

NDA PhD Bursary Land Quality

Nick Atherton, Sellafield Ltd

**Richard Short, Dounreay Site Restoration
Ltd**

05/09/16

NWDRF Land Quality Working Group Activities

- **Sub-group of the Nuclear Industry Group for Land Quality and also reports to the NWDRF Nuclear Waste Research Forum**
 - Share information on existing Research and Development (R&D) programmes
 - discussing common R&D needs, risks and opportunities
 - develop an action plan and where appropriate, take action to implement solutions to enable the improved delivery of the NDA mission and potentially aid the wider nuclear industry
- **Membership includes:**
 - NDA representative, AWE, NDA, Sellafield, MAGNOX, DSRL, RSRL, LLWR, RWM Ltd
 - Synergies exist with the Characterisation WG and Decommissioning WG

NWDRF Land Quality Working Group Activities

- **Example projects directly managed by the WG**
 - Improving the segregation of contaminated soils and building rubble during clean-up operations
 - Review of databases and archives of land characterisation and remediation techniques
 - Development of a methodology toolkit for sampling and interpretation of contaminated land data
 - Long term monitoring methodologies for contaminated land: A guide to good practice in data management and storage
 - Review of the US EPA Data Quality Objectives process
 - Industry Guidance Qualitative Risk Assessment for Land Contamination, including Radioactive Contamination
 - Real-time scanning and sorting of bulk soil and similar material
 - Dual beta-gamma probe for *in-situ* measurement of radioactively contaminated materials
 - Emerging Issues in Land Quality Management
 - Nuclear industry code of practice (NICO_P) for routine water quality monitoring
 - Use of decommissioning rubble for void filling and landscaping on nuclear sites

PhD call decommissioning topics

- 1. Development of the understanding of the migration of radioactive and chemotoxic contaminants from buried concrete structures, including mechanisms of mobilisation of these into the environment such as diffusion & desorption; effective characterisation methods; and the generation of modelling and assessment tools to support the production of more robust Environmental Safety Cases.*
- 2. Development of effective stakeholder communication tools for the representation of uncertainty and assessment of variability in determining the long term safety of radioactive waste disposals and management of contaminated land.*
- 3. Expansion of the performance envelope of the latest generation of sampling equipment and analytical instruments to address the radioactive contaminants found at NDA sites, and to allow characterisation of groundwater conditions (including anoxic groundwater at geological repository depths 200-1000mbgl).*
- 4. Novel investigation techniques for radioactive discharge pipelines from nuclear sites, including: methods for determination and application of fingerprints (using easily measured gamma emitters and the relationships between radionuclides of interest and easily measurable physical parameters (pH, eH, etc.)) to determine the presence of and quantify more difficult to detect radionuclides; innovative remotely operated vehicle designs to characterise pipelines, within the operating constraints of nuclear sites, to optimise the cost/benefit of sampling.*

Development of the understanding of the migration of radioactive and chemotoxic contaminants from buried concrete structures...

Background

- Many nuclear sites have a range of buried potentially contaminated concrete structures
- Need to understand optimal disposal options
- Potential benefits to leaving buried structures in-situ

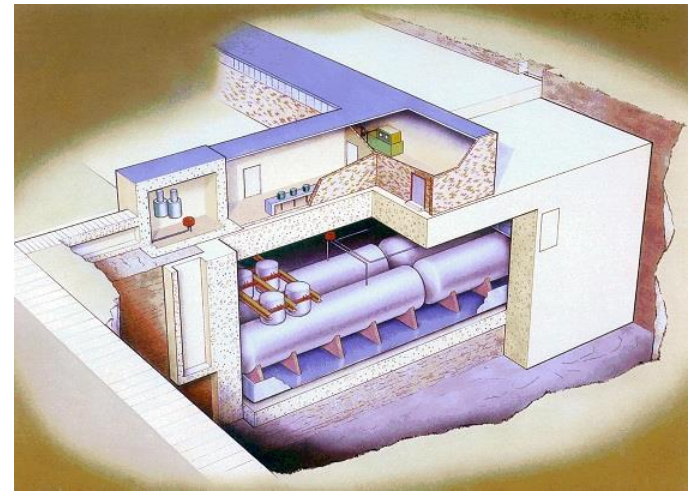
Topics

- Understanding the regulatory framework
- Mechanisms and timescales for radionuclides to be mobilised from concrete formulations when buried, or in a disposal situation.
 - Radionuclides of interest include, Caesium-137, Strontium-90, Uranium and Plutonium.
 - Chemicals of interest include, Cadmium, chromium, mercury, vanadium, etc.
 - Various concrete types used in a nuclear setting from 1940s to present day.
 - Data needs to underpin model parameters.

Development of the understanding of the migration of radioactive and chemotoxic contaminants from buried concrete structures...

- Effective characterisation methods
 - Potential in-situ characterisation
 - Optimal sample collection techniques (alternatives to coring?)
 - Identification of radionuclide fingerprint
 - Determination of concentration depth profiles
 - Importance of ‘average’ bulk activity vs. surface activity within joints / on external walls
- Optimising backfill and pre-treatment
 - Decisions to breach floors / walls to allow groundwater flow
 - Requirement to cap or leave open
 - Granular / rubble backfill vs. poured concrete
- Modelling and assessment tools
 - Underpinning Environmental Safety Cases and Waste Management Plans
 - Decision making tools
 - Environmental controls
- Case Study

Development of the understanding of the migration of radioactive and chemotoxic contaminants from buried concrete structures...



Background

- Site wide environmental safety cases need to take into account uncertainty and variability in demonstrating the safety of disposals and land contamination
- Consultation across a wide range of stakeholders is required during the determination of decommissioning plans and disposal permits
- Need to be able to effectively communicate potentially complex assessment outputs

Topics

- Presenting the outcomes of environmental risk assessments
- Showing the effects of geomorphological and climate changes
- Presenting the outcomes of contaminant flow and transport

Expansion of the performance envelope of the latest generation of sampling equipment and analytical instruments to address the radioactive contaminants found at NDA sites, and to allow characterisation of groundwater conditions...

Background

- Significant resources are committed each year to characterisation and monitoring tasks to provide data in support of decommissioning and waste management/disposal
- Developments of sampling equipment and analytical instruments has progressed in the wider industry, however these tend to be slow to be adopted for use in the nuclear industry

Topics

- Nuclearisation of latest sampling equipment and methods
- Benchmarking of sampling equipment and methods
- Development of methods on latest generation of analytical equipment to address radioactive contaminants
- Testing of in-situ characterisation methods

Novel investigation techniques for radioactive discharge pipelines...

Background

- Many nuclear sites have pipes of variable diameter used for a range disposal / transfer purposes
- Pipes are often inaccessible to characterise in conventional ways.
- Established use of ROVs and gamma surveys
- Potential underutilisation of other environmental parameters

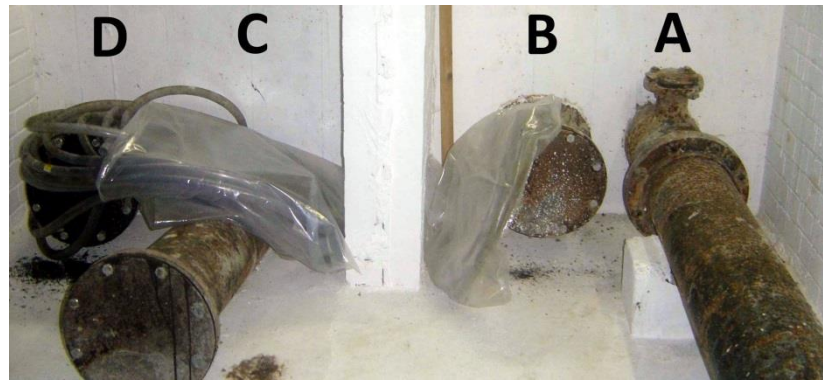
Topics

- Mechanisms for radionuclides to enter and be mobilised from pipeline surfaces and corrosion products.
 - Radionuclides of interest include, Caesium-137, Strontium-90, Uranium and Plutonium.
 - Various pipeline construction materials used; concrete, cast iron, steel etc.
- Innovative ROV design and optimisation
 - Restricted access
 - Physical sample recovery

Novel investigation techniques for radioactive discharge pipelines...

- Effective use of fingerprints
 - Dealing with uncertainties
 - Correlation with environmental factors; pH, eH etc
- Availability and application of analogues
 - What information is already out there
 - How can be applied or developed into site analogues
 - How analogues can be verified in the field
- Case Study

Novel investigation techniques for radioactive discharge pipelines...



- 4 x 800m pipelines
- 9 inch ID
- Within subsea tunnel
- Extend 600m off-shore
- Mainly sub-water table
- Sampled first ~0.5m
- Activity within (hydr)oxides
- Risk dominated by Pu
- ROV Gamma survey

