nuclear sector, both civil and defence, for many decades. The South West has been the home of the construction and development of five nuclear power stations; the first commercially operated nuclear power station at Berkeley, the reactor research site at Winfrith, followed by Hinkley A and subsequently the Advanced Gas Cooled (AGR) Reactor fleet stations at Oldbury and Hinkley B, operated by EDF. Both EDF nuclear Generation and Magnox have their Head Offices in the region and a key part of the UK nuclear submarine programme is based at Devonport in Plymouth.

This history has created an experienced nuclear capable supply chain within the region, which, prior to the recent investment in a new nuclear build programme at Hinkley Point C, focussed on supporting operational and decommissioning opportunities across all UK nuclear sites, forming local nuclear clusters in the region around these sites.

There is a huge opportunity for the South West to capitalise on this inherent nuclear supply chain capability, not only to support the ongoing decommissioning opportunities but also, the new nuclear build programmes.

The report identifies that there are likely to be significant opportunities in new nuclear build programmes with the construction of further stations at Sizewell, Moorside, Bradwell and possibly Wylfa, along with innovative research and development programmes for advanced nuclear technologies, including the STEP Programme.

The research undertaken for this report has identified several key findings and recommendations which are summarised on the following page.

This report represents a first step in providing the regional LEP's with detailed information on the South West's nuclear capability and credentials and which can be utilised in UK and International Industry events to promote and showcase this capability.

Research Area	Findings	Recommendations
Nuclear decommissioning capability within the South West region	Circa 150 regional suppliers identified with nuclear decommissioning experience. The 5 Top skills are; • Manufacture & Fabrication • Professional Services • Engineering Design Services • Electrical Control and Instrumentation • Civil Construction	Utilise the research and information gathered to develop marketing materials to promote the nuclear capability of companies in the South West as identified on the decommissioning capability Supplier List. Work with the Hinkley Supply Chain Team to continue to undertake capability mapping of companies within the South West and include all nuclear sectors, in particular harness growing capability from work on HPC.
UK Decommissioning Opportunity in the South West (near-term)	The potential value of decommissioning at the regional NDA sites over the next 5-10 years is circa £4B	Engage with the NDA/Magnox to identify requirements and to share information and promote the nuclear capability of the South West supply chain
UK Decommissioning Opportunity (medium term, 5-20 years)	The potential value of decommissioning the EDF AGR fleet (7 stations, incl. Hinkley B in south west) is circa £8B	Engage with the EDF nuclear Generation team to understand their likely requirements and formulate supply chain support and engagement strategies for south west companies
UK Decommissioning Opportunity (long Term)	The total “nuclear provision” is circa £124B over a 120-year timeframe for the 17 NDA sites. A further 4no. ONR sites are also undertaking decommissioning programmes	Engage with the NDA and Sellafield Ltd and other key stakeholders to promote the capabilities of south west suppliers and consider what support programmes are required
UK Defence programme in South West	Significant long-term Opportunities exist in both decommissioning work and the re-development of the existing facilities at Devonport	Engage with MOD/Babcock to understand the scale of the opportunity and their requirements to formulate support packages required for regional companies to enter this market. Leverage existing skills within the region.
New nuclear technologies and International work opportunities	Current activity Circa 600m Euros annual spend on International nuclear research projects via STFC, plus multi billion project at ESS in Sweden. Longer term opportunities through the SMR/AMR and STEP programmes. Long-term International decommissioning programmes in Germany, Japan, France, Canada and USA	Leverage activity on the HPC project to engage with the Tier 1 contractors with International businesses to promote south west capabilities and build upon existing relationships and collaborative strategies. Continue to work closely with DIT to promote region and capabilities and for support in overseas locations. Engage with key stakeholders incl. UKAEA, STFC to obtain visibility of strategy & opportunities and utilise Hinkley Supply Chain Team to cascade to regional companies
Challenges faced by South West companies to enter new market sectors within the UK	• Competition from more developed nuclear clusters • Lack of visibility of opportunity • Their location • Lack of market knowledge • Costs of entry to new markets • Current nuclear Industry Procurement Strategies and Regulations	Engage with key stakeholders including other regional nuclear clusters to develop collaboration strategies

2 Background

In spring 2015, the Heart of the South West Local Enterprise Partnership (HotSW LEP), together with the West of England and GFirst LEPs, commissioned a report to provide an evaluation of the existing nuclear capability within the South West Region and the opportunities for inward investment. The evaluation, and initial collective and individual LEP unique selling points identified in this report, supported preliminary inward investment engagement strategies and general cluster development.

A second report was commissioned in 2018 and prepared by Fraser Nash Consultants. Both reports concluded that the South West nuclear opportunity was extensive and extremely valuable, providing detail of prospective nuclear activity that could take place in the region over the next decade to a value of more than £50Bn.

The outcomes of the 2015 report helped to provide the evidence base that was required to underpin the creation of the South West Nuclear Cluster, and to draft the first Nuclear South West proposition.

Nuclear South West (NSW) was launched in September 2015 and is an industry led cluster supported by key public and private stakeholders, with the aim to develop and grow economic opportunities within the South West of England.

The Inward Investment support has been, from the outset, integrated with the HPC Supply Chain service, delivered by a consortium led by SWMAS Ltd. Recently, workforce development has also formed part of that offer.

A direct impact of the above activity has seen the capability and capacity of South West based businesses improve to the extent that many £Ms of nuclear related contracts have been won.

Most nuclear inward investment activity for the South West is now delivered within the NSW brand and a National profile has been established through their sponsorship, attendance and presentations at global exhibitions, national conferences and support on DIT specific events. This partnership-led campaign activity in partnership with the Department of International Trade (DIT) is supported for at least a further year and is led by the Nuclear South West Inward Investment group.

To date, NSW has focussed specifically on Inward Investment and has been successful in attracting a number of Foreign Direct Investments' (FDI's) into the region to operate in the gaps where there is no existing UK capability, or to Joint Venture with indigenous companies where there is a mutual benefit in collaboration.

In 2018 the UK Government published the Nuclear Sector Deal as part of its Industrial Strategy which had several aims and priorities and included the ambition to maximise UK content into the nuclear supply chain, as well as to increase export potential.

With the World Nuclear Exhibition (WNE) 2020 due to take place in Paris in December of this year, there is an opportunity to start promoting the South West as a region that has export potential for overseas markets, as well as prospects for inward investment.

New nuclear construction at HPC will continue to be a priority for the region for at least the next 5 years, but in terms of sustaining the transformational economic legacy of this, we need to look to other opportunities within the nuclear life cycle. This includes the upcoming decommissioning of HPB as well as the potential offered by Advanced Nuclear Technologies.

3 Scope of the Report

3.1 Purpose

The purpose of this report is to research and provide information and marketing materials about those South West companies that have existing nuclear decommissioning capability, and capacity to export their knowledge, expertise and products to win work both in the wider UK nuclear market and the developing International market.

3.2 Scope

The scope for the report will focus on the decommissioning market but will also provide an introductory review of opportunities within other nuclear sectors where supply chain capability and skills can be relatively easily transferred.

It will also look at the barriers to entry faced by South West companies into these sectors, and make recommendations for how the Heart of the South West LEP could support these companies to enter, and win work, in these markets.

The information provided will include company names, capability, and regional location for the companies, but exclude contact details in line with the General Data Protection Regulation (GDPR).

The output from the report will inform future Heart of the South West marketing campaigns, as such the information provided can be easily extracted and utilised in such campaigns.

4 Nuclear Decommissioning Opportunities and Capability

4.1 What is Nuclear Decommissioning?

The decommissioning process description from the Office for Nuclear Regulation (ONR) is shown below.

"Decommissioning is the process of dealing with redundant nuclear facilities that have reached the end of their operational life. The objective of decommissioning a nuclear installation is either:

- *to return the nuclear site to an unrestricted, de-licensed condition; or*
- *return the site to a state so that the land can be used for suitable alternative uses.*

Decommissioning is usually conducted in three stages:

- *Stage 1 – Post-operational clean out where the bulk of the radioactive material, such as fuel, is removed from the facility*
- *Stage 2 – Initial dismantling and removal of contaminated parts or care and maintenance to allow radioactive materials to decay*
- *Stage 3 – Dismantling of the facility, demolition of the structure, and remediation of land and water to meet an agree end-state for future use."*

Throughout the decommissioning process, the ONR ensures that nuclear licensees adequately control all remaining hazards on site. This is achieved through a programme of targeted interventions with licensees, designed to ensure that licensees have suitable arrangements in place for decommissioning to

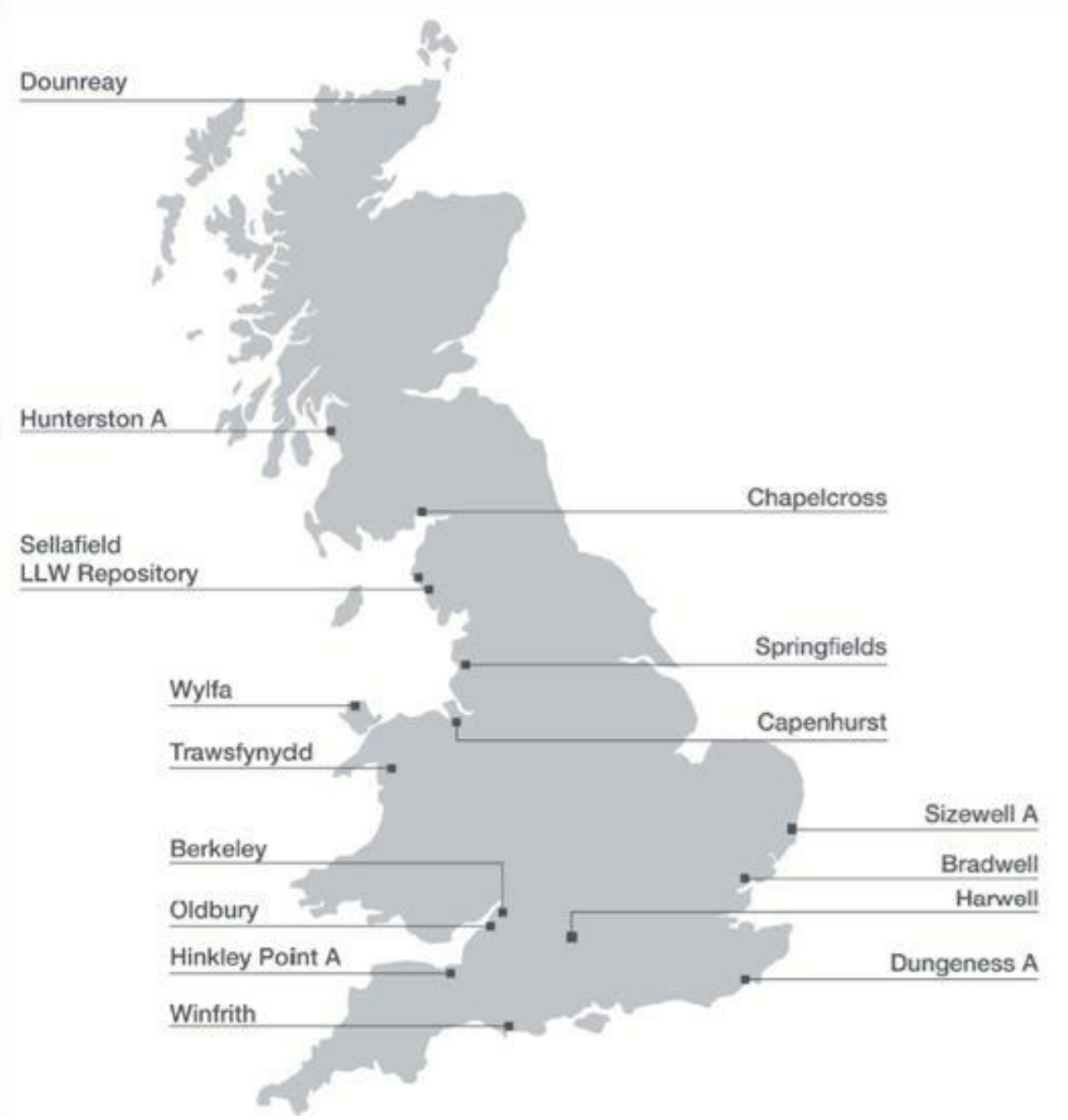
progressively reduce the risks. The ONR reviews licensees decommissioning arrangements and ensures that licensees adopt relevant good practice.

All licensees must produce a clear decommissioning strategy that will demonstrate how all redundant, operational, and proposed plants can be decommissioned safely at the end of its operational life.

4.1.1 Nuclear Decommissioning Authority

In 2005, the Nuclear Decommissioning Authority (NDA) was established as a Non-Departmental Public Body under the Energy Act (2004), with the responsibility to clean-up the UK's earliest nuclear sites, sponsored by the Department for Business and Industrial Strategy (BEIS)

Figure 1 – Nuclear Licensed sites across the UK



This includes 17 sites as shown on the diagram below - 14 in England and Wales, and three in Scotland:

The NDA have very recently issued their latest Draft Business Plan/Strategy for consultation (August 2020). Under this Strategy they have identified five strategic themes (set out below), under which all decommissioning and related activities will be undertaken:

- "Site Decommissioning and Remediation defines our approach to decommissioning redundant facilities and managing land quality in order that each site can be released for its next planned use."
- "Spent Fuel Management defines our approach to managing the diverse range of spent nuclear fuels for which we are responsible."
- "Nuclear Materials defines our approach to dealing with the inventory of uranium and plutonium currently stored on some of our sites."
- "Integrated Waste Management considers how we manage all forms of waste arising from operating and decommissioning our sites, including waste retrieved from legacy facilities."
- "Critical Enablers support the overall delivery of our mission and, in some cases, reflect the supplementary duties assigned to the NDA by the Energy Act (2004) (ref 1)."

The NDA have been reviewing their strategy for the decommissioning of the Magnox Reactor Sites. These strategies were developed over 30 years go and followed the ONR Stage 2 option of initial decommissioning and dismantling, followed by Care and Maintenance for up to 85 years.

Following a review between the NDA and Magnox Limited, as well as taking account of lessons learnt from their recent decommissioning experience, the latest NDA strategy has now changed.

The new strategy concludes that a deferred decommissioning strategy is not appropriate across all the Magnox Sites, and a site-specific approach to Magnox reactor decommissioning will provide greater benefits.

For some sites, this will mean that decommissioning will be accelerated and brought forward, and for others, the care and maintenance options will remain but with options that could vary from one site to another. Magnox Limited are responsible for the preparation of decommissioning strategies for their sites. Further detail on the Magnox strategy is covered later in the report.

This change in strategy could offer greater opportunities for companies in the South West and will be explored in the following sections.

We have used the above NDA decommissioning definitions to categorise the capability of the South West suppliers on the Supplier List included within this Report.

4.2 What is the value of the Decommissioning Opportunity in the South West?

4.2.1 Magnox Limited

The NDA's nuclear decommissioning sites in the South West include the former Magnox Stations at Berkeley, Hinkley A and Oldbury and the former RSRL site at Winfrith, now all managed by Magnox Ltd.

An example of a South West decommissioning project from Cavendish Nuclear on the Berkeley Active Waste Vault Retrieval Project can be viewed on the following page:

cavendish nuclear

Module installation at Berkeley.

CASE STUDY:
Berkeley Vaults

OVERVIEW

The Berkeley Active Waste Vaults (AWV) retrieval programme comprises a number of discrete projects for the design and installation of mechanical handling and processing equipment required to retrieve legacy Intermediate Level Waste (ILW) from three subterranean vaults.

Cavendish Nuclear was tasked to deliver plant and equipment capable of retrieving, processing and packaging the waste for safe interim storage.

The programme is scheduled for completion during early 2020.

KEY INFORMATION

Customer:	Magnox
Site:	Berkeley Power Station
Value:	~£100 Million (to date)
Duration:	2011 - present
Capabilities:	Programme & Project Management, Optioneering & Design Services Complete project lifecycle: Engineer, Procure, Construct, Commission (EPCC)


Off-site integrated works testing at Cavendish Nuclear Limited, Whetstone.

OUR SOLUTION IN DETAIL

Our Approach

Cavendish Nuclear adopted a modular build strategy, the key benefits of which were:

- Maximisation of off-site assembly and testing.
- Reduced durations for both the onsite construction phase and overall project duration.
- Reduction in costly onsite rework
- Technical risk mitigation, facilities had been demonstrated prior to installation.
- Greater programme predictability particularly on critical path construction and commissioning activities.
- Health & safety - reduction in radiological and working at height hazards.

The technical solutions were based on the use of proven commercially available equipment. Cavendish Nuclear then applied integration expertise to provide facilities that were appropriate for the required application and operating life.

Programme constraints dictated that module fabrication and equipment manufacture had to be completed in parallel, at multiple locations. Cavendish Nuclear utilised long standing relationships with approved suppliers to ensure delivery to budget, programme and quality.

Cavendish Nuclear carried out module assembly and integrated works testing at their Whetstone facilities near Leicester. This integrated works testing ensured that hardware and software was appropriately demonstrated prior to delivery to the Berkeley site.

In vault Brokk deployment during commissioning.

Collaborative Working

Cavendish Nuclear has a long-term relationship with Magnox, which is built on the back of a successful project delivery record over many years.

Collaborative working is the cornerstone of the relationship, key aspects of this are:

- Co-location of Cavendish Nuclear and Magnox engineering personnel as a single project delivery team, which minimised rework and allowed the design review and approval processes to be expatiated.
- Use of the off-site module assembly and test programme as an opportunity to carry out early familiarisation and training of Magnox operations personnel.
- Implementation of an externally facilitated workshop programme to ensure that collaborative working behaviours were maintained in demanding project delivery environments.
- Active Commissioning was carried out under Magnox working arrangements and in compliance with the site license conditions; safe and timely completion of these activities required Cavendish Nuclear and Magnox to function as a single team.
- To facilitate vital knowledge transfer, Cavendish Nuclear provided post-handover technical support, which included the embedment of commission and engineering personnel into the Magnox operations team.

Key Learning

- The use of commercially available equipment provides simplified technical solutions that can be reliably and repeatedly operated.
- Affordability is dependent on equipment specifications being commensurate with their application and operating life.
- Off-site integrated testing provides highly effective mitigation of technical risk to critical path construction and commissioning activities.
- Modular build reduces the time spent on site and reduces cost and programme inefficiencies associated with working arrangements on a nuclear licensed site,

Achievement and Awards

- The Cavendish Nuclear Berkeley R2 project team were awarded the Babcock International Group Team of the Year for 2015
- R3 Project Team - Winners of the Cavendish Nuclear Team of the Year 2019.

PROJECT SUCCESS FACTORS

Progress from concept design to operations took a little over four years, supporting the programme for transfer of Berkeley site into long term care and maintenance.

The use of commercially available equipment provides Magnox with an affordable and fit-for-purpose technical solution, commensurate with its application and operating life.

The facilities provide Magnox with the capability to retrieve and process all waste types from all vaults - reliably and repeatedly.

cavendish nuclear

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www.cavendishnuclear.com

July 2019

The latest Magnox Procurement Plan (issued August 2020) has identified tender opportunities listed on the Magnox decommissioning sites in the South West of £100m+ between now and the end of 2021.

Many of these procurements are for large decommissioning projects with long delivery programmes, ie over one year, and will be competed for by the large Tier 2 contractors. These projects should provide significant opportunities for supply chain companies in the South West with the following capabilities:

- **Design Engineering/Consultancy Services**
- **Manufacturing**
- **Mechanical and Electrical Installation**
- **Construction and Demolition,**
- **Electrical control and Instrumentation**
- **Heating and Ventilation**
- **Industrial Services**
- **Commissioning**

A section of the Magnox Procurement Plan for August is shown below, and a link to a current copy is attached within section 10 Appendix 10.3:

Figure 2

Magnox Limited Procurement Plan as at end of July 2020

UNIQUE EXTERNAL REF	DIRECTORATE OR CATEGORY TEAM	SITE	CONTRACT DESCRIPTION (Values in brackets represent anticipated duration)	CATEGORY	PROCUREMENT ROUTE	BANDING	PRE QUAL ADVERT PUBLI	ITT ISSUE (a) Actual (f) Forecast		CONTRACT AWARD DATE (a) Actual (f) Forecast	
DEC 0434	Decommissioning	Hinkley	Turbine Hall Backfill	Decommissioning, Demolition & Deplant	Non-OJEU Competition	£1m to £5m	Feb-21	Mar-21	(f)	Jul-21	(f)
DEC 0410	Decommissioning	Wylfa	Electrical Overlay System Phase 1	Engineering	Sole Source - No Choice	£1m to £5m	n/a	Aug-20	(f)	Nov-20	(f)
DEC 0318	Decommissioning	Oldbury	National Grid Sub Station hazard removal, deplant & demolition	Decommissioning, Demolition & Deplant	Mini Competition F/W	£1m to £5m	n/a	Oct-19	(a)	Oct-20	(f)
DEC 0448	Decommissioning	Trawsfynydd	Ponds Radiological & Chemical Waste Characterisation	Remediation & Environmental Services	OJEU Open	£100k to £500k	n/a	Mar-20	(a)	Aug-20	(f)
DEC 0216	Decommissioning	Harwell	Provision of Service for Re-generated Carbon Mobile Filter units for Ground Water Plant	Engineering	OJEU Open	£100k to £500k	n/a	Mar-20	(a)	Oct-20	(f)
DEC 0387	Decommissioning	Winfrith	A Pilot scale enhanced TCE Bio rededication Project	Manpower	Non-OJEU Competition	<£100K	n/a	Mar-20	(a)	Jun-20	(a)
DEC 0444	Decommissioning	Hinkley	Turbine Hall Backfilling - engineering support to draft the technical specification	Engineering	Sole Source - No Choice	<£100K	n/a	Mar-20	(a)	Jul-20	(a)
DEC 0461	Decommissioning	Winfrith	Non-radiological support for Groundwater Daughter Directive advice and permit application support	Manpower	Sole Source - No Choice	<£100K	n/a	May-20	(a)	May-20	(a)
DEC 0409	Decommissioning	Oldbury	Construction Joints/Voids	Construction	Non-OJEU Competition	£100k to £500k	n/a	Oct-20	(f)	Apr-21	(f)
DEC 0442	Decommissioning	Berkeley	Safetsores (not in plan, needs a new DV) Removal of primary circuit plant in Blowerhouses - estimated value £20m from April 2021	Waste management, disposal & storage	Mini Competition F/W	£10m to £25m	Mar-21	Mar-21	(f)	Jun-21	(f)

The UK Government, with the NDA, have prepared a publication – "Nuclear Provision: the cost of cleaning up Britain's historical nuclear sites."

This report, updated in July 2019, provides details of the UKs nuclear legacy and the "nuclear provision" which is the best estimate of how much it will cost to clean up 17 of the UKs nuclear sites, which are the responsibility of the NDA.

It should be recognised that the figures prepared are estimates and there remains considerable uncertainty, not least because of the programme timescale of approximately 120 years. However, this publication of the "nuclear provision" provides a good understanding of the scale of the decommissioning opportunity and how this is distributed across the 17 sites.

The 2019 forecast states that the clean-up cost across the 17 sites will be £124 billion (discounted provision £131 billion) over a 120-year programme.

The current annual costs to manage and decommission the NDA estate are around £3billion.

The report identifies the % spend across each of the 17 sites. Not surprisingly, the highest provision is for Sellafield, more than 75% of the total and, also includes more than 8% for the Geological Disposal Facility.

There are four nuclear decommissioning sites across the South West region:

- **Winfrith**
- **Berkeley**
- **Oldbury**
- **Hinkley Point A**

The total provision for the decommissioning of these sites is only around 3.15% of the total, though this is still equivalent to just over £4 billion.

Figure 3 – Table showing the indicative value and timeline for decom opportunities in the SW

Site	Decommissioning provision	% of overall provision	Timeline 2020	2024	2028	2032
Winfrith	£150m	0.15%				
Berkeley	£1.2b	0.9%				
Hinkley Point A	£1.4b	1.1%				
Oldbury	£1.3b	1.0%				

Whilst the overall percentage of work within the South West is relatively small on a UK scale, £4 Billion represents a large opportunity. As important for the South West, is that the decommissioning programme for Winfrith, and potentially for Berkeley and Hinkley Point A sites, will be accelerated and will be undertaken over the next 5-10 years.

The timeline for the decommissioning and strategy options on the likely end state for the Oldbury site is currently being reviewed by Magnox Ltd as part of the new overarching NDA decommissioning strategy. At the very least, the Oldbury site will undergo the first phase of the decommissioning programme which will provide opportunities for the South West supply chain over the next 7 years.

4.2.2 The EDF Fleet - AGRs

The second generation of nuclear power stations, the advanced gas cooled reactors (AGR) fleet, operated by EDF will be decommissioned utilising the Nuclear Liabilities fund.

The value of this fund, and therefore the minimum decommissioning opportunity, is circa £8 billion spread across the 7 stations.

The programme for the decommissioning of the first AGR Reactor is planned to start in 2025* (this is under review and may commence earlier, see note below), and similar to the original NDA and Magnox strategy, the decommissioning Strategy option for the AGRs is Safe Enclosure (SafeStore).

Under this strategy the dismantling of the reactor will be deferred for a period of up to 80 years. There will be a period of decommissioning and dismantling of the AGR associated plant and equipment, following defueling, which is planned to take around seven years for each station. (Ref. EDF Energy presentation at the International Symposium on Preparation for Decommissioning (PREDEC) in 2016).

Safestore has 3 key phases:

Key Phase 1—Pre-Closure Transition, Defuelling and early decommissioning (commences circa 5.5 years before station closure)

Key Phase 2—Site Surveillance, Care & Maintenance (commences circa 10 years after end of generation)

Key Phase 3—Reactor Building Decommissioning & Final Site Clearance (Commences circa 85 years after end of generation) dependant on disposal facility being available.

Market conditions mean that operators keep plans and strategies under review , EDF may well commence the Advanced Gas-cooled Reactor (AGR) decommissioning earlier than originally planned, and it is likely that the sole AGR station in the South West, Hinkley Point B, will be one of the first stations to be decommissioned on the AGR programme. The first station to commence decommissioning is likely to be Hunterston B in 2023, followed by Hinkley B commencing in 2024.

A statement on the Government website from BEIS regarding the AGR decommissioning programme from August 2019 is quoted below:

"EDF Energy currently owns and operates eight nuclear power plants in the UK. On current plans seven of those stations, the Advanced Gas-Cooled Reactor stations (AGRs), are due to start to close from 2023 on a rolling basis to 2030. The decommissioning of the stations will be funded by the Nuclear Liabilities Fund, a segregated fund managed by trustees and underwritten by Government. The Department for Business, Energy, and Industrial Strategy (BEIS) is working with EDF Energy and the Nuclear Decommissioning Authority to consider how efficient and cost-effective decommissioning of EDF Energy's stations can be planned for and delivered. This work includes consideration of how the stations will be owned and managed in the future."

"BEIS expects this review to conclude by the summer of next year." (i.e. 2020).

Any accelerated programme for the decommissioning of Hinkley Point B will provide further opportunities for supply chain companies in the South West. If this becomes the case, the timing for Hinkley Point B decommissioning would dovetail nicely with the Magnox decommissioning programme, and extend the opportunity within the South West without an extended break to these programmes, and disruption to the sustainability of the supply chain.

Attached below is a Case Study from AMS Nuclear, who are based in Bridgwater, about a project they have undertaken for EDF at Hinkley B station:

AMS Nuclear Engineering (AMS) is an engineering firm, based in Bridgwater, Somerset that have specialised in providing Control & Instrumentation systems, Environmental Sampling systems and Ageing & Obsolescence solutions to the nuclear industry for over 20 years.

Their Suitably Qualified & Experience Personnel (SQEP) have extensive plant and licenced site knowledge enabling them to provide their services across all parts of the nuclear industry including Generation, Decommissioning, New Build and Defence.

Case Study: MOISTURE MEASURING SYSTEMS Customer Organisation: EDF ENERGY Project value: ~£1.5m

Problem statement

Existing gas sampling and measurement systems, that had been in operation since station commissioning in 1976, had become obsolete and the systems had become too difficult to support and maintain. A new system was required that had to meet the new safety case requirements as well as the client's technical standards for C&I modifications and replacement.

Scope

AMS were tasked to design, substantiate, build, test, install and commission 8 moisture measuring systems. Against a new/revised safety case and updated reactor system operations AMS, in collaboration with the client, had to adopt innovative 'back to the drawing board' approaches to meet an evolving specification.

Outcomes

AMS' Nuclear SQEP resource successfully delivered a suit of moisture measuring systems on time and to budget. Key features of the solution included:

- Providing diverse measuring technologies within each system
- Improvements in sample gas path to enhance sample conditioning and system configuration.
- Removing the prescriptive nature of the current architecture thereby allowing installation of any type of analyser.
- Improvements in the system alarm philosophy to align with standard company practices.
- Full seismic qualification by design and shaker table test
- Full EMC qualification of the system taking an As Low as Reasonably Practicable (ALARP) approach.
- Modifications to the control logic to ensure that any single analyser going into an alarm state could initiate the alarm.

Feedback from the client

"We are very pleased with the progress on this project as it is looking to complete several months ahead of schedule. This is seen as a real success of a project"

https://ams-nuclear.com/

Chedzoy Lane, Chedzoy, Bridgewater, Somerset, TA7 8QS
+44 (0) 1278 444 650
info@ams-nuclear.com
www.ams-nuclear.com

4.2.3 The Nuclear Defence Programme

The UK nuclear Defence Programme is delivered through two inter-dependent programmes:

- **The Nuclear Deterrent Programme:**
  Providing the management, maintenance, manufacture, and day to day operations for Britain's submarine launched nuclear deterrent capability, delivered by the Ministry of Defence and the Atomic Weapons Establishment (AWE)

- **The Naval Nuclear Propulsion activities in the UK:**
  Relating to the design, fabrication, maintenance, service, and operation of the Royal Navy nuclear powered submarines, and is delivered by the Royal Navy, Babcock International Plc, Rolls-Royce Plc and BAE Systems Plc

The current fleet of vanguard submarines will come to the end of their working life in the 2030s. A new fleet of trident submarines has been commissioned and are expected to become operational by 2028.

The estimated acquisition costs for the renewed nuclear deterrent solution is more than £30Bn. This will provide significant opportunity and demand for the nuclear defence supply chain.

In addition, the Submarine Dismantling Project has commenced it's programme to dismantle 27 of the UK's de-fueled nuclear-powered submarines that have left service with the Royal Navy. This programme is estimated to cost around £2Bn with most of the work being undertaken at the Devonport and Rosyth dockyards.

At the Devonport Dockyards, based in Plymouth, they have a large planned major refit and modernisation programme which will also provide opportunities for the South West supply chain.

South West companies with experience in both nuclear decommissioning and new build activities should be ideal for skills transfer into the Devonport programme, along with regional companies who already support the nuclear defence sector.

Several companies in the South West already support these programmes, although not specifically researched for this Report, an example of such a company, which is also looking to become involved in the nuclear new build programme, NESC Limited are a systems engineering and safety case consultancy business supporting the UK submarine defence programme in Devonport.

NESC Ltd have provided a capability statement, which is included on the following page:

NESC are based in Plymouth, Devon. We are made up of a team of nuclear engineers with experience from both the civil and defence nuclear sectors.

The organisation was created to improve the provision of high-quality nuclear design and safety engineering services, in addition to filling the demand for well-respected Suitability Qualified and Experienced Personnel in the industry.

Who Are We?

NESC is a reputable professional engineering support provider, specialising in high hazard and high consequence engineering and assurance. Principally focussed towards the defence and civil nuclear industries, NESC is a multi-disciplinary engineering consultancy, which thrives on tackling engineering challenges and finding cost-effective solutions to complex problems.

NESC are fully equipped to manage and undertake projects at our security certified offices, or equally happy to embed suitably qualified and experienced consultants into customer organisations, whether that be directly or through tiered provision. We pride ourselves in our flexible approach to supporting clients. All our operating practices are fully ISO9001 accredited.

Safety Case Engineering

We have the highly skilled and technically experienced personnel capable of undertaking Safety Case work covering:

- The investigation and assessment of nuclear operations and associated hazards and risks.
- Identifying improvement measures and delivering arguments and justifications.
- Management of Emergency Arrangements.
- Security considerations, including physical and cyber threats on industrial control and process systems.
- Identification, creation, and maintenance of technical documentation.
- Commissioning and decommissioning.
- Technical support.

If you would like to find out more about our capabilities, please visit www.nesc.co.uk.

5. Nuclear Decommissioning Capabilities of Companies in the South West

5.1 Decommissioning Capability – Supplier List

Research has been conducted on those companies based in the South West who have undertaken work within the nuclear decommissioning market, both civil nuclear and defence. As part of this research, existing supplier lists and earlier research relating to the nuclear decommissioning sector has been utilised (listed below):

- Nuclear Industry Association (NIA) members list of companies
- Sellafield list of companies who have signed onto LINC
- DNA Associates Report for the Heart of the South West LEP in 2015
- Cavendish Nuclear Capability Report for Winning UK business
- Supplier information for SMEs in the South West supplied by the NDA
- Supplier information provided by Nuvia for the South West
- Hinkley Supply Chain Portal
- Inherent knowledge within the Hinkley supply chain team

Based on this information a new Supplier List of companies in the South West with decommissioning capabilities has been prepared. It is based on the industry recognised list and those companies with demonstrated experience of working on the UK decommissioning programmes. From our research to date circa 150 companies have been identified and listed. This includes companies of all sizes and capability, from Regulators to Individual Consultants.

Included on the Supplier List is the Company name, their postcode, type of business, their capability within decommissioning, and their export experience and/or potential where known.

Company	Product & Service Category	Post code	Region	Nuclear Decommissioning Capability				Export	
				Decommissioning	Spent Fuel	Nuclear Materials	Waste Management	Export Ready	Export Potential
OC robotics	Robotics	BS34 7JU	Somerset						
AMS nuclear	Instrumentation	TA7 8QS	Somerset						
Frazer Nash	Consultancy	BS1 5UD	Somerset						
Atkins	Design Engineering & Consultancy	BA6 9AS	Somerset All LEP areas						
Nuvia	Design Engineering Project Management, Health Physics, Operational services	DT2 7UA	Dorset						
Tradebe	Waste Management	SN2 8EA	Wiltshire						
Ultra nuclear	Instrumentation	BH21 7SQ	Dorset						
James Fisher Nuclear Ltd	Design Engineering Project Management, Health Physics Instruments, Operational services	DT2 7UA	Dorset						
SC Innovation	Design and manufacture special vehicles	EX14 4LF	Devon						
Blackhill eng	Steelwork structures Manufacture	EX5 1JL	Devon						
GRE – as relates to STFC and CERN	Process engineering - cooling systems	EX15 2FB	Devon						

Figure 4

A copy of the complete Supplier List of Companies is provided in Appendix 10.2 to this report.

Through the continuing work being undertaken by SWMAS and the Hinkley Supply Chain Team, there is an opportunity to enhance the information maintained on this list and update on an ongoing basis. This would ensure that capability in the South West across all nuclear sectors will be captured.

Through the continuing work being undertaken by the Hinkley Supply Chain Team, there is an opportunity to enhance the information maintained on this list and update it on an ongoing basis, and recommend that this is undertaken beyond the period of this report.

A key contributor was Cavendish Nuclear about the work they have been undertaking through the Winning UK Business Working Group as part of the Nuclear Sector Deal.

The Winning UK Business Working Group has started to develop a map of the UK nuclear capability. The capability was ranked across 143 services, products and technologies derived from an original survey by the NIA (Capability of UK NNB Supply Chain) in 2012.

The Cavendish survey also asked companies to respond to the following questions:

- Do you currently export your products / services to overseas nuclear industries?
- Are you looking to export?
- Would establishing / increasing your ability to export require a significant investment on your part?

Responses were received from 46 companies, and 11 of these have offices/facilities in the South West.

The results provided by the 46 firms were aggregated and, from these, the top five capabilities were identified. On reviewing the capabilities of the 11 companies responding with offices in the South West their capabilities compare well with this result. However, these companies are predominantly UK national businesses with a focus on design engineering, project management and consultancy.

The results from the Working Group are shown in the table below:

Position	Services	Products / Technologies
1	Mechanical Engineering / Design	Waste Packages
2	Project Management	Decommissioning Tools
3	Design Management	Instrumentation
4	Instrumentation and Control Engineering / Design	Remote Handling
5	Optioneering / Decision Analysis	Robotics / ROV

5.2 Capability Graphs

Figure 5

By comparison, on the research undertaken to compile the Supplier List for this Report, this demonstrates the decommissioning capabilities existing in the South West, across 15 products and services categories identified.

From the Supplier List, it is possible to run a report across all these 15 categories to produce a simple Pie Chart which identifies the Top 5 capabilities as well as providing a easy to view graphic of the capability in the region across all 15 categories.

The Top 5 Categories for the South West in order are:

- Manufacture, Fabrication and Precision Machining
- Professional Services (includes consultancy businesses)
- Engineering Design Services (includes project management)
- Electrical Control and Instrumentation
- Civil Construction

The Pie Chart is included below including the 15 categories:

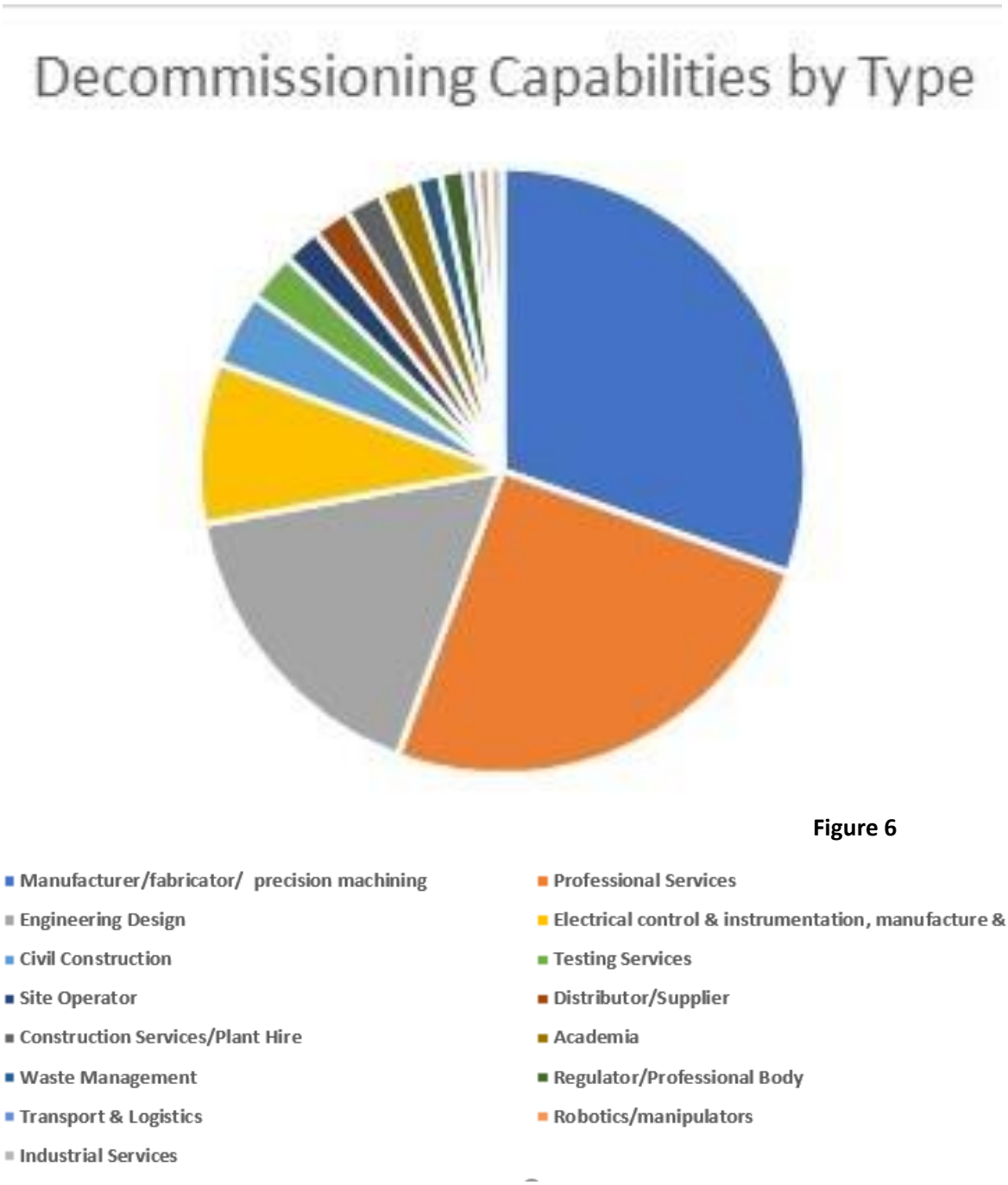


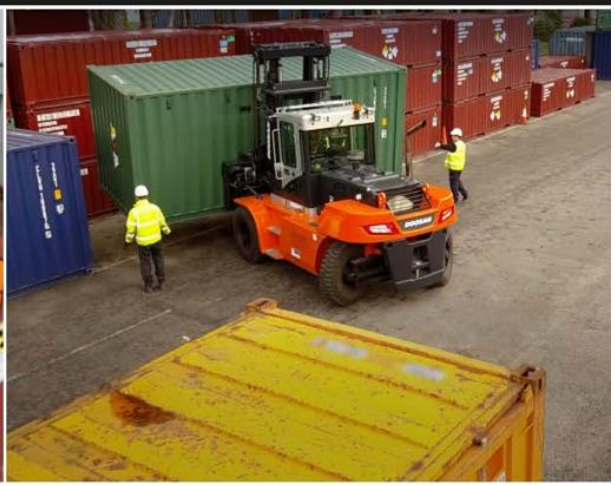
Figure 6

The results for the South West provide a similar pattern to those from the Working Group in that Project Management, Engineering Design, Consultancy and Electrical Instrumentation and Control are high on the capability list. The main difference being the predominance of Manufacturing, fabrication, and Precision machining in the South West Decommissioning companies.

This could be explained by how the companies have been categorised, and the types of companies responding to the Working Group survey, the size of the sample will have an effect also. However, we believe it is important to note this difference.

Included below is a case Study from Tradebe Inutec Ltd for a project they have undertaken for Magnox at Hinkley A power station:

Case Study: Magnox Hinkley Encapsulation & Disposal



Tradebe Inutec reduced the volume of waste for disposal by 20% through innovative technologies for sludge mixing, retrieval and cementation

Magnox

The Customer Challenge

A number of Magnox stations have Active Effluent Treatment Plant (AETP) sludges stored in a variety of tanks which require safe final treatment and disposal. These sludges have been expensive to manage, as they have had poor final volume utilisation of less than 40% within LLWR disposal ISOs. This often meant that these wastes were more likely to kept at site, where they used up valuable storage space.

The Tradebe Inutec Solution

20 Intermediate Bulk Containers (IBCs) containing 11m³ of settled sludge from the HPA site were transported to Tradebe Inutec's facilities, where the sludge was remobilised, retrieved and cemented cement to minimise the volume of waste for disposal. Innovative, industry-leading mixing, retrieval and direct pouring techniques were used by Tradebe Inutec's experienced personnel within its Winfrith Nuclear Licensed Site to complete the project.

Value to Customers

By applying innovative mixing, retrieval and direct pouring techniques, Tradebe Inutec was able to help Hinkley Point A realise a significant increase in volume utilisation to more than 60% leading to a more cost-effective solution that was also better aligned to LLWR's waste minimisation objectives.

#makingcomplexwastesimple

Member of NIA Nuclear Industry Association

2020 ROSPA Order of Distinction

UKAS TESTING

Contact Details
Chris Macey - 07775 996 234, chris.macey@tradebe.com
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David Ferguson - 07968 707 069, david.ferguson@tradebe.com
W: www.tradebe.co.uk / www.inutec.co.uk

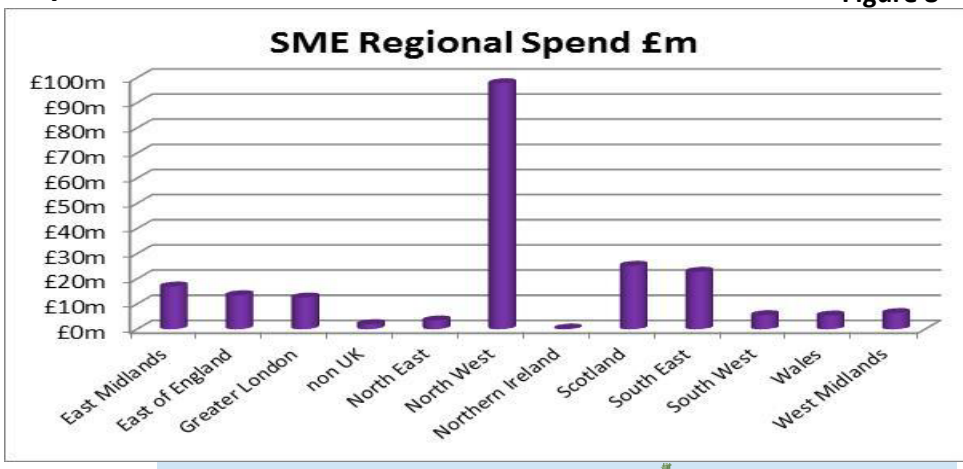
TRADEBE INUTEC

The Hinkley Supply Chain Programme has been working with South West companies to understand their Nuclear capability since March 2017. This programme has engaged with nearly 1200 businesses to conduct supplier capability reviews with the South West and South Wales supply chain. The majority of these reviews have been conducted face to face in the company's premises but with the impact of COVID-19 this activity has transitioned online. In making this transition additional questions have been added which now cover a full suite of questions around the company capabilities and aspirations including questions to understand their experience in the context of International business and exporting. This work could be shared to supplement the supplier capability map for the South West.

Figure 7

5.3 NDA SME Supplier Heat Map

Figure 8

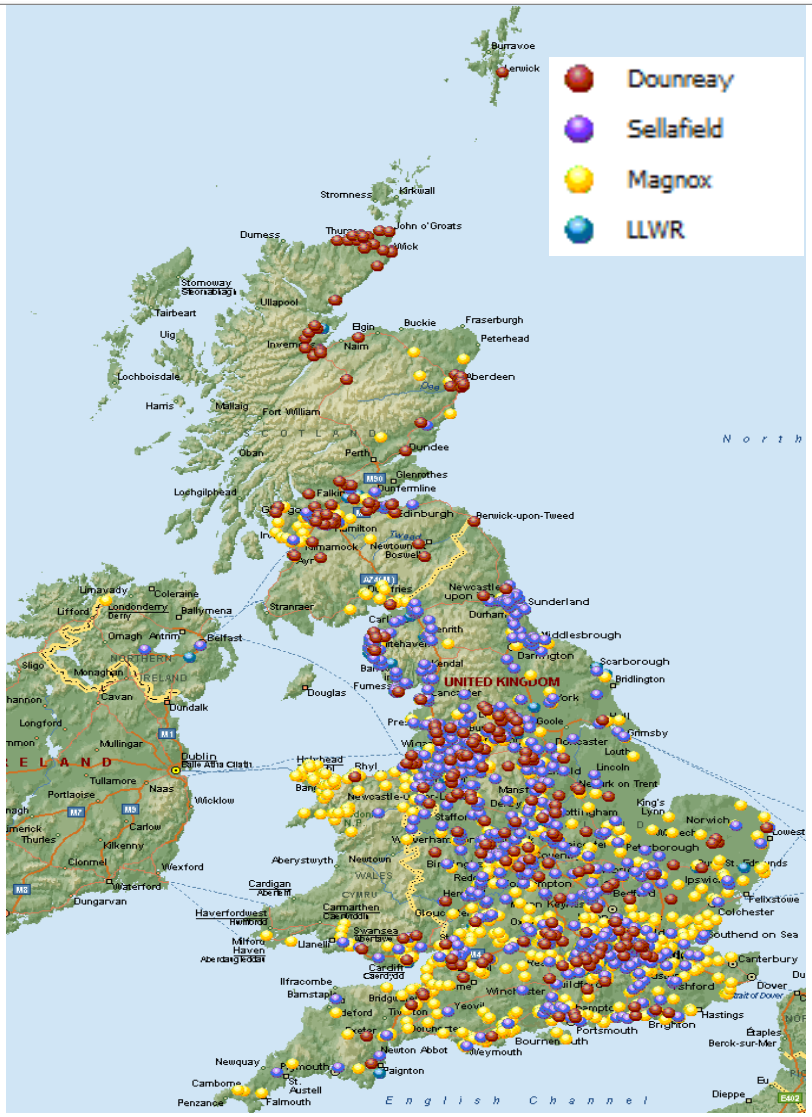


The NDA are one of the primary stakeholders in relation to the Nuclear decommissioning activities across the UK and were invited to contribute to this report any information that they may have on South West supplier capability and experience or challenges in working with regional companies.

The NDA were able to provide information on South West companies who have undertaken work for the NDA. This enabled another 20 companies to be identified and added to our Supplier List.

There could be a benefit for both Parties in continuing to map decommissioning capability across the South West of England and sharing this work with the NDA beyond the timeframe of the Report.

We have included the NDA's SME Supplier Heat Map (right) showing the distribution of companies who have worked within the NDA estate by Site Licence company, and this provides a good correlation with the list we have researched for the South West.



The "Heat Map" identifies the existing SME community in the South West and the distribution of work undertaken across the different Site Licence Companies. Most of the companies have worked for Magnox Ltd, which given the number of Magnox sites which are present across the South West and the Magnox HQ being based in Berkeley is hardly surprising. Magnox are not the only route to market for South West firms and several companies have worked for Sellafield Ltd and Dounreay Site (now part of Magnox Ltd) and one company has worked with the Low-Level Waste Repository (LLWR).

The Heat Map was produced as part of the NDA SME Action plan and shows the direct spend with SME's. There are over 150 companies identified across the South West of England (this is likely to be a larger region than that covered by this Report) who are engaged with the NDA, despite having a significant number of companies, the spend with SME's in the region is approximately £5m (2019).

The region currently has the 3rd lowest area of spend, only above the North East and Northern Ireland, despite having companies with the capability to support the decommissioning activities.

Included below is a Case Study from Steve Vick International on their innovative solution to a challenge on the Harwell site to prevent contamination spread from pipework:

Decommissioning and New Connections

STEVE VICK INTERNATIONAL

Steve Vick International offer solutions to the problems associated with decommissioning and sealing disused pipework, ducts, sleeves and ventilation shafts. Our technology can also be designed for the mass filling of large and complex voids and is a lightweight alternative to cement grout.

Decommissioning of pipes, ducts or chambers

- Our bespoke hot-tapping systems allow for a fully contained insertion of our FOAMBAG™, effectively capping & decommissioning the pipe before it's cut
- The SVI FOAMBAG™ is excellent at encapsulating loose debris or contamination within the pipe
- Our products can be introduced from a remote location allowing application in contaminated or hard to reach places

Canadian Nuclear Laboratories carrying out a pipe sealing operation on an active pipe using a bespoke FOAMBAG™ kit designed specifically for their project

Foam cap-end installation at Harwell BEPO storage block

- Our techniques are able to seal off vertical, horizontal and tapered pipes with diameters up to and even above 1000mm
- Annular spaces between pipes and cables and their host pipe can be filled with our formulated closed cell expanding foams
- Our systems have been developed for use in underwater environments
- Suitable for all pipe materials including steel, asbestos, concrete and plastic
- Our techniques have radically reduced exposure times and costs during glovebox removal
- Our highly experienced technicians have carried out projects in the UK and Internationally. Alternatively, a range of our products are available in kit form for customers to perform their own sealing operations

Harwell BEPO storage block on completion of SVI foam filling operation with 250 bespoke FOAMBAG™

A foam filled chemical drain at Chapelcross

New connections

- Using our bespoke under pressure systems we can provide a method for making new connections to existing pipeline networks whilst under live conditions

A new connection being made under live conditions using our under pressure system

CCTV Surveys

- Through our pressurised hot-tapping system, we are able to carry out CCTV inspections under live conditions & from remote locations
- Our surveys can assess pipe conditions, allow for remediation and for removal of a pipe wall sample for metalurgical testing

Further information on case studies, nuclear products and our nuclear brochure can be found on our website

Over 30 Years Experience | International Coverage | Bespoke Project Design

For technical specifications please contact Richard Ditte:

stevevick.com | 01225 864864

5.4 Hinkley Point C Context

Research to prepare the decommissioning capability Supplier List did not seek to include South West companies currently working on the nuclear new build programme at Hinkley Point C. However, as an ongoing activity, the inclusion of South West companies undertaking work on HPC within the Supplier List is recommended as this will then demonstrate the overall capability and capacity of the nuclear supply chain in the South West.

The table below identifies the number of South West suppliers who have won contracts on the HPC project to provide some context of the overall nuclear engagement within the South West:

Figure 9

Region	Suppliers	Contracts won	Total value	Ave. Value
HPC all of SW	983	1226	£1.25B	£1.3M
Devon	137	147	£62M	£452K
Gloucestershire	49	58	£23.7M	£483K
Somerset	369	504	£351M	£952K
Wiltshire	23	31	£19.3M	£837K
Cornwall	15	17	£63.4M	£4.2M
Dorset	18	21	£1.8M	£101K

Included on the next page is a Case Study from Blackhill Engineering Ltd on their work on the Marine Jetty at Hinkley Point C.

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Exeter, Devon EX5 1JL
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e: info@blackhillengineering.co.uk
w: www.blackhillengineering.co.uk

Major Projects carried out during the last 3 years with references highlighting Nuclear & other relevant experience.

HPC Aggregates Jetty – Jetty Head Steelworks - Costain Limited

Due to Blackhill Engineering's heavy engineering capability and their 50 tonne lifting capacity, Blackhill were successful in securing a contract with Costain in 2016 to undertake a package of work linked to the New Infrastructure Jetty.

This work entailed the procurement and handling of over 650 tonnes of steel, which in turn was used to fabricate the 30 steel caps required for the piles supporting the top of the jetty, as well as the 48 steel bridge beams spanning the piles. Some of the bridge beams measured up to 14 metres in length.

The temporary jetty, which extends 500m into the Bristol Channel, had been designed to allow freight movement of cement, sand and aggregates away from local roads to more sustainable sea transportation. Some 80 per cent of the aggregates needed to build Hinkley Point C will be delivered to site via the jetty.
All works associated with the Aggregates Jetty were subject to nuclear level testing, traceability and documentation requirements (including full Lifetime Records) which Blackhill fully satisfied as part of the contract requirement.

Blackhill Engineering delivered the full scope of work under this contract on time and to budget, including successfully mitigating an initial delay of 3 months to work commencing, which resulted from a customer design change meaning the drawings not being available as previously planned. Based on our performance on this contract Blackhill where awarded "best Equipment Manufacturer 2017" and "Best Regional Supplier 2017" by EDF for the efforts in maintaining the schedule at Hinkley Point C.

5.5 Decommissioning Capabilities at Winfrith

5.5.1 Background

To provide some background information as provided by the ONR website:

The Winfrith Nuclear Site was opened in 1957, to offer additional space for the UK's civil nuclear research programme.

It became a centre for research and development, including the prototype high gas cooled reactor DRAGON, and the SGHWR (Steam Generating Heavy Water Reactor) which provided enough electricity to the National Grid to power a small town. Later the site also diversified into other disciplines, such as safety testing and oil exploration.

Winfrith has had at various times, nine research and development reactors. The last operational reactor at Winfrith closed in 1995, since then the focus for the site has been on decommissioning. The decommissioning programme is due to be completed to an interim end state by 2024.

During the life of the Winfrith nuclear site, from construction, through operations and early decommissioning, a nuclear engineering capability was developed in the local area which could be referred to as a "cluster."

5.5.2 Decommissioning

The operating station went into the decommissioning phase in the mid to late 1990's.At this stage the ongoing nuclear capability of the local engineering "cluster" has seen a challenging environment due to the decline of opportunities and demand from the Winfrith site. At the same time, the number of people working on the site, principally UKAEA and latterly Magnox, has also declined.

A few nuclear focussed companies known to remain in the area, including Tradebe Inutec Limited, Nuvia Limited, James Fisher Nuclear Limited, and Ultra Nuclear Limited, supporting work on the site as well as the wider nuclear market.

However, the research undertaken to compile the Supplier List has identified a further 23 companies located in Dorset with nuclear decommissioning capability and experience.

In detail these companies' capabilities include the following categories:

Number of suppliers	Category
8	Manufacturing, Fabrication & Precision machining
6	Electrical Control & Instrumentation
4	Engineering Design (includes Project Management)
2	Professional Services (includes Consultancy)
2	Laboratory Services
1	Waste Management
1	Civil Construction
1	Construction Services
1	Distributor/Supplier
1	Transport/Logistics

These results are very similar in Capability/category distribution to the results from across the entire Supplier List.

Included below is a Case Study from Nuvia Ltd on their experience on projects at Winfrith:

CASE STUDY

Winfrith Decommissioning

Over the last two decades, NUVIA has supported the Winfrith site with numerous decommissioning, hazard reduction and clean-up activities and projects. Based on this heritage, NUVIA's unparalleled experience and know-how for sensitive site decommissioning and waste treatment now span across 15 countries with a workforce of more than 3000 nuclear specialists.

From experience gained on projects at the Winfrith site, and internationally across the world, Nuvia can provide the overall management of decommissioning programmes, including new build requirements, from the development of safe and cost-effective strategies to final clearance. The strategies are developed into detailed methodologies, safety documents and schedules that include the following:

NUVIA's experience gained on the Winfrith site include support on the following projects.

The operation, decommissioning and demolition of the Active Handling and Decontamination Building A59.

The A59 Active Handling Building was an NII Category 1 facility. The facility contained two large, heavily shielded cave lines constructed from reinforced concrete, a decontamination centre, and a pressurised suit area together with a range of supporting of workshops and laboratories.

Maintenance and decommissioning work at other facilities on the Winfrith Site including:

- SGHWR Reactor
- ZEBRA Reactor
- DRAGON Reactor

Nuvia carried out Stage 1 decommissioning of the Steam Generating Heavy Water Reactor, SGHWR, essentially the removal and packaging of all significant plant outside of the reactor.

DRAGON Reactor Shield Door

DRAGON was a research reactor constructed in the 1950s and shut down in 1975. Some decommissioning had previously been undertaken, but the next phase of decommissioning involved remote decommissioning of the reactor core itself for safe disposal.

NUVIA is designing, manufacturing, installing and commissioning specialist plant and equipment to deploy, carry out and support core segmentation and waste processing operations.

In terms of ongoing occupation of the site by nuclear businesses and on a positive note, the ONR has granted a nuclear site licence to Inutec Ltd (Tradebe Inutec) who occupy part of the Winfrith nuclear site in Dorset, following Tradebe Inutec's acquisition of buildings and land at the Winfrith site from the Nuclear Decommissioning Authority (NDA) in February 2019.

The two major remaining contracts on the site are for the design manufacture and installation of equipment for the decommissioning of the SGHWR and Dragon Reactors. Most of the contracts relating to these projects have now been let and are progressing with the aim to reach the interim end state (i.e. completion of decommissioning activities). The current intent is that the Magnox staff working at Winfrith will undertake the final operational dismantling of the Reactors in-house following installation and commissioning of the decommissioning plant and equipment.

5.5.3 Future Challenges

Clearly, as the decommissioning work programme at Winfrith draws to a close, the greater the challenges to local engineering businesses to maintain their nuclear capability. These businesses will have to seek nuclear work further afield or look to transition into other markets and more likely, will need to do both. To transform their businesses in this way will require support from the Local Government stakeholders.

For the larger, national nuclear businesses, with greater resources, including Magnox, decisions will have to be taken around how much resource and capability will remain in the Winfrith locality and how much will be transferred to other nuclear sites, such as Harwell in Oxfordshire, or Berkeley and the Bristol area.

To support this challenge, an Advanced Engineering Cluster has been formed around the Dorset Innovation Park, which has been set up on part of the former Winfrith Licensed site, and which is now an Enterprise zone.

The Dorset Innovation Zone is supported by Dorset Council and Dorset Local Enterprise Partnership (LEP) to promote an advanced engineering cluster focussing on Marine, Defence, Energy, and Cyber Security, and a promotional brochure has been produced to market this enterprise. Current occupants of the Dorset Innovation Park include, Inutec Tradebe, Optasense, Qinetiq, Nuvia, and Atlas Elektronik UK.

On-going support from the Dorset LEP will be required to grow the advanced engineering cluster on the Winfrith site and maintaining a presence in a variety of market sectors such as marine, defence, energy, and cyber security will be more sustainable. A nuclear presence could be maintained, both civil and nuclear, to benefit from the opportunities looking slightly further afield on the Magnox estate and to the nuclear new build at HPC, and even the AGR fleet decommissioning, as well as the opportunities within the Advanced Technologies and Fusion market, given the relative proximity of the Harwell and Culham sites.

A strategy to combine support across the South West Region to assist in the co-ordination of activities and to provide visibility of these opportunities to the Dorset based nuclear and advanced engineering businesses would seem beneficial.

6. An Overview of the Future Potential Opportunity in the Nuclear Market

6.1 What are the future opportunities for nuclear decommissioning in the UK?

This section details the scale of the decommissioning work required across all the 17 NDA sites in the UK. By reference to the NDA publication entitled "Nuclear Provision: the cost of cleaning up Britain's historical nuclear sites," the total opportunity as detailed within the "nuclear provision" is around £124billion over a 120 - year programme, and current annual costs to manage and decommission the NDA estate are around £3billion.
The likely total spend across each of the NDA sites is shown in the table below:

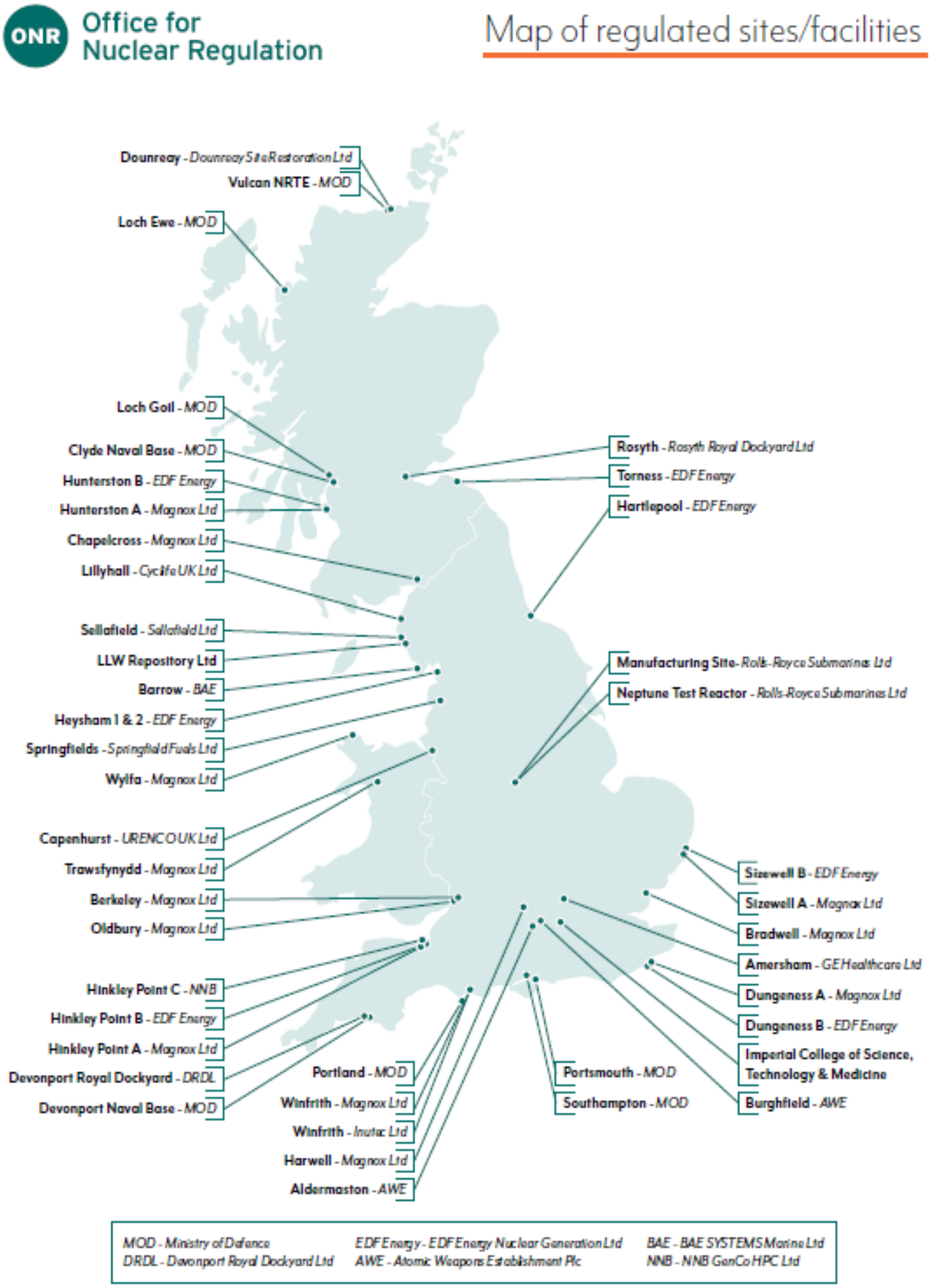
Figure 10

Sites	Decommissioning & Clean-up Costs (in million)
Magnox Decommissioning (including Harwell and Winfrith)	21,635
Dounreay 2	2,697
Sellafield	119,930
Capenhurst	1,200
LLWR	759
Springfields	881
Geological Disposal Facility	14,751
NDA Central and Group	443
Total Cost of Decommissioning	**163,505**

As these figures suggest, the ongoing opportunity within the NDA estate remains significant and is furthermore attractive due to the extended length of the decommissioning programme.

Aside from the NDA Estate there are also opportunities across the other UK nuclear sites which include, MOD sites, EDF Energy Operating sites and future decommissioning sites, EDF Energy new build sites, waste management and nuclear materials. These are all identified on the following map, produced by the Office for Nuclear Regulation (ONR). In total there are 36 ONR sites and of these 21 are undertaking decommissioning projects.

Figure 11


ONR
Office for Nuclear Regulation
Map of regulated sites/facilities
Dounreay - Dounreay Site Restoration Ltd
Vulcan NRTE - MOD
Loch Ewe - MOD
Loch Goil - MOD
Clyde Naval Base - MOD
Hunterston B - EDF Energy
Hunterston A - Magnox Ltd
Chapelcross - Magnox Ltd
Lillyhall - Cyclife UK Ltd
Sellafield - Sellafield Ltd
LLW Repository Ltd
Barrow - BAE
Heysham 1 & 2 - EDF Energy
Springfields - Springfield Fuels Ltd
Wylfa - Magnox Ltd
Capenhurst - URENCO UK Ltd
Trawsfynydd - Magnox Ltd
Berkeley - Magnox Ltd
Oldbury - Magnox Ltd
Hinkley Point C - NNB
Hinkley Point B - EDF Energy
Hinkley Point A - Magnox Ltd
Devonport Royal Dockyard - DRDL
Devonport Naval Base - MOD
Portland - MOD
Winfrith - Magnox Ltd
Winfrith - Inutec Ltd
Harwell - Magnox Ltd
Aldermaston - AWE
Rosyth - Rosyth Royal Dockyard Ltd
Torness - EDF Energy
Hartlepool - EDF Energy
Manufacturing Site - Rolls-Royce Submarines Ltd
Neptune Test Reactor - Rolls-Royce Submarines Ltd
Portsmouth - MOD
Southampton - MOD
Sizewell B - EDF Energy
Sizewell A - Magnox Ltd
Bradwell - Magnox Ltd
Amersham - GE Healthcare Ltd
Dungeness A - Magnox Ltd
Dungeness B - EDF Energy
Imperial College of Science, Technology & Medicine
Burghfield - AWE
MOD - Ministry of Defence
DRDL - Devonport Royal Dockyard Ltd
EDF Energy - EDF Energy Nuclear Generation Ltd
AWE - Atomic Weapons Establishment Plc
BAE - BAE SYSTEMS Marine Ltd
NNB - NNB GenCo HPC Ltd

6.2 Advanced Nuclear Technologies

In the following sections there is a summary of the likely opportunities which could appear and develop in the nuclear advanced technologies sector over the next few years.

6.2.1 Small and Advanced Modular Reactors

SMR's	Small Modular Reactors			
UK Programme	First plant circa 2030 Trawsfynydd potential first site	Up to 300Mwe	Rolls Royce leading team to develop prototype	£250M funding
AMR's	**Advanced Modular Reactors**			
UK programme	Government feasibility study	Review of generation IV technologies	Modular design and manufacture	

6.2.2 Fusion Technology

Fusion	Compact Fusion Reactor			
STEP Programme - Culham Centre for Fusion Energy	Programme to design and build first UK compact fusion reactor by 2040	Deliver prototype by 2040	**Over next four years –** Create an investible concept…. Understand the market and how it will be built Enable and inspire the UKs capability and capacity to deliver	£220M funding
H3AT Programme – Hydrogen 3 advanced technology	A Tritium Research centre to study how to process, store and recycle tritium.	To develop one of the fuels to power a fusion reactor	First tenders to be issued in September 2020	**Facility to open by end 2021**
ITER	Construction of the Worlds' largest experimental Fusion reactor	Produce 500MW of Fusion power	Ongoing procurements for the Mechanical & Electrical equipment and assembly	2020 - 2025

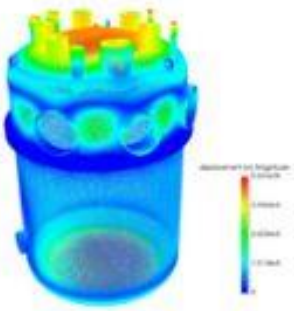
6.2.3 Science and Research

STFC – Science & Technology Facilities Council- UKRI	Science and Research Opportunities supporting new facilities across Europe			
European Spallation Source - Sweden	New build research facility	Broad range of opportunities across mechanical and electrical equipment		1.8B Euros project
CERN - Geneva Switzerland	European laboratory for particle physics	Broad range of opportunities		Spend 350M Euros per annum
ILL Grenoble	Neutron scattering facility	Instrumentation, electronics, electrical engineering, mechanical engineering equipment		Spend 50M Euros per annum
ESRF France	European Synchrotron Radiation Facility – X-Ray	Instrumentation, electrical and mechanical engineering, cryogenics, vacuum, optics		Spend 50M Euros annually
ESO	European Southern Observatory	Mechanical and electrical engineering, Optics, Detectors, Cryogenics, vacuum	Poised to commence multi Billion euro project to construct large telescope	Spend 135M Euros
FAIR	Facility for anti-protons and Ion Research	Magnets, vacuum technology, cryogenics		

Below is a Case Study from Green Resource Engineering Ltd (GRE) on work they have undertaken on Cryogenic Cooling Systems for Tokamak and CERN through the Science and Technology Funding Council (STFC):

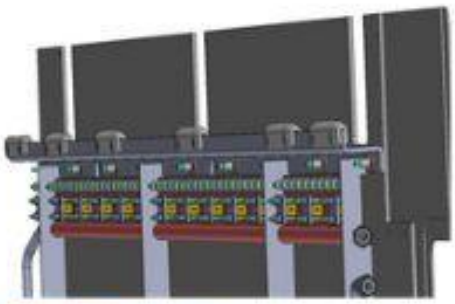
Analysis

We will analyse our client's specification and together with our partners at Monroe Brothers, design a system or piece of equipment that will perform to the required level.



Design and engineering

Using 2D and 3D design software, finite element analysis and extensive manual calculations, our products and systems are designed to cope with all operational conditions.



Manufacture

With a wealth of experience, machining and clean-room facilities, our products leave our factory with the highest standards of workmanship and quality.

Electrical and software

Our in-house team create bespoke software, using trusted hardware from Siemens, to give reliable, accurate and safe control of our equipment.

Clients

We supply to industrial, research, medical clients amongst many other clients worldwide. Here are just a few examples.

tokamak energy
a faster way to fusion

Science & Technology Facilities Council

CCFE
CULHAM CENTRE FOR FUSION ENERGY

ROLLS ROYCE

6.3 An overview of Potential International Decommissioning Opportunities

6.3.1 Decommissioning Activity

COUNTRY	DECOMMISSIONING ACTIVITY			
GERMANY	Plan to close all nuclear plants by 2022	10 reactors now shutdown	5 reactors have licensed decommissioning	38B euros programme 17 reactors due to be decommissioned
FRANCE	Operational Capacity capped at 63.2GW	14 reactors currently shutdown	48 reactors scheduled to close by 2030	
JAPAN	Current decommissioning programme at Fukushima	Under programme for re-opening reactors closed following Fukushima	9 reactors back on-line	17 reactors with pending applications to re-start
CANADA	6 reactors under care and maintenance	6 more reactors schedule shutdown by 2022	Pickering Station likely to be first major decommissioning programme	$20B Decommissioning programme by 2035
UNITED STATES	Several Operational owners now handing over Site Licences to decommissioning companies	7 reactors have now shutdown and starting decommissioning	9 reactors are under care and maintenance	12 reactors scheduled for shutdown by 2025
TAIWAN	Changing political environment	They have 6 active reactors	2 oldest plants operational licences expired	
SOUTH KOREA	Strategy to move away from nuclear	Plans to cancel plant life extensions	Intend to shutdown 7 reactors by 2029	Decommissioning plans for 17 older reactors

We have included on the next page a Case Study from Bristol University on Radiation Mapping at Chernobyl:

SOUTH WEST NUCLEAR HUB

Project title: **Radiation mapping surveys using UAVs in the Chernobyl Exclusion Zone**

Research area: Nuclear Hazards and Risks

PI: Professor Tom Scott

Partners: National Centre for Nuclear Robotics

Funders: EPSRC

Contact details: t.b.scott@bristol.ac.uk

Project website:

The Challenge

The accident at the Chernobyl nuclear power plant occurred during the early hours of Friday 26th April 1986 during a test on the Chernobyl 4 reactor prior to a routine shutdown. The resultant fallout led to radioactive isotopes being spread around the region (and beyond) leaving areas uninhabitable, whilst a much wider area was evacuated due to safety concerns.

Over 30 years has passed since the accident and whilst some radioactive isotopes have now decayed, others will remain for hundreds or thousands of years, creating hazards for humans and wildlife. Some of these areas are still inaccessible for humans and therefore creates a challenge to map and monitor the most dangerous areas.

The Solution

The team carried out a series of radiation mapping surveys using unmanned aerial vehicles (UAVs) equipped with gamma-ray spectrometers. The team conducted surveys of numerous interest areas in the Red Forest exclusion zone, using the DJI M600 UAV model.

Starting at the lowest risk site first, the village of Buriakivka, located 13 km from the accident epicentre, researchers moved on to the partially-demolished settlement of Kopachi before tackling the Red Forrest – one of the most highly-contaminated natural sites on Earth.

The gamma-ray spectrometry technology developed by the University of Bristol has previously been used in the first-ever UAV mapping of the Sellafield site in the UK and has also been deployed numerous times in the Fukushima Prefecture in Japan.

A scanning LiDAR (Light Detection and Ranging) pod was used to generate a terrain model, followed by a gamma spectrometer to measure the radiation intensity. This allowed the team to produce a highest resolution radiation map ever recorded of several areas.

Over nine field days, the total airborne time was 24 hours covering 730km to produce comprehensive 15 square kilometre radiation map.

University of BRISTOL

In a world first, fixed-wing drones were used to quickly map radiation over larger areas, flying at a height of 45 m - 60 m at a speed of c. 40 mph (65 km/h). Rotary drones were then used for more detailed investigation of key areas.

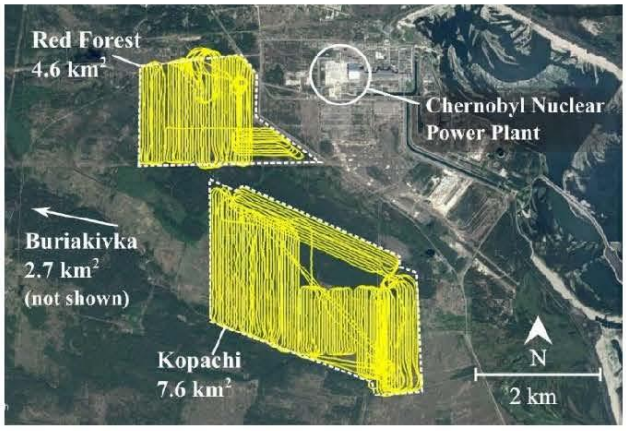


Fig 1: The areas mapped using UAVs in some of the worst-affected areas of the radioactive fallout plume

The Impact

This discovery of radioactive hotspots previously undetected will allow local authorities to recategorize zones, update safety protocols and allow the return of humans and wildlife. Large parts of the zone have already been declared safe to visit and 70,000 tourists visited the area in 2018. has increased ten-fold. This work will allow further safe areas to be identified and allow greater economic, social and environmental benefits to be realised e.g. the planned construction of new solar energy farms.

The team conducted this fieldwork research in April 2019 and were in the Chernobyl region on the 33rd anniversary of the accident. During their trip they were joined by ITV News crew and were featured on national UK television news bulletins on the 33rd anniversary.

This work demonstrated that the UK now has the capability to monitor radioactive sites and respond to nuclear incidents without exposing humans to risk. Detailed information can be gathered on a contaminated area from a safe zone, and be streamed live in real-time during the flight to researchers positioned in a safe zone.

7 Challenges and Barriers to entry facing South West Companies

7.1 Impacts of COVID 19 on UK and South West Companies

In the decommissioning sector, apart from critical activities, statutory requirements and emergency work, most project work on the NDA sites was ceased at the point of lockdown in mid-March 2020.

Whilst off-site work, such as, design, engineering and project planning could continue, productivity was impacted as new processes and equipment had to be put in place to enable staff to work from home.

Generally, manufacturing work relating to decommissioning projects has continued, though productivity has been reduced due to measures taken to make workplaces COVID-19 safe. The Manufacturing Barometer, a survey of SME manufacturers across the UK, was undertaken during the early stages of lockdown, and a summary of the findings is provided below:

- 18 companies on a national survey of 465 manufacturers who have self-identified as having more than 10% of their turnover in the Nuclear sector

- Based on this sample
    - 36% reduction in order book based on COVID-19 at the time of response
    - 33% expect high impact now on supply chain
    - All companies expect significant impact in sales and profitability

- Concerns raised around
    - Losing key staff to maintain operations
    - Lack of multi skilling which means capability is lost even if 1 or 2 staff are off work
    - H&S – lack of testing for staff who continue in production environments

On a positive note, there is some anecdotal evidence shared by businesses which suggest that productivity improved in certain activities for example, where work usually carried out within their business offices was now being undertaken from home.

In speaking to major national UK businesses in compiling this report, they confirmed that productivity levels of their office based (now home based) teams have been up to 85% - around 5% higher than pre-COVID 19 levels.

Such has been the success of adopting working from home practices in many companies, this is now hindering a return to work, with staff reluctant to come back into the office on a full-time basis.

The major UK national nuclear companies have also advised that their offices generally remain at only 10 – 20% of their pre-COVID headcount, with staff only based in the office part-time.

The main challenge for the on-site decommissioning projects is getting back to work within the COVID 19 guidelines and maintaining productivity in the longer term. Many of the NDA decommissioning sites were looking to get back to work on their projects by August. Some projects are already progressing, albeit with restrictions on numbers in line with the guidelines.

To overcome some of these challenges, the Site Operating companies like Sellafield Ltd and Magnox Ltd are largely keeping office-based activities working from home to allow more space on site for the project and operational teams. This strategy is also being adopted by their main contractors to allow more space for their project teams to work in their offices.

Certainty of funding for the NDA and their projects over the longer term, i.e. the next five years, will be key to avoid further negative impact on the supply chain. Clearly, there is a significant risk that funds previously agreed for the UK decommissioning programme will be reviewed and possibly reduced due to the overall impact of COVID 19 on the UK economy.

We have included below some results from a survey undertaken by UKAEA (August 2020) on the impacts of COVID 19 on UK businesses.

As shown, the top four issues raised in the UKAEA survey are very much in line with the survey undertaken in the manufacturing sector through Barometer earlier in the year. The UKAEA survey also identifies the visibility of procurement pipelines as being a pressing issue, which is certainly seen as a major barrier to entry for companies wanting to engage in the nuclear industry:

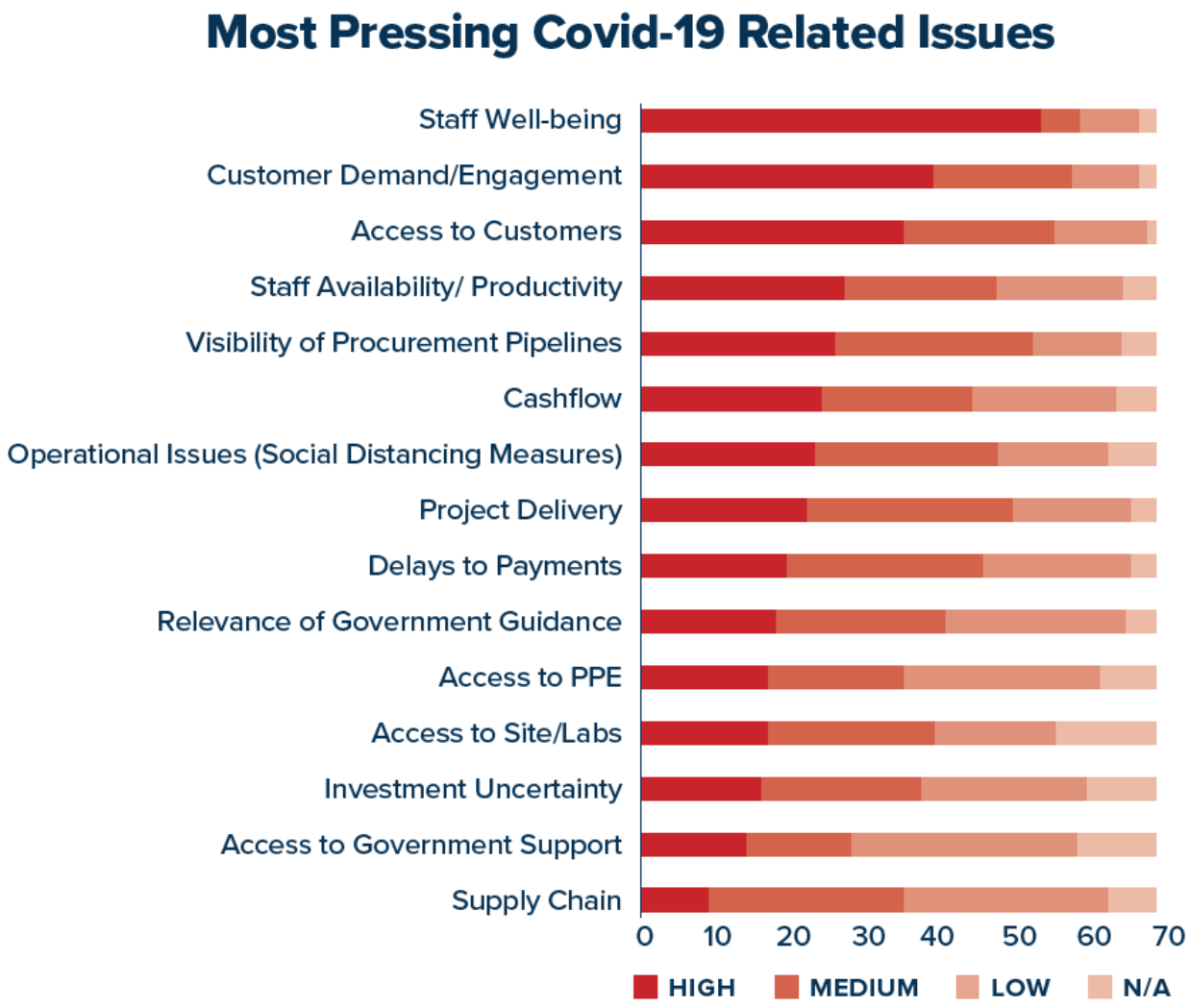
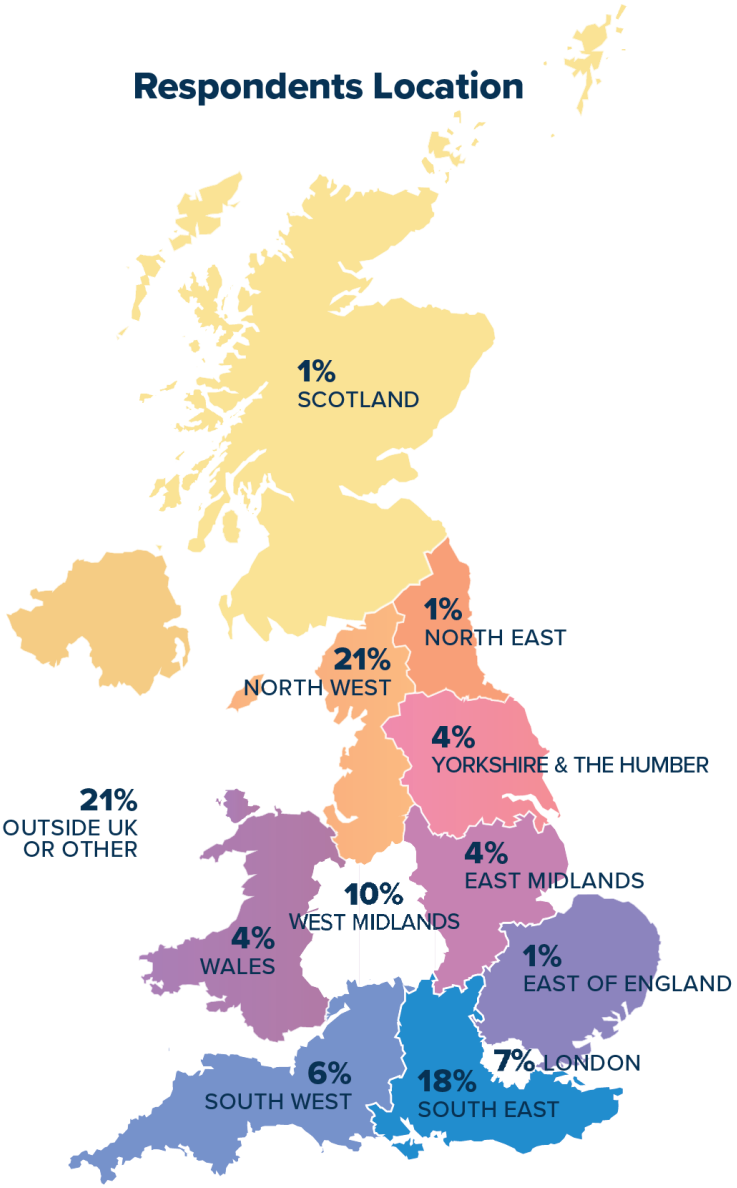
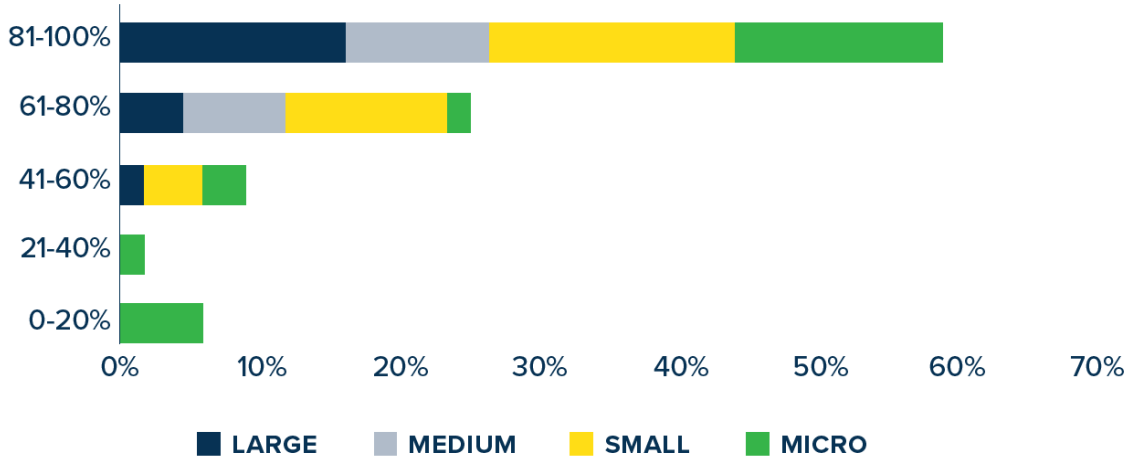


Figure 12 – UKAEA COVID Impact survey highlighting the most pressing issues to companies working with UKAEA

Respondents Location



Operating Capacity Now - Compared to Immediately Before Lockdown (23/03/20)



7.2 UK Decommissioning - Barriers to Entry and Mitigations

Barriers to Entry	Mitigations
Existing competent and experienced supply chain	Identify potential partners to collaborate on small innovation projects – UKRI, Sellafield LINC etc.
Demonstrating SQEP competence in nuclear environment, new Standards, and qualifications	Leverage work with Clients in South West in Decommissioning and HPC – ie Framatome, Cavendish, EDF
Lack of Visibility of potential Clients & opportunities	Support offered through the Hinkley Supply Chain programme
Lack of market knowledge & understanding	Support offered by Nuclear South West to market capabilities at industry events
Cost of marketing their business and altering their facilities to meet new market requirements	Support offered through local /government redevelopment funding programmes
Geography/location/ distance from target Clients' sites	Take advantage of positive changes in attitudes towards distance working and utilising new IT solutions as a response to COVID 19. Consider establishing a virtual sales process.
Difficulty in Winning work through existing Framework Agreements and Client Procurement Strategies	Engagement through Client/Local Supply Chain Programmes, ie HPC, Sellafield

7.3 International Decommissioning – Barriers to Entry and Mitigations

Barriers to entry	Mitigations
Visibility of Opportunities	Heart of the South West International market campaigns and "showing off" capabilities of the South West Companies
Lack of Market Intelligence & knowledge of Clients' and sites	Engagement between Heart of the South West and DIT showcases for South West companies
How to engage in overseas market	Support from Heart of the South West via DIT
Regulatory framework & Standards	Provision of Country specific awareness training
Export Control Requirements	Provision of awareness training and regulatory regime as the UK leaves the EU

8 Recommendations and Next Steps

1	Utilise the research and information gathered to develop marketing materials to promote the nuclear capability of companies in the South West as identified on the decommissioning capability Supplier List
2	Utilise the work being undertaken by the Hinkley Supply Chain Team to build upon the knowledge held on the Supplier List and identify more nuclear capable suppliers in the South West.
3	Engage with the Dorset LEP/Dorset County Council to consider inward investment strategies to support the existing nuclear supply chain cluster around Winfrith to raise awareness of the wider nuclear opportunities in the South West
4	Collaborate with other UK supply chain stakeholders, like the NAMRC (Winning UK Business Group), NDA, Sellafield Ltd (LINC), to share information and promote the nuclear capability of the South West supply chain
5	Undertake further work to include the nuclear capability being developed on the HPC project in the decommissioning capability Supplier List
6	Engage with key International Tier 1 contractors on the HPC project to leverage the capability of the South West supply chain to promote opportunities in the wider UK and International nuclear markets
7	Increase the overall spend/contracts won by South West suppliers in the decommissioning market by promoting their capability and readiness to support the future decommissioning of the EDF AGR Fleet, through early engagement with EDF nuclear generation
8	Undertake further research to understand knowledge of the South West supply chain capability to export their products, skills, and experience into International markets.

9 References, Case Studies, Figures, and Acknowledgements

References

Article	Source
AECOM presentation at NIA International Group May 2019	https://www.niauk.org/
Barometer	https://www.swmas.co.uk/knowledge/manufacturing-barometer
BEIS AGR Decommissioning statement dated August 2019	www.gov.uk/government/publications/advanced-gas-cooled-reactor-agr-decommissioning
EDF Energy presentation	International Symposium on Preparation for Decommissioning (PREDEC) in 2016.
Cavendish Nuclear	UK Capability Matrix – Nuclear Sector Deal's working group Winning UK Business
Ongoing trade programmes	DIT Nuclear Trade presentation
Report for Heart of the South West 2015	DNA Associates
UK Nuclear Market Assessment – Volume 1, Decommissioning, 2017	DNA Associates
Advanced Engineering Cluster	Dorset Innovation Park Brochure
EDF HPC interactive supply chain map for UK contracts	https://www.edfenergy.com/energy/nuclear-new-build-projects/hinkley-point-c/for-suppliers-and-local-businesses/built-in-britain
Frazer Nash Report ref: FNC 57481/47468R for Nuclear South West 2018	Nuclear South West
Magnox Procurement Plan issued August 2020	https://www.gov.uk/government/publications/procurement-plan
NAMRC presentation	EIC Live Conference May 2020
NDA SME Action Plan 2019-2022	https://www.gov.uk/government/publications/nda-sme-action-plan-2019-to-2022
Draft Strategy published August 2020 for consultation	Nuclear Decommissioning Authority
Nuclear Provision: the cost of cleaning up Britain's historic nuclear sites, 4th July 2019	Nuclear Decommissioning Authority
Office of Nuclear Regulation (ONR) – decommissioning	http://www.onr.org.uk/
COVID 19 survey August 2020	UKAEA
UKAEA website and STEP Programme	https://www.ukaeaevents.com/

Case Studies

Company:	Title:	Page:
Cavendish Nuclear	Berkeley AWVR project – Magnox	
AMS Nuclear Ltd	Moisture measuring systems – EDF	
NESC Ltd	Company profile	
Inutec Tradebe Ltd	Waste Encapsulation at Hinkley A – Magnox	
Blackhill Engineering Ltd	Jetty Steelworks at HPC - EDF/ Costain	
Steve Vick International	Decommissioning of Pipes at Harwell and in Canada	
Nuvia Ltd	Project work at Winfrith- Magnox	
Green Resource Engineering Ltd	Cryogenic Cooling systems – STFC/CERN	
Bristol University	Radiation Mapping Surveys at Chernobyl	

Figures

Figure number	Description
1	A map of the 17 NDA Decommissioning Sites
2	Part section, as example, of the Magnox Procurement Plan, August 2020
3	NDA nuclear provision for the decommissioning sites in the South West
4	Part section, as example, of the South West Supplier Capability List
5	Top five nuclear capabilities from the Winning UK Business Working Group
6	South West Supplier Capability Pie Chart
7	South West Supplier List Heat Map
8	NDA SME Heat Map
9	Value of contracts placed with South West suppliers on HPC
10	NDA nuclear provision for the decommissioning sites and GDF
11	ONR Map of UK Regulated Sites
12	UKAEA COVID 19 survey results of company locations and operating capacity
13	UKAEA COVID 19 survey results most pressing issues

Acknowledgements

In the compilation of this report we spoke to the following companies and would like to thank them and acknowledge their support:

- **Cavendish Nuclear Limited**
- **Green Resource Engineering Limited**
- **Nuclear Decommissioning Authority**
- **NESC Limited**
- **Nuvia Limited**
- **DNA Associates**
- **Tradebe Inutec Limited**
- **AMS Nuclear Limited**
- **University of Bristol**
- **NProjX Limited**
- **Steve Vick International Limited**
- **Green Resource Engineering Limited**

10 Appendices

10.1 Case Studies

10.1.1 Case Study provided by Inutec Tradebe Ltd on Oldbury Power Station Sludge Processing

10.1.2 Case Study provided by Bristol University on Diamond Detectors

10.1.3 Case Study provided by Green Resource Engineering Ltd on Liquid Nitrogen Cooling for the Tokamak Reactor

Case Study: Magnox Oldbury Sludge Processing

Tradebe Inutec helped Magnox's Oldbury Power Station to reduce project schedule and save disposal costs through an innovative sludge encapsulation project

The Customer Challenge

A large tank at Oldbury containing historic AETP sludge needed to be removed, treated and disposed of so that operations could continue. The two main challenges were first to mix the sludge in the tank so that it could be reliably sampled and analysed to confirm its suitability for disposal as LLW and to develop a robust treatment formulation and second to encapsulate the mixed sludge retrieved from the tank to minimise the volume of waste for disposal.

The Tradebe Inutec Solution

Tradebe Inutec's innovative solution included working closely with the Oldbury project team to use a new mobile plant to deal with the sludge at Oldbury as well as using pioneering air-driven technology to homogenise the waste in the tank without adding to the volume of the waste.Once removed, Tradebe Inutec developed a bespoke process to encapsulate the sludge into a cement treatment formulation that met LLWR requirements for disposal and used it's proprietary direct-pour technique to make full use of the capacity of the ISO container.

Value to Customers

Tradebe Inutec's team worked hand-in-hand with Oldbury's project team, providing a safe and flexible solution. Our unique approach meant that Oldbury needed to dispose of fewer ISO containers of waste to the LLWR. When combined with a 7-week reduction in processing time that helped shorten the overall project duration by four months, there was a saving of £800,000 for the UK taxpayer.

#makingcomplexwastesimple

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Chris Macey - 07775 996 234, chris.macey@tradebe.com
Tim Dowling - 07760 101 616, tim.dowling@tradebe.com
David Ferguson - 07968 707 069, david.ferguson@tradebe.com
W: www.tradebe.co.uk / www.inutec.co.uk

Diamond Detectors for Dose Rate Measurements in Highly Active Environments

Research area: Waste and Fuel Management

PI: Mr Chris Hutson

Partners: Sellafield

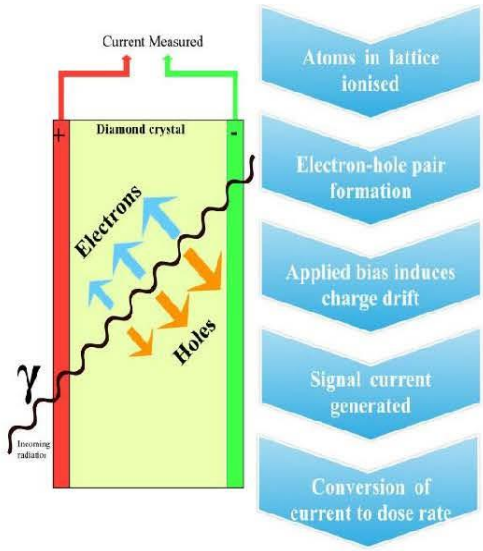
Funders: NNL

Contact details: Chris.Hutson@bristol.ac.uk

The Challenge

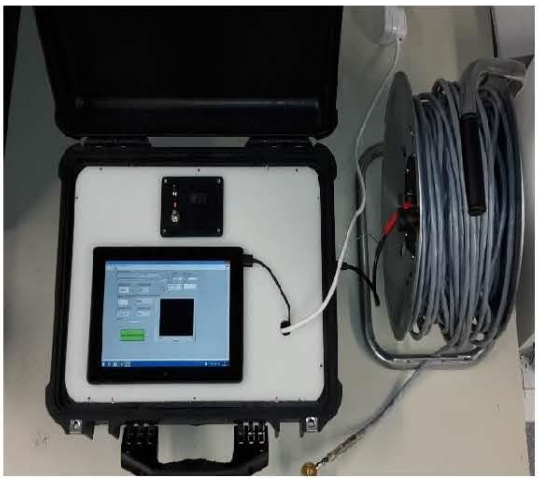
Decommissioning legacy nuclear facilities requires innovative characterisation technologies due to extreme levels of radioactive hazard, which destroys or saturates conventional detectors. Such technologies will be required to map multiple sources of radioactivity in facilities which have small access ports, contain complex networks of pipes and vessels, and have a high radiation hazard. This can either be in an operational plant that is heading towards decommissioning or following a nuclear incident.

Figure 1



Principle of dose rate measurement in diamond detectors

Figure 2



Portable dose rate measurement hardware and software

The Solution

Diamond based radiation detectors offer a novel technology allowing the non-destructive assay of highly radioactive environments in the civil nuclear sector. The miniature diamond detector system developed at Bristol allows real time dose rate measurements to be made remotely from inside difficult to access areas, creating maps of radioactivity in facilities which have small access ports, contain complex networks of pipes and vessels, and have a high radiation hazard.

Liquid nitrogen Cooling System for Tokamak fusion reactor

Design Challenge

GRE were privileged to win a contract to provide a cooling / temperature control system for an experimental fusion reactor. The requirement was to provide thermal control to a total of TWENTY-SIX separate channels, all independently of one another. Furthermore, the requirement was to bring the system down slowly – at approximately 1K every ten minutes – from ambient temperature to liquid nitrogen temperature (-196°C).

The system must operate as a "black box", entirely independently of any external control system.

Solution

GRE designed, manufactured, tested, installed, and commissioned a complete system to deliver temperature control as specified.

Primarily the system will:

- Bringing in liquid nitrogen from a cooling source (storage tank)
- Produce warn gaseous nitrogen from the cold liquid by boiling
- Mix the liquid with the gas in a measured way, in order to produce the smooth ramp down required
- Distribute the gas/liquid nitrogen mix to the experimental fusion reactor
- Stabilise the entire reactor (> 8,000kg, mostly copper) at liquid nitrogen temperature
- Re-establish temperature control and bring back to liquid nitrogen temperature after an experimental energy release has been performed







10.2 South West (Decommissioning) Supplier Capability List

Company	Product & Service Category	Post code	Region	Nuclear Decommissioning Capability				Export	
				Decommissioning	Spent Fuel	Nuclear Materials	Waste Management	Export Ready	Export Potential
OC robotics	Robotics	BS34 7JU	WECA						
AMS nuclear	Instrumentation	TA7 8QS	Somerset						
Frazer Nash	Consultancy	BS1 5UD	WECA						
Atkins	Design Engineering & Consultancy	BA6 9AS	WECA						
Nuvia	Design Engineering Project Management, Health Physics, Operational services	DT2 7UA	Dorset						
Tradebe	Waste Management	SN2 8EA	Wiltshire						
Ultra nuclear	Instrumentation	BH21 7SQ	Dorset						
James Fisher Nuclear Ltd	Design Engineering Project Management, Health Physics Instruments, Operational services	DT2 7UA	Dorset						
SC Innovation	Design and manufacture special vehicles	EX14 4LF	Devon						
Blackhill eng	Steelwork structures Manufacture	EX5 1JL	Devon						
GRE – as relates to STFC and CERN	Process engineering - cooling systems	EX15 2FB	Devon						
Aish Technologies	EC&I	BH12 4NL	Dorset						
Poole Process	Process pipework and heat exchangers	BH17 0RA	Dorset						
Arc Energy	Pipework welding and cladding	GL10 3RZ	Gloucestershire						
D3 Consulting	consultants	TQ9 6LU	Devon						
Steve Vick International	pipe handling solutions	BA15 2AU	WECA						
NRL	recruitment	BS20 7AN	WECA						
Bourne nuclear	structural steelwork fabrication and installation	BH12 4GP	Dorset						
Glasmaster	GRP fabrication	DT2 7UA	Dorset						
Heatric	Heat Exchangers	BH16 6LT	Dorset						
Inutec Tradebe	Waste management	DT2 8WQ	Dorset						
Thompson Valves	valves manufacture	BH17 7EF	Dorset						

Market Cross	consultancy	DT2 8ZB	Dorset						
Hydrock International	civil & structural design engineering and consultancy	BS1 4RW	WECA						
University of Bristol - SW Nuclear Hub	Academia	BS2 8BH	WECA						
NNL - Stonehouse	Laboratories and testing	GL10 3UT	Gloucestershire						
EDF Energy Nuclear Generation Ltd	Electricity generation	GL4 3RS	Gloucestershire						
Magnox Limited	Decommissioning	GL13 9PA	Gloucestershire						
Vulcain Engineering Limited	design engineering & consultancy	GL10 3UT	Gloucestershire						
TUV Nord (UK)	qualification and testing, consultancy	GL10 3RF	Gloucestershire						
Actemium	EC & I, switchgear	GL2 9QL	Gloucestershire						
ETL (Electronic Technicians Limited)	Electronic manufacturer	BH21 7QZ	Dorset						
P D Devices	Electronic manufacturer	TQ10 9AL	Devon						
Berry & Escott	stainless steel fabrications	TA6 5LT	Somerset						
Beran instruments	Instrument manufacturer	EX38 7HP	Devon						
Belcan	Resource & recruitment	BS34 7BD	WECA						
Spirax Sarco	Ventilation	GL53 8ER	Gloucestershire						
Rotork	Electronic manufacturer	BA1 3JQ	WECA						
NESC	Safety engineering and consultancy	PL6 8BX	Devon						
Optima SC	systems engineering	BS35 2BS	WECA						
Synoptix	systems engineering	BS34 7PZ	WECA						
Westbury Park Engineering	structural steelwork fabrication	BA13 4ES	WECA						
Cavendish Nuclear	engineering services	BS3 2HQ	WECA						
Office for Nuclear Regulation	Regulator	GL50 3PR	Gloucestershire						
Wood Group	engineering services	EX17 6AE	Devon						
Jacobs	engineering services	EX4 3AY	Devon						
Efinor	engineering services	BS1 2NT	WECA						
Kury	engineering services	BS2 0BY	WECA						
Avon Protection	Respirators for Hazardous Environments	SN12 6NB	Wiltshire						
Carrs MSM	Manipulators	SN3 4TX	Wiltshire						
Babcock International	site operator	PL1 4SG	Devon						
Costain Nuclear Limited	engineering services	BS24 7JP	WECA						

NProjX	engineering consultancy		Dorset						
Elecsis	Electronics manufacturer	TA6 4BH	Somerset						
Abbott Risk Consulting	engineering consultancy	BS1 6BN	WECA						
Aecom	engineering services	BS1 6NA	WECA						
Altran	engineering services	BS34 7PZ	WECA						
Altrad	industrial services	TA6 4FJ	Somerset						
Framatome (UK)	engineering services	TA6 4FJ	Somerset						
ARUP	engineering consultancy	BS1 6JZ	WECA						
Assystem	engineering services	BS16 7FD	WECA						
Balfour Beatty	Civil Construction	BS13 7UH	WECA						
Kier Construction Limited	Civil Construction	TA6 5LB	Somerset						
SWMAS Limited	Consultants	TA6 4FJ	Somerset						
Bridges Electrical	M&E contractor	EX5 1EW	Devon						
Bridgwater College National college for nuclear	education	TA5 2LS	Somerset						
Burges Salmon	Legal	BS2 0ZX	WECA						
C&G Services	training	GL10 3UT	Gloucestershire						
Calder Group (Helander)	Precision machining	GL20 8HF	Gloucestershire						
Capula (Imtech)	EC&I	GL3 4AE	Gloucestershire						
CRA - Corporate Risk Associates	Safety Case Consultants	GL10 3UT	Gloucestershire						
Darchem	fabrication	GL4 3DB	Gloucestershire						
RJP Property Consultants Limited	Consultants	GL6 8HP	Gloucestershire						
Doosan Babcock	engineering services	BS1	WECA						
Deloitte	consultants	BS1 6GD	WECA						
habia cable	Electronic manufacturer	BS35 3UT	WECA						
Hyder Consulting	engineering consultants	PL6 5XR	Devon						
MMI Tomasetti	engineering consultants	BS30 8FJ	WECA						
Morson International	Recruitment consultants	TA6 4RR	Somerset						
Mott Macdonald	engineering consultants	BS1 6FL	WECA						
NSG Environmental	waste consultant services	GL50 3SH	Gloucestershire						

Nuclear Engineering and Environmental Services (NEES)	safety consultants	EX6 6YD	Devon						
Nuclear Management Consultancy	safety consultants	BS1 5QT	WECA						
Nuclear Technologies Ltd	safety consultants	GL2 2SN	Gloucestershire						
Pipex Limited (Nov)	manufacturer	PL6 7BP	Devon						
Poyry Energy Limited	safety consultants	PL1 3JB	Devon						
PTG Ltd	Precision machining	PL7 5EX	Devon						
Radsafe	Health Physics	BS2 0ZX	WECA						
Draeger Ltd	manufacturer	PL7 5ET	Devon						
Radwise Ltd	Radiological Protection	TA5 1UD	Somerset						
Respirator Fit Testing Ltd	RPE testing	PL6 5JJ	Devon						
Rolls Royce	manufacturer	BS80 8AH	WECA						
Sir Robert McAlpine	Civil Construction	BS32 4TT	WECA						
RP Matters	Health Physics advice	PL6 8BX	Devon						
RPS Ltd	Consultancy	EX13 5AX	Devon						
Safelab Systems	Fume Cupboards manufacturer	BS24 8EE	WECA						
Sofinel	engineering consultants	BS32 4RF	WECA						
Strainstall (James Fisher)	manufacturer	BS5 0SP	WECA						
Technical Inspection Services (Applus)	Inspection & Test	BS21 6XU	WECA						
Sweett UK Ltd	QS consultancy	BS1 4PB	WECA						
Thales UK Ltd	manufacturer	BA5 1AA	WECA						
Truturn Ltd	Precision machining	GL5 3QF	Gloucestershire						
University of Bath	Academia	BA2 7AY	WECA						
Vinci Construction	Civil Construction	BS16 1GW	WECA						
WYG - White Young Green	Civil and Structural engineers	BS1 6DP	WECA						
WSP	engineering consultants	BS2 0HQ	WECA						
Rodford Engineering Ltd	Precision machining	BH21 7SD	Dorset						
Matravers Engineering	Structural steelwork	TA3 6PA	Somerset						
Tiflex Ltd	Gaskets manufacture	PL14 4NB	Cornwall						
RB Safety Ltd	Safety Case Consultants	BS14 9AF	WECA						

Southern Filters	Hepa filters	EX13 5RJ	Devon						
Atlas Packaging Ltd	cardboard packaging	EX31 3TT	Devon						
SRP Society for Radiological Protection	Professional Body	TQ11 0WA	Devon						
Hepco Slide Systems	manufacturer of linear slide systems	EX16 6TG	Devon						
Qwickfast Ltd	Tool supplier	DT1 2PG	Dorset						
Jade Aden	Cladding systems	BH15 2JH	Dorset						
Airepair Ltd	compressor servicing	BH12 4BT	Dorset						
Able Lifting Equipment Southern Ltd	Equipment hire & sales	BH15 3TB	Dorset						
AET Transport Services Ltd	Transport	BH16 6LT	Dorset						
Ameydoor services ltd	construction	BH17 9WE	Dorset						
DRC Dorset Repair & Calibration	Calibration service	DT5 2JU	Dorset						
Turrell Ltd	Electrical Installation	DT4 9TY	Dorset						
Breathe Safety Ltd	Breathing apparatus and testing	BH21 7RL	Dorset						
Stephens Industries	Gloveboxe manufacturer	SN13 9RD	Wiltshire						
Seepex UK Ltd	pump manufacturer	BA22 8RW	WECA						
Parker Hannafin	valves manufacture	EX31 1NP	Devon						
Barnwood Construction	construction	GL4 3HS	Gloucestershire						
Avocet Engineering Solutions ltd	fabrication	BS24 8PB	WECA						
Bridwey Precision Manufacturing Ltd	Precision machining	DT4 9TH	Dorset						
CJS Precision Engineering Ltd	Precision machining	BH21 7QD	Dorset						
CJS Engineering Design Ltd	design engineering	GL2 5JH	Gloucestershire						
AJM Consulting Services Ltd	Engineering Consultants	PL6 8BX	Devon						
Atlantas Marine Ltd	Generator distributer	PL7 5BG	Devon						
Broadband Visual Communications	Video Conferencing	BS4 3EH	WECA						
Built Intelligence Ltd	Training Provider	BS1 4QD	WECA						
Client Managers Toolkit Ltd	IT Software (CEMAR)	GL4 3GG	Gloucestershire						

Clue Computing Company Ltd	IT Software	BS14 9BZ	WECA						
Custom Cameras Ltd	Camera manufacturer	BA5 1EY	WECA						
CYBERIS LIMITED	Cyber security consultants	GL20 8GD	Gloucestershire						
Dart Systems Ltd	Industrial camera surveys	BA3 4BS	WECA						
Diane Jenkins Consulting Ltd	management Consultancy	SN4 0TE	Wiltshire						
Gleeds	Construction Consultancy	GL3 4AD	Gloucestershire						
GVH Projects Ltd	Engineering Consultancy	GL5 5DQ	Gloucestershire						
Johnson Elevanja Ltd	manufacturer	TA6 4YQ	Somerset						
Labeline International Ltd	Label manufacturer	EX31 4AY	Devon						
MechaTech Systems Ltd	manufacturer	BS35 3UR	WECA						
Monmouth Scientific Ltd	Glovebox manufacturer	TA6 4DB	Somerset						
Olympia Triumph Manufacturing Ltd	Manufacturer	BH20 4SP	Dorset						
Rapid Rail GB Ltd	Manufacturer	GL2 5HY	Gloucestershire						
Socitec UK Ltd	manufacturer	GL14 2UJ	Gloucestershire						
Tecalemit Garage Equipment Co Ltd	equipment retailer	PL7 5JY	Devon						
Verelogic Ltd	IT consultancy	SN1 2NR	Wiltshire						

10.3 Magnox Procurement Plan for August 2020:

https://www.gov.uk/government/publications/procurement-plan

11 Glossary

AGR	Advanced Gas-Cooled Reactor
AMRs	Advanced Modular Reactors
AWE	Atomic Weapons Establishment
BEIS	Department for Business, Energy and Industrial Strategy
DIT	Department for International Trade
DNA	Davies Nuclear Associates
DRAGON	Prototype High Gas Cooled Reactor
EDF	EDF Nuclear Generation Limited
EU	European Union
FDI	Foreign Direct Investment
Fusion	Compact Fusion Reactor
GDF	Geological Disposal Facility
GDPR	General Data Protection Regulation
HOTSWLEP	Heart of the South West LEP
HPB	Hinkley Point B power station
HPC	Hinkley Point C power station
LEP	Local Enterprise Partnership
LINC	Supplier Opportunities Portal managed by Sellafield Limited
LLWR	Low Level Waste Repository
Magnox	Magnox Limited
MOD	Ministry of Defence
NDA	Nuclear decommissioning Authority
NIA	Nuclear Industry Association
NSW	Nuclear South West
ONR	Office for Nuclear Regulation
SGHWR	Steam Generating Heavy Water Reactor
SL	Sellafield Limited
SME	Small and Medium size enterprises
SMRs	Small Modular Reactors
STFC	Science and Technology Funding Council
SW	South West
SWMAS	SWMAS Limited
UK	United Kingdom
UKAEA	United Kingdom Atomic Energy Authority
UKRI	United Kingdom Research and Innovation
WECA	West of England Combined Authority
WNE	World Nuclear Exhibition