Data Quality Objective Process: Applications in UK Waste Stream Characterisation and De-licensing

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Overview

This presentation covers:

- Data Quality Objectives (DQO)
  - Basis of DQO
  - Stages of a DQO

- Details of applications of DQO at three Magnox Ltd. Sites:
  - Chapelcross (Scotland)
  - Trawsfynydd (Wales)
  - Oldbury (England)
DQO SYSTEMATIC PLANNING:
The DQO process was developed in the USA, by the Environmental Protection Agency (USEPA), to determine appropriate courses of action in decommissioning and environmental remediation that are underpinned by demonstrably defensible sampling.

- Based on the scientific method
- Step by step process
- Promotes better communication between individuals involved in any environmental program
- A team can develop acceptance criteria for the quality of the data collected and for the quality of the decision
- The planning process is the first element, which gives an open methodology to the decision process
- Enables decision-makers to show what has been undertaken.
DQO DESIGNED TO ANSWER:
• Why are data needed?
• What type of data is needed?
• Where should the data be collected?
• When should data be collected?
• How will the data be used to make decisions?
• How often are you willing to make decision errors based on the data?
• How much data is needed?
DQO PLANNING CAN BE USED TO:

• Should facilitate better, faster, and cost effective method for meeting regulatory requirements.
• Enable the collection of the right amount of data
• Enables the sampling to be representative of the population of interest
• Minimize unnecessary data
• Reduces the possibility of third-party challenges
• Reduces unnecessary re-work
• Reduce unnecessary clean up
• Using the DQO process will help to ensure that when data collection has been completed it will have accomplished two goals:
  – provided sufficient data to make the required decisions within a reasonable uncertainty.
  – collect only the minimum amount of necessary data.

• The DQO process achieves this by determining the quality and quantity of data needed, ensuring you don’t collect data you:
  – can’t use
  – don’t need
  – don’t use
SEVEN STEPS OF THE DQO PROCESS

• **Step 1: State the problem**
  To clearly define the Problem that has initiated the study so that the focus of the project will be clear.

• **Step 2: Identify the goals of the study**
  Develop decision statements that require environmental data to address the objective of the problem statement.

• **Step 3: Identify information inputs**
  Identify the inputs that will be required to resolve the decision statements identified in Step 2 and to determine which inputs require environmental measurements.

• **Step 4: Define the Boundaries of the Study**
  To define the spatial and temporal boundaries that the data must represent to support the decision statement.
• **Step 5: Develop the Analytic Approach**
  This step combines Steps 1 - 4 to produce the following major elements to form decision rules:
  – Parameter of interest
  – Unit of decision making
  – Action level
  – Alternative actions

• **Step 6: Specify Performance or Acceptance Criteria**
  To specify the decision makers' tolerable limits on decision errors, which are used for limiting uncertainty in the data.

• **Step 7: Develop the Plan for Obtaining Data**
  Identify the most resource effective data collection and analysis design that satisfies the DQOs specified in the preceding 6 steps.
MAGNOX EXPERIENCE

• Magnox Ltd. have included the use of DQO in their company standard for the characterisation of waste.

• The process has been used at three sites and through the central programme resource on a variety of characterisation programmes:
  
  • Oldbury
    *Delicensing of 35 Hectares of previously nuclear licensed site*
  
  • Trawsfynydd
    *Fuel cooling ponds decommissioning:
      Inner pond walls - highly contaminated (coring for depth analysis)*
    *Ponds outer walls – zoned contamination*
    *Basements & walkways – flooding and tread-wear.*
    *Contaminated land under the Pond Complex*
• **Trawsfynydd Miscellaneous Activated Component (MAC) Vaults**
  Fuel End Debris (FED) Vaults contaminated particulate material

• **Chapelcross:**
  Graphite Handling Facility (GHF) decommissioning and demolition
  Chapelcross Production Plant decommissioning analysis
  Fuel cooling ponds decommissioning.

• **Programmisation:**
  Sludges
  Resins
  Fuel End Debris Vault materials
  Miscellaneous Contaminated Articles
SUCCESSFUL CHARACTERISATION OF GRAPHITE HANDLING FACILITY AT CHAPEL CROSS

• The Chapelcross Power Station graphite handling facility dates back to the 1940’s. The building has had many different uses over its lifetime and was converted into two separate buildings; the apprentice training building and the graphite handling facility.

• The building is designated as a controlled area under the Ionising Radiation Regulations 1999; with areas of fixed contamination and the potential for loose contamination to be present or created.
• The facility was taken out of use in the 1990’s and has lain dormant in the intervening period.
• In 2006 the internal components of the building were removed (including removing contaminated items from the mortuary holes).
• This left the main structure of the building and a few operational aspects such as the ventilation system ducting in the roof space leading to the ventilation system which is positioned adjacent to the building, and the crane used for bringing in graphite flasks
• The area for characterisation was limited to:
• Floor Area
• Hunterston pit
• Mortuary Tubes
• Areas of known fixed floor contamination (hot spots)
• Ventilation duct
• Trench cover

• In summary the main components of the project scope are the building fabric, the ventilation system(s) and the concrete floor slab, particularly the section of floor slab where the mortuary tubes, pits and troughs are situated. It is anticipated that all of the components have radiological contamination to varying degrees.
Traws Ponds Outer walls

- Trawsfynydd Power Station has a ponds complex on site that has been used to decay cool fuel prior to transport for reprocessing. As a consequence of the nature of the materials and process the pond walls became contaminated and this has generated a Low Level Waste (LLW) waste stream.

- Sampling and characterisation of surfaces in buildings in the ponds complex has been undertaken to determine the depth of contamination to underpin the scabbling depth to ensure that waste for sentencing is minimised.

- It is intended to take samples from the upper and lower walkways and the outer walls of the pond lanes, and the flask wash-down basement area of the complex for radiochemical analysis.
This work was undertaken to underpin the current data, and to give a more complete data set that will ensure adequate confidence in the characterisation.

Samples from the following locations will be obtained:
- Upper Walkways paint scrapings & 50mm cores (10 each).
- Lower Walkways paint scrapings & 50mm cores (12 each).
- Pond outer walls sample locations (paint scrapings, concrete dust and where applicable joint mastic (24)).
- Basement paint scrapings and cores (14)

Samples are to be taken from several points along both walkways; a total of forty four (44) core samples, from twenty two paired locations.
Activity Survey for Ponds Outer walls – For Sampling Plan Characterisation

Area of elevated activity – Measured by Electra G1X

Proposed Sampling Plan
Grouping
1. Samples below NCD openings
2. North Expansion joints
3. NAB patch
4. General wall areas

Background activity levels
400 to 700 cps

Background activity levels
400 to 500 cps

Background activity levels
80 to 100 cps

North CD
CBE
South CD
North AB
CBW
South AB

Holding Tank

Below Ground

Background activity levels
400 to 500 cps

Below Ground

Background activity levels
80 to 100 cps
SUCCESSFUL DELICENSING – DQO AT OLDBURY

Objectives

• To vary the site license to remove approx. 35 hectares of land that are not required for operational purposes.
• To demonstrate that the NIA 65 ‘no danger’ criteria are met
• To demonstrate that there is no detrimental impact on future site operations.
SETTING AND HISTORY OF OLDBURY SITE

• **Pre-construction:** ‘green field site’

• **Construction:**
  – Main site between 1961 to 1965
  – Operational 1967
  – Further developments – Drough Rhine redirected, OTC, Silt Lagoons & Visitors Centre built and woodland, orchard & meadows planted

• **Operations:**
  – Security Fences
  – Radiological Controls
  – Active Effluent Discharges
OLDBURY DELICENSEING LAND INVESTIGATION

- Desktop studies
- Large Areas Ground Survey
- Sampling Plans developed from DQO
- Soil and drainage samples, building surveys
- Hydrogeological assessment
- Sample analysis
- Data interpretation
REQUIRED TO GENERATE A NUMBER OF SAMPLES.

- Develop a conceptual model of the site
- Contaminants of concern
- Study Boundaries: assessment of the need to zone/sub-divide “study” into areas to be analysed
- Decision Rule
- A “null Hypothesis” for making a decision on assumption on the condition of the site.
- An action level of activity that should not be breached.
- An estimate of the standard deviation of the activity.
- Decision Error Tolerances (area of uncertainty).
Sampling Areas:

1 – SL2a
2 – SL2b
3 – SL2 bund
4 – Other land
5 – OTC land
6 – Parking & Drains
7 – Buildings
8 – SL2 construction waste
RADIOLOGICAL CRITERION FOR DELICENSING

• Magnox had to provide evidence to the ONR that there is ‘no danger’ from ionizing radiations from anything on that part of the site under consideration for de-licensing.

• The ONR requirement of ‘no danger’ is “any residual radioactivity, above background, that will lead to a risk of death to an individual using the site for any purpose, of no greater than one in a million per year”

• The ONR criterion for de-licensing refers to the Euratom Basic Safety Standards Directive (Euratom 96/29) which sets a value of 10 microSieverts or less per year

• Comparing the measured radioactivity content of samples collected with the IAEA radionuclide-specific concentrations, it is possible to estimate the annual dose arising from exposure to man-made radioactivity.
DE-LICENSING ACTION LEVEL

0.1 Bq g\(^{-1}\) is the most restrictive of the IAEA activity limits for radionuclides of artificial origin was chosen. It is the limit for several radionuclides of interest in this study including Cs-137, which is likely to be the predominant radionuclide of interest. The limit for each radionuclide is apportioned using the quotient rule.

0.025 Bq g\(^{-1}\) was chosen as the standard deviation and is an upper estimate based on a pessimistic assumption that Cs-137 activity could range up to the action level of 0.1 Bq g\(^{-1}\).

SAMPLE COLLECTION

• **Shallow soil samples**
  Following removal of surface vegetation, shallow soil samples were collected from the top 0.1m of using a rotary core cutter or, in ground conditions where the cutter could not collect a consolidated core, by removing a cube of soil using a small spade.

• Samples were placed in plastic tubs, labeled with the location, depth, and date of sample collection.

• A sub-sample was collected from samples that were scheduled to undergo analysis for tritium; these samples were placed in amber glass bottles and stored in cool boxes packed with ice.
COLLECTION OF DEEP SOIL SAMPLES

- A tracked percussive drilling rig was used to drill 6m deep boreholes at four locations within Silt Lagoon 2 and at one location on the eastern side of the lagoon bund. A further two 3m deep boreholes were drilled in the grassland and outside the Oldbury Technical Centre.

- Soil cores were collected in 0.5m long U4 liners, and these were subsequently sectioned to provide samples for analysis. Four samples were collected at the surface and at 2m intervals of depth for 6m boreholes, and from the surface and 1m depth intervals for 3m boreholes.
BUILDING SAMPLING

High Resolution Gamma Spectrometry carried out in OTC and Information Centre.