

eOMEGA - ISDC DECOMMISSIONING COSTING PLATFORM

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Abstract

The purpose of the paper is to present the results of development of the ISDC based eOMEGA platform used for decommissioning costing of nuclear facilities. The International Structure for Decommissioning Costing (ISDC) of Nuclear Installations (issued in 2012) is the costing format recommended by the IAEA, OECD/NEA and European Commission. Implementation of the ISDC enables transparent presentation of decommissioning costing data in the harmonised international data format.

The basic idea behind the eOMEGA development is to merge the advantages of two existing matured solutions: the decommissioning costing software OMEGA and the web-based ADIOS platform with tools and processes to implement any web-based software solution with user-friendly interface. Moreover, the eOMEGA costing platform is intended to be one of the modules of the universal eOMEGA platform which covers also the other activities within the back-end of nuclear power engineering.

The methodology for decommissioning cost calculation in the eOMEGA is in line with the international recommendations and best practices, is completely based on the ISDC and is applicable for any type of nuclear facility. Previous experience with development of decommissioning inventory data, determination of input data, calculation of waste management parameters using unique system simulating the material and radioactivity flow were implemented to the eOMEGA. Main goal of the eOMEGA costing platform is to provide the flexible, user-friendly and internet based tool for transparent decommissioning costing in the ISDC format for any stakeholders involved to preparation of decommissioning projects. Costing cases may be graded from preliminary up to the detailed costing at the level of final decommissioning planning. Access by any authorities/stakeholders may facilitate building of confidence in the decommissioning cost estimates and understanding the cost elements.

1. Introduction

In general, the purpose of decommissioning costing is to prepare qualified project management data; these data should ensure that the decommissioning projects will be performed:

- Safely - with minimal actual and future impact on decommissioning staff, public and environment; costs and other planning data should document that enough finances will be available to ensure the overall safety during decommissioning and also in post-decommissioning phases.
- Economically - according to the cost optimised decommissioning option; it is recommended to evaluate set of possible options covering all realistic/possible approaches and to select the optimal one.

- In due time - according to the optimised schedule of decommissioning; the schedule should be optimised according to the selected decommissioning techniques, waste management system and related resources.
- Publicly acceptable - agreed by all involved parties; acceptance by all stakeholders is facilitated by using the harmonised cost structure with known content of individual cost elements

Reliable cost estimation is considered to be one of the most important elements of decommissioning planning. On the other hand, the appropriate and harmonised decommissioning costing structure and methodology should be applied as well as a proper costing tool to be able to present a decommissioning costing data transparently, to understand the differences in decommissioning costs and to compare the results for different decommissioning costing project.

2. International Structure for Decommissioning Costing (ISDC) of Nuclear Installations

The International Structure for Decommissioning Costing (ISDC) of Nuclear Installations was jointly issued in 2012 [1] by OECD Nuclear Energy Agency (NEA), International Atomic Energy Agency (IAEA) and European Commission to act as the standard and common platform for presenting the cost estimates for decommissioning projects of type of nuclear facility. The purpose of the ISDC is to:

- encourage common usage and facilitate the communication between cost estimators and involved stakeholders;
- promote uniformity in decommissioning costing;
- avoid inconsistency or contradiction in the results;
- be of worldwide interest to all stakeholder involved in decommissioning.

ISDC should be also used as a project oriented, systematic list of typical decommissioning activities which may be identified in any decommissioning project and offers also a new costing approach which is based on using the ISDC as the cost calculation structure.

ISDC decommissioning activities are organised as a hierarchical structure with three numbered level aggregating the data from bottom to top i.e. 3rd level is the reference level and 1st and 2nd level are aggregating levels. Moreover, ISDC is opened down for any additional user's defined numbering down to 3rd level (Figure 1).

Four cost categories are defined at each level (as seen also in Figure 1):

- labour costs - payments to employees, payments to social security and health insurance according national legislation, companies benefits and overheads;
- investment costs - capital/equipment/material costs; national accounting legislation defines the limit what is included into investment cost;
- expenses - consumables, spare parts, taxes, insurances, etc.;
- contingency - a specific provision for unforeseeable elements of costs within the defined project scope.

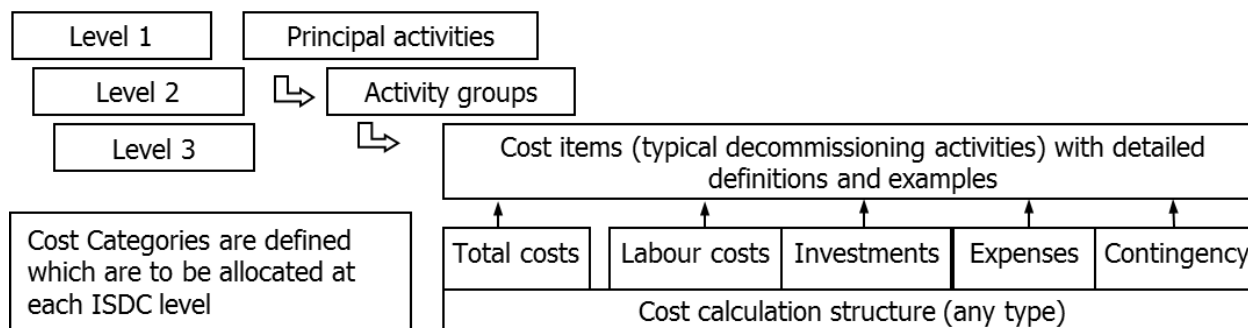


Figure 1 Hierarchical Structure of ISDC and ISDC cost categories

At Level 1, eleven Principal Activities are identified:

- 01 Pre-decommissioning actions
- 02 Facility shutdown activities
- 03 Additional activities for safe enclosure or entombment
- 04 Dismantling activities within the controlled area
- 05 Waste processing, storage and disposal
- 06 Site infrastructure and operation
- 07 Conventional dismantling, demolition and site restoration
- 08 Project management, engineering and support
- 09 Research and development
- 10 Fuel and nuclear material
- 11 Miscellaneous expenditures

3. eOMEGA costing platform – Introduction

The basic idea behind the eOMEGA costing platform development is to merge the main advantages of two existing and matured solutions:

- Decommissioning costing software OMEGA, developed in DECOM company, with fully implemented ISDC structure, methodology and ISDC costing approach. Moreover the long term experience (about 15 years) with the following specific areas of decommissioning costing are applied in the eOMEGA:
 - o development and implementation of inventory data (physical and radiological) for the decommissioning costing purposes;
 - o determination of input data for decommissioning costing (e.g. unit factors);
 - o calculation of decommissioning waste management data using unique system simulating the material and radioactivity flow in the decommissioning process;
 - o calculating and presenting the costing results in the ISDC format.
- Web-based ADIOS platform with tools and processes to implement any web-based software solution with user-friendly interface. It is the open architecture with the possibility to include ready modules and new specific modules into a customer installation and to link/arrange the modules according to customer requirements.

The motivation for development of eOMEGA costing is to create the decommissioning costing tool taking into account following assumptions:

- fully implemented ISDC structure, methodology and costing approach to achieve that eOMEGA should also:
 - facilitate the harmonisation, transparency and benchmarking in the decommissioning costing;
 - contribute to promoting, extending or future upgrading of the ISDC.
- meet the actual international requirements, trends and best practices in the decommissioning costing [2], [3];
- applicable for any type of nuclear facility (nuclear power plant, research reactor, waste management facility, etc.) with any systems, structures and radiological situation at the end of the operational period;
- applicable in any phase of the decommissioning planning process starting from very preliminary phase during construction of the facility up to final planning just before the start of decommissioning;
- high level of customization of costing cases by reflecting specific facility conditions or national framework - user should have the costing case fully in “own hands”;
- available to any stakeholder involved in the decommissioning planning;
- flexible, open, transparent, modern and user-friendly environment;
- accessibility via internet and supported by secure internet technologies with possible expert support and maintenance to be performed remotely;
- no special software is required; only internet browser is needed but linkings to other professional software (e.g. MS Project, Primavera) are possible.

4. eOMEGA – calculation procedure

The procedure for calculation of costs and other decommissioning parameters in eOMEGA consists of following steps:

A. Development of input inventory database

Inventory database of the facility (Figure 2) is considered to be a key input for the decommissioning costs calculation and the basis for calculation of costs for inventory dependent decommissioning activities (decontamination, dismantling, demolition, waste management). The development of facility inventory in the eOMEGA, following the approach from the OMEGA code, should be divided into two main steps:

- Development of the hierarchical structure of the nuclear site: nuclear facility – buildings – floors – rooms – technological equipment and civil structures components;
- Definition of the relevant database parameters (data):
 - Physical data e.g. mass, surface, volume, room dimensions (including data related to hazardous materials);
 - Radiological data e.g. surface contamination, induced activity, dose rates, relevant nuclide vectors;
 - Calculation data e.g. decontamination, dismantling and demolition category of equipment.

The screenshot displays the 'eOmega Administrator' interface for the 'Model calculation case - Inventory database'. It features a hierarchical tree on the left for site structure, a central form for node details, and a right-hand form for inventory items. Annotations highlight the 'Hierarchical structure of site', 'Parameters of building/floor/room', and 'Parameters of inventory item'.

Figure 2 Definition of Inventory database in eOMEGA

B. Definition of input data

Except the inventory, the following set of input data should be defined for the successful run of the costing case in eOMEGA:

- General calculation data e.g. labour rates, radiological limits for release of materials to environment, waste acceptance criteria;
- Unit factors (manpower, expenses and investments unit factor) for decontamination, dismantling and demolition as well as for waste management calculation procedures;
- Technological data e.g. capacities of technologies for waste management, radioactivity distribution coefficients, composition of the working groups.

All the input data could be updated by the user before the start of the calculation.

C. Definition of ISDC costing case

The definition of the individual costing case is based on the development of ISDC case specific calculation tree (Figure 3). The previously defined inventory database (site structure) is linked to the relevant ISDC item. Set of pre-defined parameters specific for each calculation node (ISDC item) should be modified by the user – especially for the period dependent activities (e.g. preparation or management of the project, site security, maintenance) and for collateral costs (taxes, fees, other one-off payments).

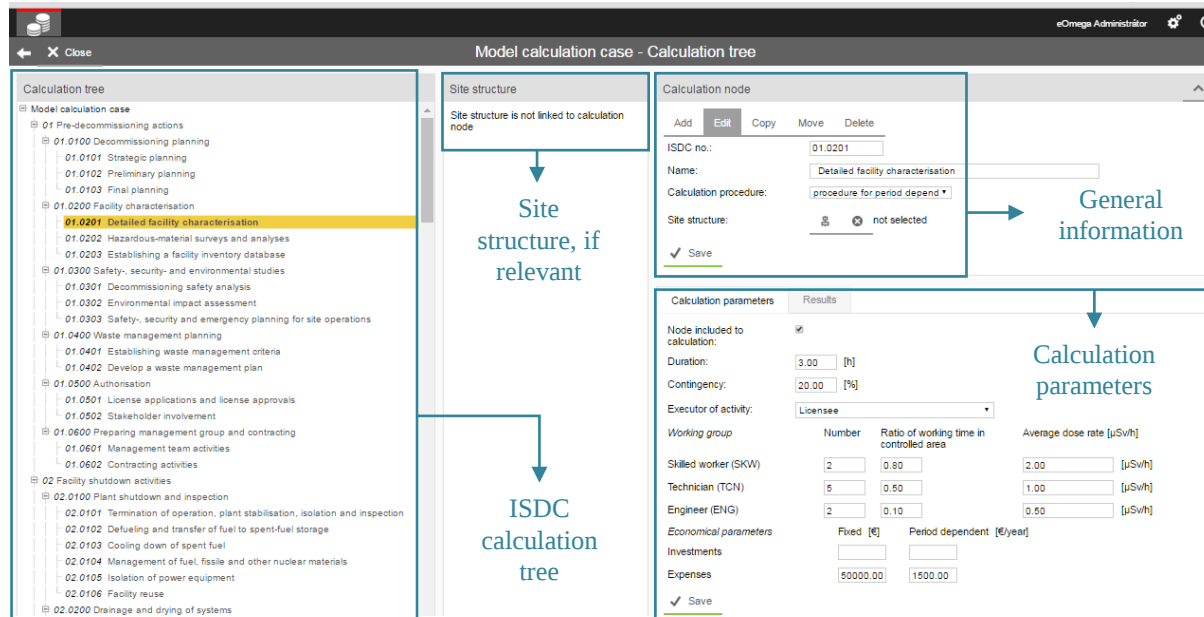


Figure 3 Definition of ISDC costing case (calculation tree) in eOMEGA

D. Performance of calculation

The calculation algorithm applied in the eOMEGA code is based on the ISDC calculation methodology i.e.:

- costs are calculated for each cost category as defined in the chapter 2 of the paper (see also Figure 1);
- unit factors approach is applied for the calculation of decommissioning parameters for inventory dependent activities;
- duration of the activity together with the work group composition and definition of fixed and period dependent expenses or investments are the basis for the calculation of decommissioning parameters for period dependent activities and collateral costs.

Calculation of waste quantities and other waste management related parameters are performed by using the unique system simulating the material and radioactivity flow in the decommissioning process used also in the OMEGA code. This tool allows linking physical and nuclide resolved radiological characteristics (radioactive decay of individual nuclides is taken into account) of each material item, it means that every parameter of material item is traceable from dismantling (demolition) up to release to the environment or disposal in radioactive waste repository.

E. Analysis of results, optimisation of calculation case

The following types of results are generated by the eOMEGA for each calculation case:

- Decommissioning costs according to the ISDC structure and ISDC cost categories (Figure 4);
- Other decommissioning parameters i.e. manpower and exposure according to the ISDC structure (Figure 4);
- Waste quantities according to the IAEA radioactive waste classification [4] – should be re-defined based on the national specific classification or requirements;

- Schedule of all planned decommissioning activities together with time distribution of the costs and other decommissioning parameters.

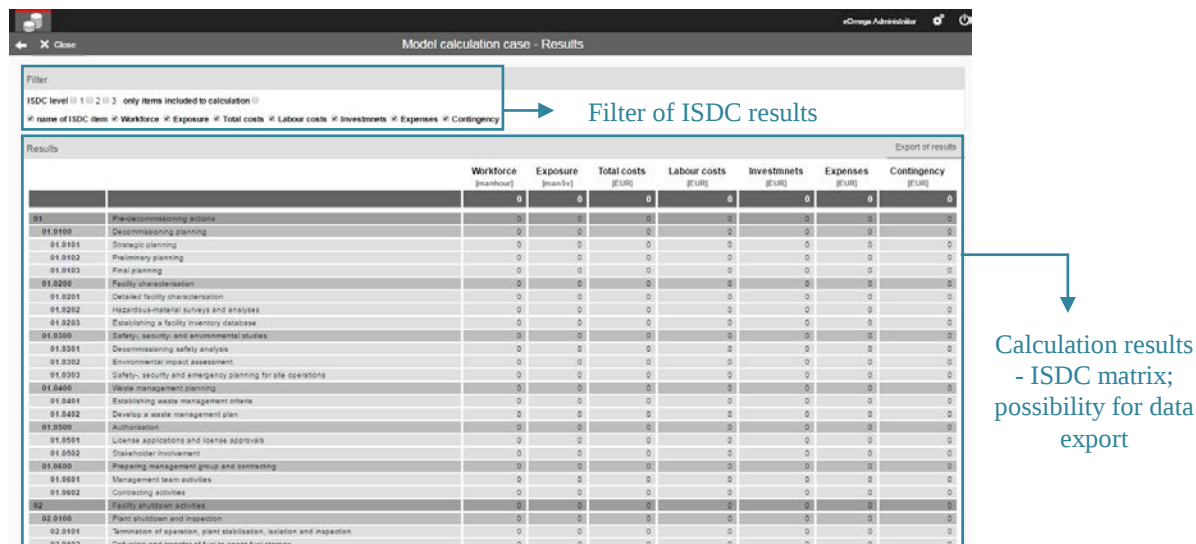


Figure 4 ISDC matrix – basic format for presentation of results in eOMEGA

5. eOMEGA – Future vision as a universal complex platform

The future vision related to the eOMEGA software is to develop a universal and complex eOMEGA platform as one compact package covering:

- *General ISDC decommissioning costing*, as described in the paper, with additional modules intended to be added:
 - o *ISDC probabilistic cost risk assessment* providing the possibility to evaluate selected cost data in order to include the impact of project in-scope and also project out of scope risks on decommissioning costs;
 - o *ISDC costing for transition period* between the shutdown and start of decommissioning when the operational activities continue in sequentially reduced extent and the activities related to the preparation of decommissioning are performed in parallel.
 - o *Transforming cost data to ISDC* to be supported by set of conversion matrixes and factors. After conversion to ISDC the benchmarking of decommissioning cost data should be done very effectively.
- Other activities of back-end of peaceful use of nuclear energy:
 - o *Waste management optimisation* providing the possibility to evaluate the various options for the radioactive waste management and to find the optimal one under the specified conditions.
 - o *Site remediation* to be used for evaluation of costs for remediation of legacy waste sites, contaminated sites or even large scale areas contaminated after accident of nuclear facilities supported by the extension of the existing ISDC structure with more detailed activities relevant for site remediation.

- o *Back end of nuclear fuel cycle* covering the activities related to e.g. long term storage, final disposal or reprocessing of spent nuclear fuel. Also the standardised structure for such activities is planned to be developed.
- o *Funding* is intended to be used for evaluation of back end funding parameters in connection with other modules (decommissioning costing or back end of nuclear fuel cycle) and taking into account the legislative background, conditions for funds collection, contributions of the license holder and revenues from the operations on the financial market.

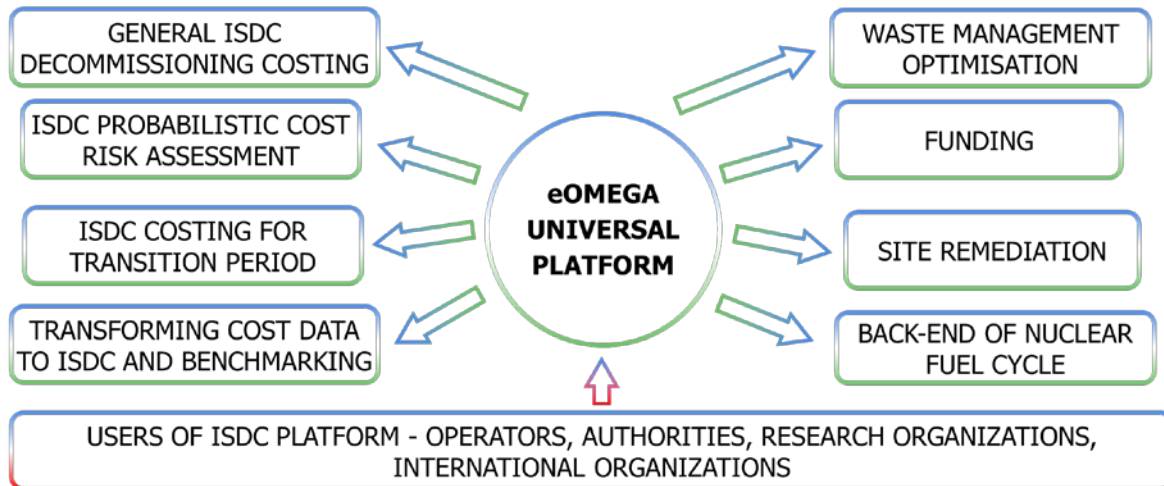


Figure 5 Principal scheme of universal eOMEGA platform

6. Conclusion

The paper presents the decommissioning costing software eOMEGA with fully implemented ISDC structure, methodology and ISDC costing approach and taking into account the international recommendations, best practice and recent trends in decommissioning costing. The eOMEGA is aimed to provide the flexible, open, transparent ISDC costing platform in user-friendly environment, accessible via internet and be available to any stakeholder involved in any phase of decommissioning planning process. In the future, the eOMEGA is intended to be universal and complex platform covering not only the decommissioning costing but also the other activities under the back end of nuclear power engineering.

7. References

- [1] Organisation for Economic Co-operation and Development /Nuclear Energy Agency, International Atomic Energy Agency, European Commission. International Structure for Decommissioning Costing (ISDC) of Nuclear Installations. OECD/NEA No. 7088, Paris, 2012.
- [2] International Atomic Energy Agency. Financial Aspects of Decommissioning. IAEA TECDOC 1476, Vienna, 2005.

- [3] Organisation for Economic Co-operation and Development /Nuclear Energy Agency. The Practice of Cost Estimation for Decommissioning of Nuclear Facilities. OECD/NEA No. 7237, Paris, 2015.
- [4] International Atomic Energy Agency. Classification of Radioactive Waste. General Safety Guide No. GSG-1, Vienna, 2009.