Speaker Series

Decommissioning and legacy remediation in the UK – Progress and Challenges

Mark Foy – Chief Nuclear Inspector
21 November 2018
Overview

1. The UK nuclear waste management and decommissioning challenge – a National Overview
2. UK Regulatory Framework and Approach
3. UK Spent Fuel & Higher Activity Waste Strategy
4. Low Level Waste Management – Improved use of Waste Hierarchy
5. Case Studies:
   - Sellafield
   - Bradwell Care & Maintenance
   - Berkeley
   - Sizewell B Dry Store
   - New Build
Sellafield

- Large, complex fuel cycle site – operations are critical to other parts of the nuclear sector
- Large inventory of radioactive materials
- Ageing and degrading facilities
- Clean-up will take decades but there has been recent progress
- New facilities needed to support remediation and for safe long-term waste storage
- Change of mission and organisational transformation

Sellafield, image copyright of Sellafield Limited
Shutdown Magnox Power Stations

- 26 reactors on 11 sites
- Built 1956 -1971
- Gas cooled - natural uranium fuel with graphite cores
- All ceased operation and most are defuelled
PWR Power Station – Sizewell B

- Operational since 1995
- Owned by EDF Energy
- Output 1.2 Gw
- Spent fuel is stored on site in a purpose built dry store – US Holtec Design
- 60 year and 80 year lifetime extension ambitions
Research Sites

- Dounreay
- Harwell
- Winfrith
- Imperial College CONSORT
- All in decommissioning
Low Level Waste Treatment and Disposal

- Dedicated engineered disposal facilities at LLW Repository and Dounreay
- Conventional landfill disposal
- Metal treatment
- Incineration
- Trans-Frontier Shipments (eg for metal smelting)
UK Regulatory Framework and approach
UK Regulatory Bodies

Protection of People & the Environment

- Environment Agency
- Cyfoeth Naturiol Cymru
- Natural Resources Wales
- SEPA

Safety, security, safeguards and inland transport: Single UK-wide regulator

There are no licensed nuclear sites in Northern Ireland
ONR legal responsibilities

- **ONR** regulates nuclear safety, civil nuclear security, transport and conventional health and safety
  - With respect to handling, treatment and storage of nuclear matter upon the licensed site
  - Conditions of the site licence

- **Environment Agencies** regulate protection of people and the environment from the use of radioactive substances and disposal of radioactive wastes
  - grant permits or authorisations for the discharge and disposal of radioactive wastes (including VLLW)
UK Regulatory Philosophy

- Site operators are responsible for safety and environmental protection
  - Regulation is non-prescriptive and goal setting
  - Risks should be reduced so far as is reasonably practicable
  - Adequate Arrangements

- Delivering clarity of regulatory expectations
  - Graded approach
  - Open and transparent guidance
  - Routine and targeted stakeholder engagement – ‘Early Engagement’
Relevant Conditions of site licence

- Nuclear matter is stored in accordance with adequate arrangements.
- All operations that may affect safety need a safety case to demonstrate safety & identify limits and conditions of operation.
- Adequate arrangements for minimising the rate of production and total quantity of radioactive waste accumulated.
- The licensee is to ensure that radioactive waste is at all times adequately controlled or contained.
- The licensee is to have adequate decommissioning programmes, divided up into stages.
ONR legal responsibilities

- **ONR** regulates nuclear safety, civil nuclear security, transport and conventional health and safety
  - With respect to handling, treatment and storage of nuclear matter upon the licensed site
  - Conditions of the site licence

- **The Environment Agencies** regulate protection of people and the environment from the use of radioactive substances and disposal of radioactive wastes
  - grant permits or authorisations for the discharge and disposal of radioactive wastes (including VLLW)
Spent Fuel and Higher Activity Waste Policy
Spent Fuel Policy

- Spent fuel is not considered to be a waste while the option of reprocessing remains open
- Present assumptions are:
  - Magnox fuel reprocessing at Sellafield to end in 2020
  - Oxide fuel reprocessing at Sellafield to end in 2018
  - PWR and future reactors – Government policy is not to reprocess but to interim store pending geological disposal
HAW Policy

- HAW = Intermediate Level Waste and High Level Waste
- Safe interim storage followed by Geological Disposal - policy in England since 2006:
  - Welsh policy is Safe interim storage followed by Geological Disposal (2015)
  - Scottish policy is for long-term management in near-surface facilities near to the nuclear site where it is produced (2011)
HAW Future Disposal

Government policy is for:

- long-term management of higher activity radioactive waste (HAW) via geological disposal
- GDF to require a nuclear site licence
- No intent for ONR to regulate disposal of LLW or VLLW
HAW Future Disposal

Geological disposal: making it happen

- **AROUND 2 YEARS**
  - National geological screening
  - Preparing to work with communities
  - Developing land-use planning processes
  - Site investigations
  - Designing and planning for a facility

- **15-20 YEARS**
  - Talking to communities, providing information and investment
  - up to £1m a year per community in process
  - up to £2.5m a year per community
  - £££... Continued investment

- **100+ YEARS**
  - Construction
    - Site identified, job opportunities and local investment
  - Operation
    - Continued opportunities and local investment
  - Closure
    - Radioactive waste safely disposed
Low Level Waste – Waste Hierarchy
Low Level Waste Policy

- LLW is defined as waste with radioactive content not exceeding 4GBq/te of alpha, or 12GBq/te of beta/gamma
- Current policy was established in 2007
- The Waste Hierarchy is embedded in UK legislation
- Policy is implemented through:
  - Strategies for each LLW producing sector
  - National Nuclear LLW Programme
LLW – Effective application of waste hierarchy

- Recognised Joint Convention ‘Good Practice’
  One of only 6 countries

- Extends lifetime of LLWR by 100 years

Diversion of wastes from LLWR FY 2017-18:
- Landfill
- Combustion
- Metallic treatment
- LLWR
Berkeley Boilers enroute to Sweden
Decommissioning strategies in the UK: Prompt versus Deferred
As soon as reasonably practicable, taking into account all relevant factors

A safe, progressive and systematic reduction of hazards

NDA owns the UK’s civil public sector nuclear liabilities and is obliged to refresh its strategy every 5 years with full consultation
Guidance on the Requirements for Release from Regulation (GRR)

- GRR has a dual role: it defines the standard for radioactive waste management and final site clearance – both now (during the period of regulation) and in the future (after all regulatory controls have been removed)
- GRR is about identifying optimised solutions for waste management & the clean up of nuclear sites
Proportionate Regulatory Controls

(a) Current approach to regulatory control throughout lifetime of site
- Nuclear Installations Act 1965
- Environmental Permitting Regulations, Radioactive Substances Act
- Other controls, e.g. Town and Country Planning Act 1990; Ionising Radiations Regulations 1999; Health and Safety at Work Act 1974

(b) Preferred approach to regulatory control throughout lifetime of site
- Nuclear Installations Act 1965
- Environmental Permitting Regulations, Radioactive Substances Act
- Other controls, e.g. Town and Country Planning Act 1990; Ionising Radiations Regulations 1999; Health and Safety at Work Act 1974
Case Studies
Hazard & Risk reduction at Sellafield

- Legacy ponds & silos – LP&S (legacy spent fuel, liquids, sludges)
- Plutonium management facilities (plutonium oxide powder)
- Nuclear fuel reprocessing and storage (spent fuel, highly active liquor)
Following stagnation in Sellafield’s remediation, ONR instigated a **new strategy** to enable acceleration & progress.

**Key principles** are:
- Fostering alignment and co-operation between key stakeholders;
- Prioritisation – *agreeing and communicating priorities with key stakeholders*
- Removal of Barriers /unnecessary Bureaucracy;
- Avoidance of Distractions and Diversions;
- Encouraging incentives aligned with Sellafield’s main mission;
- Application of fit-for-purpose solutions;
- Balance of risks and risk appetite
Hazard & Risk reduction at Sellafield

- Pile Fuel Cladding silo (PFCS)
- Pile Fuel Storage Pond (PFSP)
- Magnox Swarf Storage Silo (MSSS)
- First Generation Magnox Storage Ponds (FGMSP)
Example: Pile Fuel Storage Pond
Example: Pile Fuel Storage Pond

The Programme has closed out two tranches on retrieval and export of canned and metal fuel reducing the pond inventory by 70%.

Pond sludge export and treatment capabilities are imminent and require the consolidation of pond solids which can be directly exported to existing downstream plants resulting in an accelerated completion timeline.
Example: Cutting holes in the Pile Fuel Cladding Silo

- Revised, simplified solution introduced - A necessary step to retrieve the waste - involved accepting (controlled) heightened short-term risk (major structural changes to a vulnerable building with a large, flammable radioactive waste inventory).

We:

- assessed SL’s proposals, inspected their arrangements and preparatory work, secured improvements in emergency preparedness
- granted permission when satisfied that all reasonable steps had been taken to control the risks
- are regulating construction of new facilities to secure their timely availability for safe storage of waste
Example: Evaporation & “highly active liquor” stocks

- Highly active liquor (HAL) is a by-product of spent fuel reprocessing and must be concentrated (evaporation)
- Evaporation produces HAL; extremely hazardous, stored on site before being turned into glass for safer longer-term storage (vitrification)

Regulation focused on control of hazard:

- new evaporative capacity (Evaporator D) to support continued reprocessing
- Securing better control measures on HAL stocks to enable sustainable reduction in the stored inventory

In 2004: around 133 reactors’ worth of HAL
Now: reduced to around 40 reactors’ worth of HAL (less than 1/3 of the peak)
Enabling progress in legacy ponds & silos

**Magnox Swarf Storage Silo**
- 2018: Passive vents
- 2018: Liquor activity reduction
- 2020: Start waste retrieval
- 2023: Start comp 5 retrievals
- 2030: 95% waste removed
- 2045-2050: Retrieval complete

**Pile Fuel Cladding Silo**
- 2017: Deflector plates removed, doors fitted and holes cut
- 2020: Start comp 5 retrievals
- 2023: Start full retrievals
- 2030: 95% waste removed
- 2036: from 2029

**First Generation Magnox Storage Pond**
- 2016: Started fuel exports
- 2018: D-bay sludge removal
- 2018: from 2019
- 2031: All fuel removed
- 2039: tbc
- 2039: Dewatered

**Pile Fuel Storage Pond**
- 2016: Fuel export started
- 2018: ILW removal started
- 2023: All skips emptied
- 2025: All ILW removed
- 2029: from 2029

Comparison of old vs current plans
Summary

- Sellafield will continue as ONR’s top priority;
- Following a period of stagnation in SL’s remediation, ONR’s new strategy stimulated hazard and risk reduction with notable achievements
- Timely retrieval of hazardous legacy waste into modern facilities is essential. Undue delays increase risk and reduce options for intervention
- Remediating the legacy hazards at Sellafield are long-term projects, necessitating intrusive intervention and inevitable (controlled) increases in short-term risks
- Our regulatory strategy for Sellafield is dynamic, goal setting and continues to be effective achieving; accelerated safe remediation, securing compliant operational safety and robust emergency response capability
Bradwell Care & Maintenance

- Reactor buildings Clad for ‘Safestore’
- For 70-year period of Care & Maintenance to commence 2018
- Safety benefits are from radioactive decay
Retrieval of Fuel Element Debris at Berkeley

- Mixed FED/ILW contained in 3 underground vaults
- Retrieve-Process-Store pending a GDF
- Vault 1 - 270 Te FED
- Vault 2 – 350 Te FED retrieval commenced June 2016
- Vault 3 – 1400 sludge cans
Sizewell B Dry Store

- Spent fuel is presently wet stored in the station pond
- Construction of a dedicated building for dry storage of spent fuel on site started in 2014
- Active commissioning took place in February 2017
- Spent fuel will be held in an inert atmosphere within metal casks
- Spent fuel may be stored on site for many decades after station closure, pending disposal to a Geological Disposal Facility
Generic Design Assessment

- ABWR, AP1000, EPR & HPR1000
- GDA has included regulatory assessment of:
  - How spent fuel and radioactive wastes will evolve over the envisaged storage period;
  - Data and records management;
  - Disposability of spent fuel and Higher Activity Wastes;
  - Implications for the national disposal strategy, and;
  - Adequacy of the provided storage capacities.
Plans for new nuclear power stations

- UK Government identified candidate sites for new nuclear power stations in England, Hinkley Point C, Sizewell C, EDF Energy and Wales, Wylfa Newydd, Horizon

- The Energy Act 2008 requires operators to cover all liabilities; management of spent fuel, radioactive wastes and decommissioning

- Funded Decommissioning Programmes are independently scrutinised and approved by the Secretary of State