



INTERNATIONAL ATOMIC ENERGY AGENCY

**DATA ANALYSIS AND COLLECTION FOR COSTING OF  
RESEARCH REACTOR DECOMMISSIONING  
  
("DACCORD" PROJECT, PHASE 2)**

TERMS OF REFERENCE

*September, 2016*



## Objectives

The main objective of Phase 2 of the DACCORD project is to improve the common capability to prepare cost estimates, to determine the implications of different characterisation strategies on cost and designation of waste classes to assist the development of optimal approaches, and to understand the level of uncertainty of the cost estimates and the source of this uncertainty. A further objective is to continue and deepen the collaboration on research reactor costing that was developed during Phase 1.

## Scope of Activities

To fulfil this objective, the following actions will be performed:

1. Extend the existing database of costing cases (from Phase 1), to provide additional benchmarking data. Specifically, improve cost estimates for cases analysed in Phase 1 and perform new cases introduced in Phase 2. Make this information accessible on CONNECT.
2. Improve the Reference Cost Cases that could be used as a basis for project-specific cost estimating and analysis.
3. Prepare/enhance training materials for use of CERREX-D.
4. Upgrade CERREX-D to improve user-friendliness and to support the functionality required to complete the activities of the project and to meet the objectives.
5. Gather data and good practices from decommissioning plans and characterization plans and perform analysis of impact on cost estimates. Make accessible all plans that participants are willing to share.
6. Determine the impact of level of characterization and material and waste inventories on cost estimation and on the accuracy of cost results. This will be supported by empirical information where available.
7. Generate additional unit factors (e.g. Waste Management) from the additional collected data sets and from other sources.
8. Deepen the sensitivity analysis of decommissioning cost estimates begun in Phase 1, including consideration of uncertainty in the estimate. Perform analysis of cases individually and through benchmarking.



## Method of Working

The Project will be organized as shown in Figure 1.

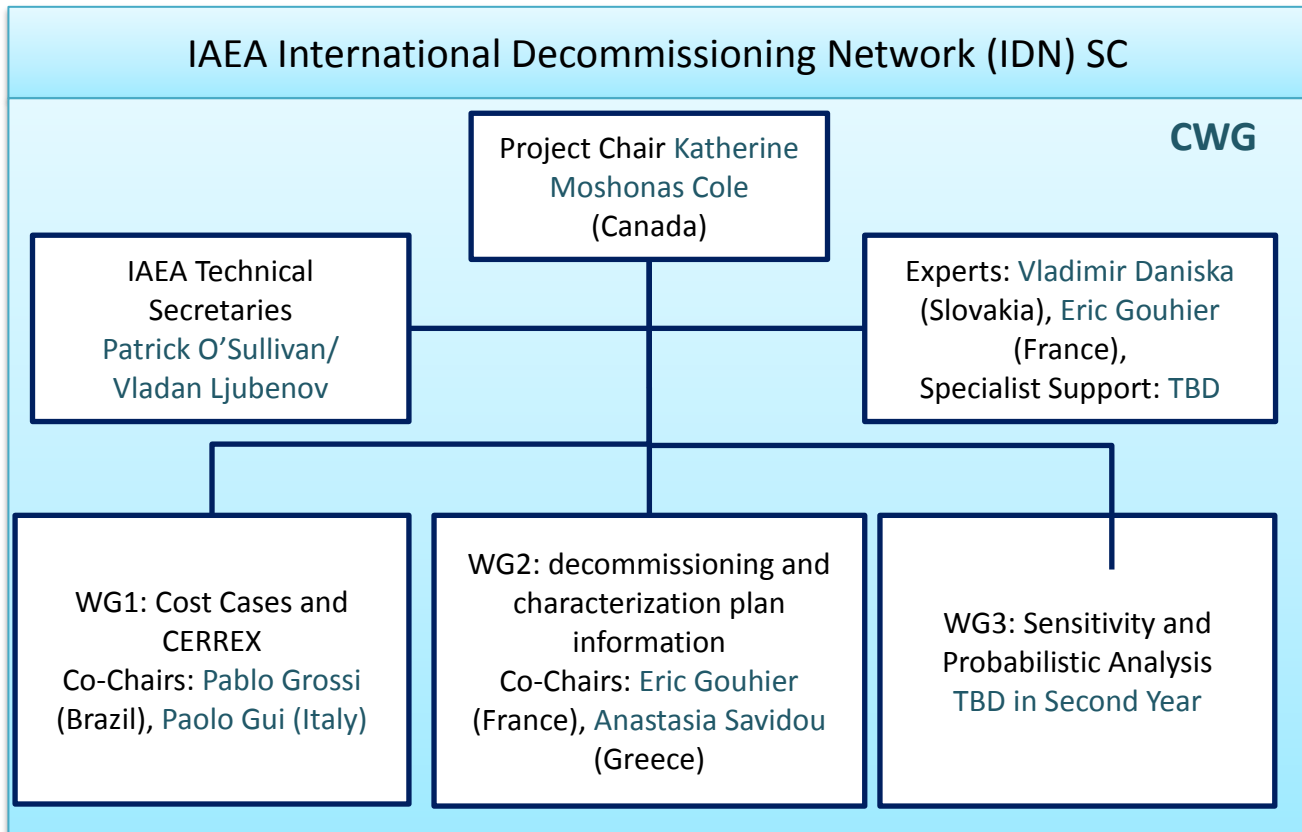


Figure 1: Project Organization

As was done in Phase 1, the participants will be organised into sub-groups in order to facilitate the execution of the work. Specifically, this will facilitate the data collection and analysis, as well as experience sharing amongst individuals with common interests. A coordinating working group (CWG) will be established to integrate the results of the group activities, manage the project activities, and ensure consistency in the project report.

Initially, there will be two main working groups as described below. By the beginning of the second year of work, a third working group (Working Group 3) will be established and will comprise of members interested in deepening the sensitivity and probabilistic analysis using the available cost cases that have been prepared within the project.



Initially, Working Group 1 (WG-1) will focus on the following principal activities:

- collecting cost case data and on the preparation of costing cases using an advanced version of CERREX-D.
- development of Reference Cost Cases for new users
- collecting information on unit factors and use for cost estimating
- Primary responsibility for the identification of software improvements and development of training material for use of CERREX-D.

Working Group 2 (WG-2) will have primary responsibility for the collection and analysis of information and data on the following topics:

- Decommissioning plans
- Characterisation plans and waste management approaches
- Identify inventories and unit factors based, where possible, on empirical information to be used with CERREX

The working groups will self-organize and will identify tasks and task leads to complete the work. The working groups will not work in isolation of each other. The participants of each group will provide information that is available to support both groups. For example, cost cases may be prepared and shared by members of WG-2 just as decommissioning plans may be shared by members of WG-1.

Fundamental to the completion of this project is the availability of improved versions of the CERREX code. It is anticipated that there will be two improved versions available for DACCORD's use as follows:

**CERREX-D2** will be an upgrade to CERREX-D to improve user friendliness and allow for more analysis features by incorporating the following:

- Re-arrangement / grading of D&D and WM categories
- Waste Management Routes
- Ability to undertake sensitivity analysis
- Currency Conversion

**CERREX-D2+** will be a further upgrade to improve rigour of cost estimates where an advanced understanding of decommissioning cost estimating and more detailed input data is available. This version will incorporate the following:

- Implementation of detailed inventory data and characterization data using an advanced inventory database



- Calculation of radiological inventory information (taking account of decay) and calculation of waste quantities
- Advanced sensitivity analysis
- Scheduling / cash flow data
- Probabilistic analysis for estimation of contingency and out-of-scope risks

## **Expected Outcomes**

A project report will be prepared that addresses all the issues discussed above under project objectives. Specifically, the project report will describe good practice in the development of cost estimates for research reactor decommissioning, incorporating the outcomes of the data collection and analysis activities. The report will include discussion of:

- Decommissioning planning
- Waste management strategies, associated characterisation scenarios and radiological inventories
- Unit cost factors
- Sensitivity of decommissioning cost estimates to different input assumptions

The report will include representative costing cases for different types of research reactor.

Updated versions of CERREX will be produced over the course of the project.

Improvement of costing cases from Phase 1 and development of new costing cases.

Improved training material for use of the CERREX code.

## **Work Plan**

### **Year 1**

#### Software Development

- Finalize requirements and determine changes to be made to CERREX-D for the two new versions.
- Release CERREX-D2 for use by DACCORD participants (target December 2016)
- Release CERREX-D2+ for use by DACCORD participants (target March 2017)
- Initiate the development of training material requirements for use of CERREX

#### Cost Cases



- Initiate collection of input data. Collect data to improve CERREX cost cases from Phase 1 as well as for new Phase 2 costing cases.
- Define inventory data required and begin collection of this input information to use with CERREX-D2+.
- Provide support throughout project from experienced users for DACCORD participants preparing cost cases.
- Initiate the development of representative costing cases (where available from Phase 1 outputs)
- Begin extraction of unit cost factors from available information

#### Decommissioning and Characterization Plan information

- Begin collection of dedicated reference documents and perform preliminary analysis on information relevant to cost estimating
- Begin collection of decommissioning plans and perform preliminary analysis on information relevant to cost estimating
- Begin collection of characterisation plans and radiological data and perform preliminary analysis on information relevant to cost estimating.

#### Project Report:

- Prepare annotated Table of Contents

#### **Year 2**

##### Software Development

- Enhance CERREX to incorporate requests to improve user-friendliness, if required.
- Identify improvements to incorporate information obtained from analysis of decommissioning plan and characterization plan experience.
- Continue development of training material.

##### Cost Cases

- Complete preparation of cost cases.
- Develop representative costing cases
- Continue generation of additional cost unit factors from the additional collected data sets and from other sources
- Perform sensitivity analyses
- Initiate probabilistic analysis



### Decommissioning and Characterization Plan information

- Undertake analysis of current good practice in the preparation of characterization and preliminary decommissioning plans
- Undertake an analysis of cost implications of different characterisation strategies and waste routes, to assist the development of optimal approaches that are supported by this analysis.

### Project Report:

- Prepare draft report chapters as information is available.

### **Year 3**

### Project Report:

- Complete Project Report addressing the above issues