Collaborative Research Programme in Decommissioning, Immobilisation and Storage Solutions for Nuclear Waste Inventories (DISTINCTIVE): Overview

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Industry Road Show, NNL and Sellafield Ltd., 1st July 2014

Background

- EP/L014041/1, stared 10th February 2014 to 9th February 2018, although no-cost extension likely
- £4.91M EPSRC → total £6.13M, plus £2.23M from industry = £8.36M
- World-class University network:

Imperial College London

LANCASTER UNIVERSITY

Loughborough University

UNIVERSITY OF BIRMINGHAM

University of BRISTOL

UCL

UNIVERSITY OF LEEDS

MANCHESTER 1824 The University of Manchester

The University Of Sheffield.

University of Strathclyde Glasgow

- Key project partners:

NATIONAL NUCLEAR LABORATORY

NDA Nuclear Decommissioning Authority

Sellafield Ltd

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Objectives

- Carry out internationally leading science and engineering research in area of decommissioning and nuclear waste management
- Support research that provides routes to innovative technology developments that can be applied to decommissioning and nuclear waste management
- Foster and develop new multi-disciplinary research partnerships between academic and industry researchers
- Train next generation of UK researchers, equipping them with skills and experiences relevant to nuclear waste management and decommissioning issues
- Provide focal point for government, industry and academics through which current and future R&D issues associated with nuclear waste and decommissioning can be discussed
- Provide route for public understanding of underlying research and development needs, opportunities and solutions to nuclear waste and decommissioning

Industrial Engagement

Project Building:

- Strong support from NDA, Sellafield Ltd. and NNL (strategic guidance, challenge definition, academic/industrial bridge, people/facilities)
- Engaged during consortium building (challenges at workshop, >60 proposal reviews, ranking and advice, projects revised as result)

Project Delivery:

- Industry partners want to be engaged in delivery:
  - Further development of scope will be required in some areas
  - One or more industry supervisors/advisors for each project
  - Scholarship/in-kind industry support greater than would typically be offered
- Industry looking for partnership in delivery:
  - Embedding of 2 PDRAs in joint industry-academic team
  - Several other projects planning secondments to active labs or plant
  - Accelerated development of subject matter experts
- Consortium intends to be inclusive in industry engagement – other industrial partners will be encouraged to give input and support (support to date from BAM Ritchies, PNNL, SRNL, US DOE)

Key Issues

National Importance:

- In line with Nuclear Industrial Strategy (2013), NDA Strategy (2011) and current EPSRC strategy (joined up approach to nuclear R&D across government, industry and academia; benefit to economy and security of supply; establish UK industry as global leader in decommissioning and waste management)

National/International Links:

- Members of consortium already have extensive links (direct research partnerships, members of international research consortia)
- Invite key international players to participate in consortium meetings (offer advice, membership international advisory group)

Technical Programme:

- Can't cover all areas of interest, but research primarily at TRL 1-3 with some higher risk projects
- Active work key focus
- Modelling underpins safety cases

Research Plan: Technical Work Packages/Themes

- AGR, Magnox and Exotic Spent Fuels (Lead: Tom Scott/Nick Evans):
  - Wet fuel storage issues
  - Transitions to dry fuel storage
  - Long-term storage effects and exotic fuels
- PuO_2 & Fuel Residues (Lead: Colin Boxall/Neil Hyatt/Nik Kaltsoyannis):
  - Behaviour of PuO_2 during interim storage
  - Behaviour of Pu bearing wasteforms and encapsulants
  - Methods for characterisation of stored Pu, PCM and Pu contaminated facilities
- Legacy Ponds and Silo Wastes (Lead: Joe Hriljac/Bill Lee):
  - Wasteform durability
  - Effluent treatment and analysis
  - Pond and silo sludges
- Structural Integrity (Lead: Rebecca Lunn) Andrea Hamilton presenting:
  - Physical ground barriers for in-situ contaminant containment
  - Remote crack detection, infrastructure health prediction and building preservation
  - Development and real-time management of autonomous systems for decommissioning

Research Plan: Technical Work Packages/Themes

Lead Academic	Lead Inst.	Researcher	Project Title
Theme 1 AGR, Magnox and Exotic Spent Fuels			
Tom Scott	Bristol	PDRA	An investigation of waste form evolution during wet-recovery and drying of SNF
Tom Scott	Bristol	PhD	UO_2 surface reactivity and alteration - a fundamental study of photocatalytic and structural effects related to long term storage of SNF
Bill Lee	Imperial	PhD	Options for exotic carbide fuels
Bruce Hanson	Leeds	PhD	Determination of optimum drying conditions for AGR fuels
Nick Evans	Loughborough	PDRA	Use of TRLFs of investigate dissolution rates
Enrique Jimenez-Melero	Manchester	PhD	Determining the consequences of radiation sensitisation of AGR fuel cladding on long term storage
Neil Hyatt	Sheffield	PhD	Understanding the effect of transmutation on the long term stability of radioactive wasteforms
Paola Lettieri	UCL	PhD	A life cycle approach as a decision tool for nuclear waste management and decommissioning of existing and future plants
Theme 2 PuO_2 and Fuel Residues			
Mark Read	Birmingham	PhD	Computational modelling of PuO_2 ageing and fuel residues
Malcolm Joyce	Lancaster	PhD	The non-destructive assessment of isotopic composition for in-situ characterisation of aging and criticality risk in plutonium storage
Malcolm Joyce	Lancaster	PhD	In-situ characterisation of heavily- contaminated plutonium finishing environments
Colin Boxall	Lancaster	PDRA	Understanding the interfacial interactions of plutonium dioxide with water
Simon Pimblott	Manchester	PDRA	Understanding the interfacial interactions of plutonium dioxide with water
Neil Hyatt	Sheffield	PDRA	Understanding the structure and dissolution kinetics of radiation amorphised ceramics
Neil Hyatt	Sheffield	PhD	Understanding actinide sorption and binding to cement materials for radioactive waste management
Nik Kaltsoyannis	UCL	PDRA	Modelling the surface chemistry of PuO_2 at the molecular level

Research Plan: Technical Work Packages/Themes

Theme 3 Legacy Ponds and Silo Wastes			
Joe Hriljac	Birmingham	PDRA	Novel ion exchange materials
John Day	Bristol	PhD	Development of Raman spectroscopy techniques for the remote analysis of nuclear wastes in storage
Bill Lee	Imperial	PDRA	Durability of heterogeneous ILW glass/ceramic waste forms from complex waste streams
Mary Ryan	Imperial	PhD	Magnetic nanoparticles for waste separation or sequestration
Simon Biggs	Leeds	PhD	Gas hold-up in sludges
Mike Fairweather	Leeds	PDRA	Measurement and modelling of sludge mobilisation and transport
Nick Evans	Loughborough	PhD	One step extraction and quantification of radionuclides using superparamagnetic bead and nanopore technologies
Richard Holdich	Loughborough	PhD	Enhanced shear micro- and ultra-filtration without recycle pumping

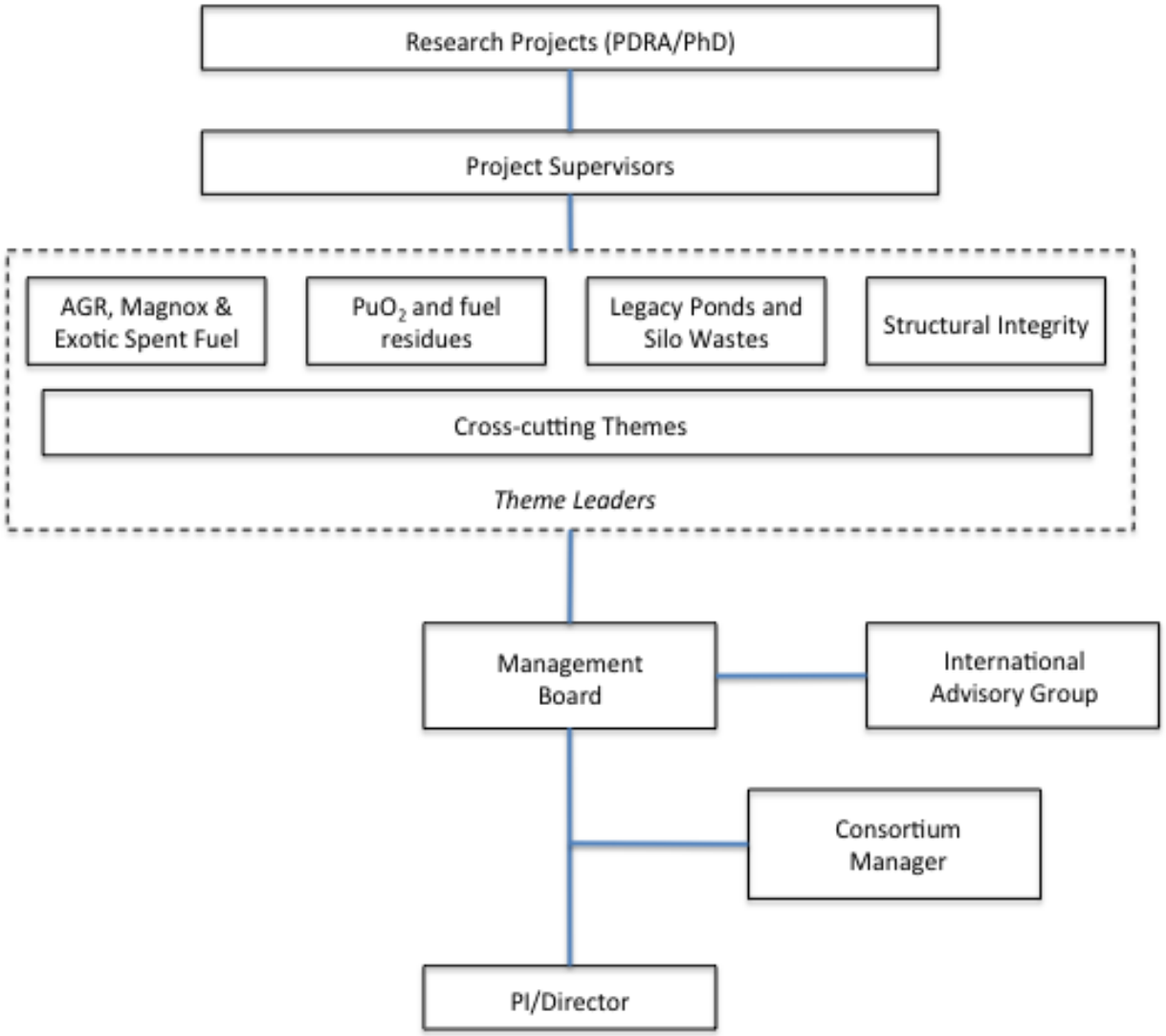
Theme 4 Structural Integrity			
Rustam Stolkin	Birmingham	PhD	Production of real-time segmented as-built CAD models for the planning and execution of remote and human intervention tasks
Barry Lennox	Manchester	PhD	Autonomous systems for nuclear decommissioning in extreme radiation environments
Andrea Hamilton	Strathclyde	PhD	Controlling deterioration of contaminated storage structures
Andrea Hamilton	Strathclyde	PhD	Nano-fracturing in cement
Mohamed Saafi	Strathclyde	PhD	Senor development for monitoring structural integrity (funding application in progress)
Grainne El Mountassir	Strathclyde	PDRA and PhD	In-situ ground contaminant containment (Physical barrier)

Research Plan: Cross-Cutting Activities

- Active Research Projects (Lead: Simon Pimblott):
  - Use of active research facilities at NNL and elsewhere
  - Two major projects already planned, others indicated potential need for active facilities
  - Simon to act as champion to promote use of active facilities and to ensure that consortium receives appropriate advice and support

- Impact, Outreach and Public Engagement (Lead: Neil Hyatt) Simon Pimblott presenting:
  - Three groups of non-academic beneficiaries: Site licence companies and supply chain; Government, regulators and implementation authorities; Society and stakeholder groups
  - Impact in 4 key domains: Knowledge; People; Economy; Society
  - 5 critical enablers: Building and maintaining relationships and networks; Communication and dissemination; Public, media and government engagement; Knowledge transfer and commercialisation; Training and development

Management



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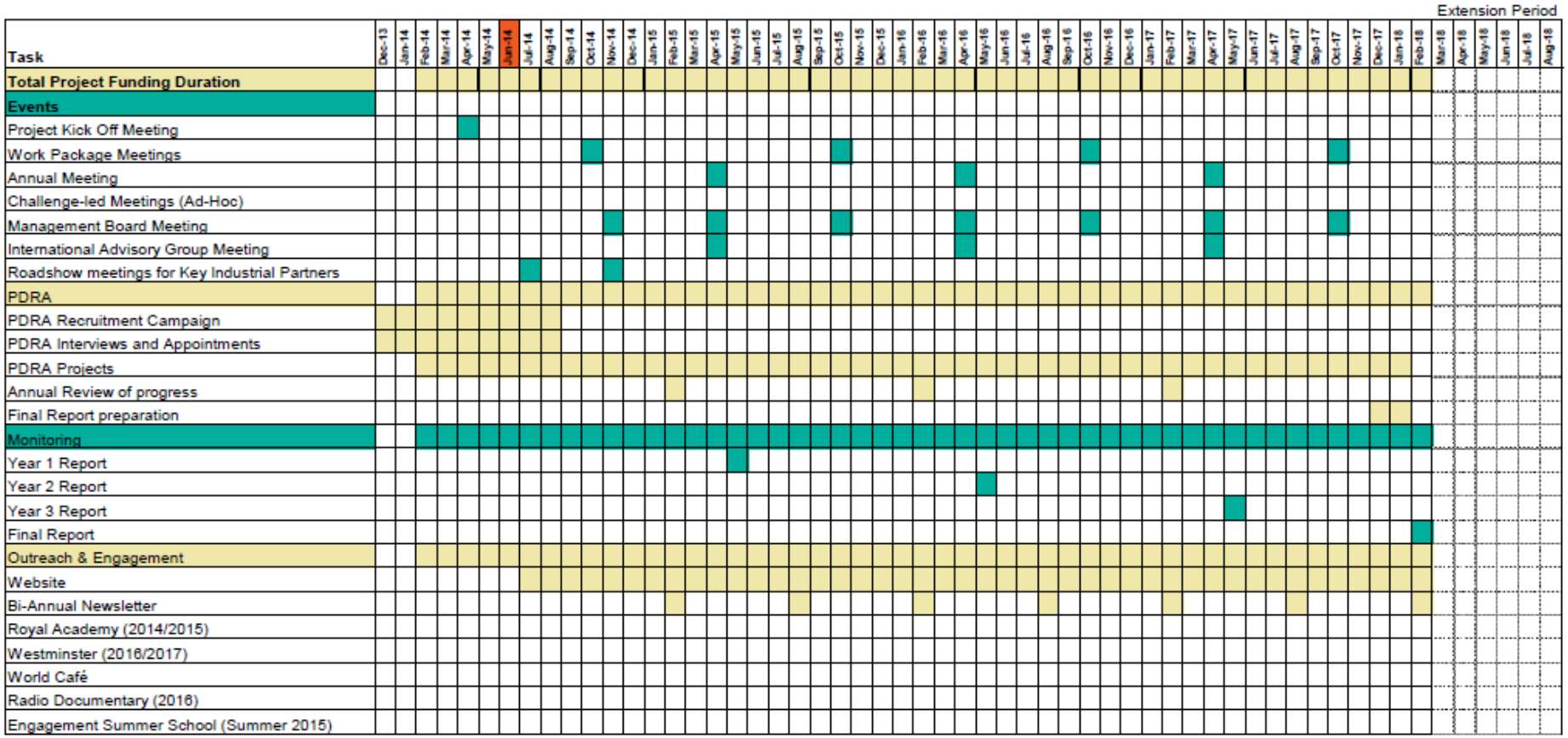
DISTINCTIVE.

Decommissioning, Immobilisation and Storage Solutions for Nuclear Waste Inventories

Timeline

Gantt Chart for DISTINCTIVE: Decommissioning, Immobilisation and Storage Solutions for Nuclear Waste Inventories



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Summary

- Excellent team of researchers:
  - Significant track-record of success in supporting relevant R&D in nuclear area
- Builds from earlier EPSRC consortia KNOO (Keeping the Nuclear Option Open) and DIAMOND (Decommissioning, Immobilisation and Management of Nuclear Wastes for Disposal):
  - Learning from these consortia input into this new activity
  - Success of earlier consortia gives confidence for this new activity:
    - Supply of researchers into industry
    - Technical developments for deployment
    - General awareness of industry needs
- Expands earlier groupings:
  - Wider coverage
  - Stronger team
  - Larger international profile