International Good Practice on Practical Implementation of Characterisation in Decommissioning – 17186

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ABSTRACT

The OECD Nuclear Energy Agency (NEA) Task Group on Radiological Characterisation and Decommissioning within the Working Party on Decommissioning and Dismantling (WPDD) was established in 2011 to identify and present characterisation good practice at different stages of decommissioning and to identify areas that could, or should, be developed further through international cooperation and coordination.

By the mid 2017 two phases of work will be complete. The first phase developed strategic guidance for decision makers on the selection and tailoring of strategies for radiological characterisation, which gives an overview of good practice for radiological characterisation at different phases of the life cycle of a nuclear installation.

The second phase has focused on strategies for practical implementation of radiological characterisation from a waste and materials end-state perspective.

This paper provides a summary of the phase 2 findings.

INTRODUCTION

Within the NEA, the Working Party on Decommissioning and Dismantling operates under the umbrella of the Radioactive Waste Management Committee (RWMC). The WPDD provides a focus for the analysis of decommissioning policy, strategy and regulation, including the related issues of waste management, release of buildings and sites from regulatory control and associated cost estimation and funding. WPDD also convenes task groups comprised of experts from the NEA member countries to review related topics such as characterisation techniques which support decommissioning and associated waste management.

Over the years several important reports have been provided by the WPDD task groups. They are all available on the OECD/NEA public web page.

Currently there are four ongoing task groups within WPDD:

- Decommissioning Cost Estimation Group
- Preparing for Decommissioning under Operation and after Final Shutdown
- Optimizing Low Radioactive Materials and Waste Management in decommissioning
- Radiological Characterisation and Decommissioning

It is well recognized that radiological characterisation is a key activity in the decommissioning process which makes all efforts on enhancing characterisation very important.

The first phase of the task group's work developed strategic guidance for decision makers on the selection and tailoring of strategies for radiological characterisation, and gives an overview of good practice for radiological characterisation at different phases of the life cycle of a nuclear installation [1].

The second phase of the task group's work has explored the practical implementation of characterisation. In particular this has considered how the selection and tailoring of strategies for optimisation of nuclear facility characterisation from a waste and materials end-state perspective is applied in practice. It aim to identify relevant good practice and set out advice for the practical implementation of radiological characterisation to support all stages of decommissioning. It also seeks to highlight areas that could or should be developed further through international co-operation and co-ordination.

This has been achieved through:

- A major international survey (questionnaire) to elicit the views of characterisation experts regarding good practice [2].
- The collation of a series of international case studies
- The collation and analysis of regulations, standards and guiding documents
- Learning distilled from an international conference co-organised by the task group

Additional information has compiled using the knowledge and experience of the task group and their national networks.

The target audience for the phase 2 report is characterisation practitioners who carry out the tactical planning, preparation and implementation of characterisation to support the decommissioning the nuclear installations and the management of associated materials and waste arising. Decision makers are referred in the first instance to the companion phase 1 report [1] which provides more strategic good practice guidance.

STRATEGIC FRAMEWORK

In general, the term "radiological characterisation" represents the determination of the nature, location and concentration of radionuclides in a nuclear installation. It is one of the fundamentals on which to build a decommissioning project. Since properties other than the pure radiological also are of impact those should be considered as well. It can be both chemical and physical.

Physical properties to characterize can for example be to characterize the possibility to decontaminate objects like physical form and whether a surfaces have a coating

or not. Chemical properties to characterize can be composition, quantification of substances with limitations in waste acceptance criteria and content of hazardous substances.

Especially radiological and chemical characterisation must be seen as an ongoing process of high priority and importance. It will change over time but not cease until the successful completion of the final survey and the termination of the nuclear license.

Characterisation does not only consist of sampling, measurements and analyses of the results, but will also involve evaluation of information from the operating history, from calculations, from collections of existing data and many more sources.

The main steps in the proposed characterisation program structure are outlined in Figure 1 below.

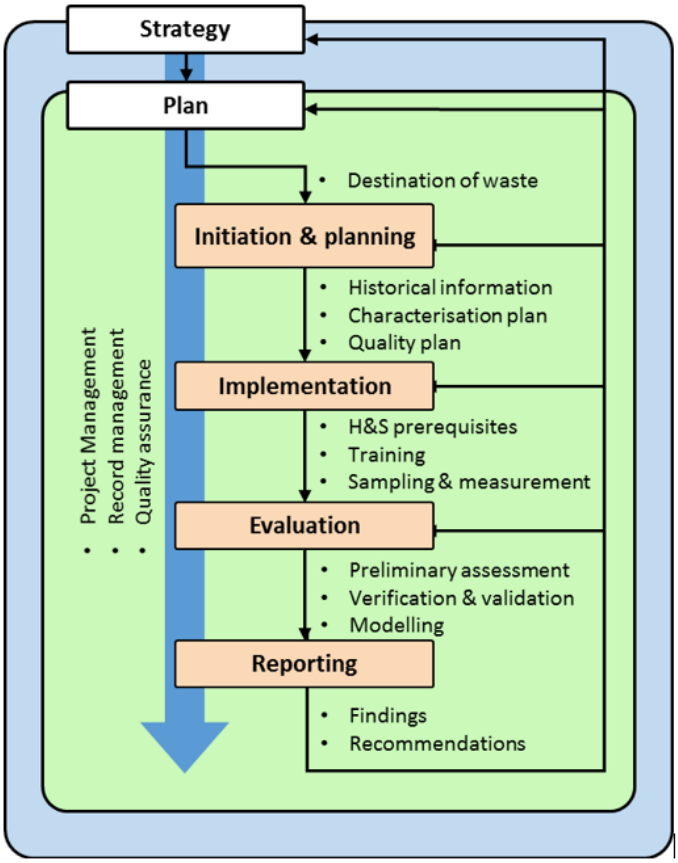

Figure 1: Illustration of the steps involved in a characterisation program and approach to integrated management.

The characterisation program should be managed and assured by an Integrated Management and Quality Assurance program covering all areas from Initiation to Reporting. It is of high importance that the QA program covers the in-situ activities as well as the interfaces between the different steps and activities of the process.

Radiation protection aspects should not be forgotten. In situ characterisation activities, especially in areas with higher dose rates, should be seen as a dose investment which need to be motivated by lower future doses to workers and/or public or improved radiological safety.

Another consideration is the level of risk/uncertainty which is tolerable in a decommissioning project which will inform the level of characterisation required.

For the user of the characterisation results the following is typically pointed out to be of most/strategic importance:

- Amount of waste per category
- Composition, uncertainty and boundary conditions for nuclide vectors
- Radiological inventory and uncertainties in estimates

INTERNATIONAL VIEWS ON GOOD PRACTICE

A significant element of the phase 2 work of the task group involved establishing learning from the international characterisation community.

The work undertaken and the corresponding findings is shortly presented below. For a full overview the reader is asked to read the final report to be published.

Questionnaire

A questionnaire structured around a lifecycle approach to characterisation [1] and the use of systematic planning approaches such as Data Quality Objectives methodology [4] was developed.

The questionnaires were sent to a broad range of international characterisation experts who are able to draw upon practical experience in radiological characterisation of materials and waste.

53 survey responses from characterisation experts from 13 countries, including 10 European countries, Canada, Japan and the USA were received. Both the regulators and owners responding to the questionnaire have a broad experience across the nuclear industry; with the regulators' experience generally being marginally broader.

A detailed and systematic evaluation of the responses to the questionnaire was undertaken by the task group [2]. This was followed by a consultation process regarding the key learning points, with the original questionnaire responders and other interested experts identified through international conferences [3].

Taking account of the consultation process, the key learning points are summarised below, covering the national context in which characterisation takes place followed by the systematic characterisation process involving initiation, planning, implementing, assessing and quality assurance.

<u>Initiation Phase</u>

- For planning campaigns the most important characterisation objectives

are those that contribute toward the development of the decommissioning and waste management plans, cost estimation and safety analyses.
- For characterisation campaigns to be conducted during dismantling the primary objectives of radiological characterisation become waste and hazard management, with waste management generally being most important with the exception of large, and significantly contaminated, facilities/sites.

Planning Phase
- A detailed and systematic characterisation plan should be developed, including details what samples and measurements are required and what analysis (including determinants, acceptable uncertainty and detection limits) should be undertaken.
- Operational history and facility documentation are seen as most useful to support characterisation assessments, with characterisation results from previous activities, interviews with operating personnel and radiological inventory data also being important. These are all needed at the planning stage.
- Vectors/fingerprints of a material or waste are commonly used to estimate hard to measure contaminants. Great care is needed in their use as there can be significant temporal or spatial variations in the contaminant concentrations across facilities and within waste streams.
- Non-radiological characterisation should be fully considered.
- Reducing uncertainty about waste and identification of waste classification are generally the highest priorities for characterisation, both of which support securing waste route availability.

Implementation Phase
- The choice of the sampling/measurement locations, to characterize at both the surface and at depth, should be tailored on a case by case basis, using specific information about the materials or waste.
- Characterisation, prior to and during dismantling, mainly relies on: dose rate or gamma measurements; sampling followed by gamma, alpha and beta analysis; and the use of in-situ handheld beta measurements and volume gamma counter.
- Systematic verification process which checks results on a random basis and when extreme results are identified.
- The importance of review and flexibility of characterisation plans during implementation, taking account of new information and early results.

Data Assessment Phase
- Material and waste characterisation data should be evaluated using a combination of judgmental and probabilistic approaches, with selection of the appropriate methodology on a case by case basis.
- Use of graphical modelling for evaluation and presentation of results is largely adopted by owners and regulators.
- When considering the impact of uncertainties on the evaluation of material and waste, characterisation sampling / measurement

representativeness is the most important factor followed by variations in activity distribution and nuclide composition (heterogeneity).
- When implementing the data quality assessment process, waste management and quality assurance/independent experts are seen as the most important resources.

Quality Assurance
- Dedicated Quality Assurance Plan developed early on in the characterisation process.
- The most important quality assurance measure is developing and following specific documented characterisation arrangements.
- Regulators consider independent control measures and reviews by external experts to be particularly important during the characterization implementation phase.
- Characterisation records are best held on a centralized electronic system.
- Review of characterisation results and evaluation should be undertaken by independent experts.
- Approximately 5% duplication of in-situ measurements and analysis.
- Characterisation records management is essential since years and decades may pass between characterisation and final disposal.

Learning from case studies

Case studies have been made on several types of facilities (NPPs, research reactors, other research facilities, uranium milling facility and contaminated sites) spanning over the following countries (Belgium, France, Germany, Italy, Japan, Norway, South Korea, Spain, Sweden, UK and USA).

Each of the 13 case studies was reviewed by the Task Group to identify relevant practices, experiences and learning for each stage of characterisation.

An excerpt of the findings from this review are listed below.

- Final destination of material/waste was considered to optimise efficiency and effectiveness of characterisation
- Characterisation in parallel with decommissioning planning
- Characterisation data was input to decommissioning design, plans and actual implementation
- Characterisation results was important to define dismantling method, to evaluate options and impact on workers and public.
- Combination of calculations, in-situ measurements and sampling
- Definition of stakeholders and contributors and their acceptance was crucial
- Review of historical information, unexpected events and characterisation activities important to develop list of radionuclides of concern and initial categorisation of the plant
- Numerous cycles of sample collection was needed

- Verification of activity calculation models by sampling and analysis was important
- Involvement of retired staff in planning
- Exploit of all relevant information – identification of gaps
- Assessment of historical data collection in the light of current requirement
- Statistical methods was helpful to determine radioactivity distribution
- Combined materials – analysed separately and combined
- Advanced databases for managing plans, historical data and characterisation results as well as management of materials
- "Four eyes" principle to secure quality.
- QA in two steps

International Conference

Based on an initiative by two Task Groups within OECD/NEA Working Party on Decommissioning and Dismantling a group of organisations arranged a symposium on "Preparation for Decommissioning". The symposium took place in Lyon, France February 16 – 18, 2016 and was named PREDEC 2016 [3].

The objective for the task group to organise this conference was to learn about current practices, understand strategic issues related to radiological characterisation in decommissioning, discuss experiences, innovative and new techniques as well as understand the needs for improvements.

In most of the high quality presentations in the seven sessions the importance of radiological characterisation was highlighted. Below are some of the presenters and attendee views highlighted during the meeting.

- Characterisation is crucial in all steps
- Early characterisation lower costs and financial risks
- Early characterisation mainly are to confirm and validate records
- High interdependency between waste management, dismantling and characterisation
- Characterisation and categorisation performance may reduce radioactive waste for disposal with up to a factor 10
- Non-radioactive characterisation becomes more and more important
- Quality audits appear to focus on the paperwork side of characterisation rather than the practical implementation
- Example: decommissioning project delayed 10 years due to characterisation during dismantling instead of in advance
- Defined needs for further improvement

International Standards and Guidance

A wide range of international and national standards and guidance have been published to inform radiological characterisation which have relevance from a materials and waste end states perspective. To inform the exploration of the strategic and more practical aspects of radiological characterisation, international and national regulations, standards and guiding documents have been collated and analysed. This has been undertaken in a systematic manner.

The documents have been reviewed for content and to consider their utility with information recorded to a standard template. Using this information, a five point ranking system applied to categorise each document.
To aid the reader a colour coded guide is used. See figure 2.

The output from this process will be published in an annex to the final report.

Credibility	Applicability	Relevance	Status	Age
HIGH	Mandatory	HIGH	Current	<10y
MEDIUM	Guidance	MEDIUM	Superceded, but still useful	10-20y
LOW	Information	LOW	None / Unknown	>20y

Figure 2: Document ranking system.

CHARACTERISATION IN PRACTICE

The Task Group findings is that a comprehensive radiological characterisation program normally comprises the following steps:

- Defining the characterisation strategy which includes the objectives, including destination of the wastes, and competent authority approval (if needed);
- An initiation and planning step where historical information from the facility is evaluated and where a characterisation plan for sampling and measurements is developed.
- An implementation step where sampling and measurements are carried out, if necessary aided by calculation methods, e.g. for determination of activation.
- A step for data assessment and evaluation, in which the various results are interpreted and reviewed, statistical evaluation of measurement results is carried out, etc., and where calculated results and measured data are compared.
- A finalization step where the results are documented and (if necessary) reported to the competent authority and are used to meet the characterisation objectives.

Throughout the program an integrated approach to project, record and quality management should be adopted to ensure consistency at each step. It is important to recognize that outcomes from each step should be considered against the overall program and that strategies and plans are adapted according to the findings as the program progresses.

CONCLUSIONS

The phase 2 final report will provide a high level guidance for characterisation in practice based on the task group findings. The work has shown that there is a lot of characterisation knowledge in the NEA member states which forms a good basis for further enhancement by international cooperation.

A further enhancement of characterisation in practice will most likely reduce the amounts of waste for disposal to the benefit for recycling and reuse. It will also help in reducing dose and improve the radiological safety.

REFERENCES

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