

CEA's Radioactive Waste Management Optimization -11034
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ABSTRACT

In the field of clean up and decommissioning of nuclear facilities the knowledge of the radioactive waste inventories is crucial. For CEA (French Commission in charge of Atomic Energy and Alternative Energies), this knowledge is a key issue : in the short term to guarantee a continuous flow in the disposition pathways as well as in the middle and long terms for investment strategy in nuclear support facilities.

These needs also appear in France nationwide, with the enforcement of two laws promulgated in 2006 dealing with radioactive waste and with transparency in Nuclear Safety.

More generally, a precise and reliable knowledge of inventory and flow production forecast is indispensable to give pertinent answers to the questions related to radwaste cost and efficiency. Thus, all these subjects are also worked out with our authorities in charge of financial aspects because they are essential for the cost control of clean-up and decommissioning projects that CEA has to manage. Indeed, in these projects, waste management represents a great part of cost and risk.

For this reason CEA has developed a coherent panel of tools with two complementary applications: CARAIBE and INFLUVAL.

This paper describes the tools used by CEA Clean-up and Decommissioning Division to manage radioactive waste and unused fuel with the following objectives :

- Consolidation of stock and expected flows,
- Evaluation of reference costs
- Help for dimensioning and investment decision for facility programs (storage, waste conditioning facility,...)
- Validation of waste cost ratio.

INTRODUCTION

In the field of clean up and decommissioning of nuclear facilities the knowledge of the radioactive waste (radwaste) inventories is crucial [1], [2], [5]. For CEA (French Commission in charge of Atomic Energy and Alternative Energies), this knowledge is a key issue: in the short term to guarantee a continuous flow in the disposition pathways as well as in the middle and long terms for investment strategy in radwaste support facilities (treatment and storage)

These needs also appear in France nationwide, with the enforcement of two laws promulgated in 2006 dealing with Nuclear Safety and Radwaste Management Policy.

More generally, a precise and reliable knowledge of inventory and flow production forecast is essential to give pertinent answers to the questions related to radwaste cost and efficiency. Thus, all these subjects are also worked out with our authorities in charge of financial aspects because they are essential for the cost control of clean-up and decommissioning projects that CEA has to manage. Indeed, in these projects, waste management represents a great part of cost and risk.

For this reason CEA has developed a coherent panel of tools based on two Relational Database Management Systems (RDMS):

- the first one is the CARAIBES data base which is combined with sixteen software applications. This RDMS, along with the appropriate processes and procedures, guarantee the traceability of every single waste package produced by CEA facilities from production to final repository or

intermediate storage. This tool allows the individual management of each radioactive waste parcel. The main characteristics of CARAIBES include:

- o traceability of all the operations to constitute the individual parcel,
 - o shipment of the package until the definitive repository,
 - o the guarantee of the activity declarations.
- the second one is the INFLUVAL database which will be combined with a software featured with consistency checking and analysis modules to provide the second RDMS used for inventories and forecasts. The main characteristics of INFLUVAL include:
- o Radioactive waste production forecast by project
 - o Following of all the waste routes and tiers
 - o Valuation of the waste.

RADWASTE MANAGEMENT POLICY OF THE CEA.

The policy strategy of the CEA in the field of the waste management joins within the framework of the national strategy described in the National Plan of Radioactive Waste – support of the law promulgated in 2006 dealing with Radwaste Management Policy.

The main stakes for the CEA are to be able to send common radwaste on line thought operational disposal pathways without congestion.

The main objective is to allow the nominal progress:

- Activities of R&D
- Programs of cleaning up - dismantling

The strategy of the CEA leans:

- On a good knowledge of the inventories and the flows of waste to appropriately size areas and facilities for processing, treatment, storage or disposal;
- On the research for solutions to reduce the volumes of waste and to avoid unnecessary facility or process upgrades;
- On an optimized management allowing to send as much waste in the operational disposal pathways and to find solutions (i.e. new processes) in order to send the rest either in the existing ones or in a new disposal pathway;
- totally eliminate the waste without a disposition pathway, directly at the production.

Figure 1 illustrates the different items of radwaste management covered by the Nuclear Decommissioning and Dismantling Directorate (DADN).

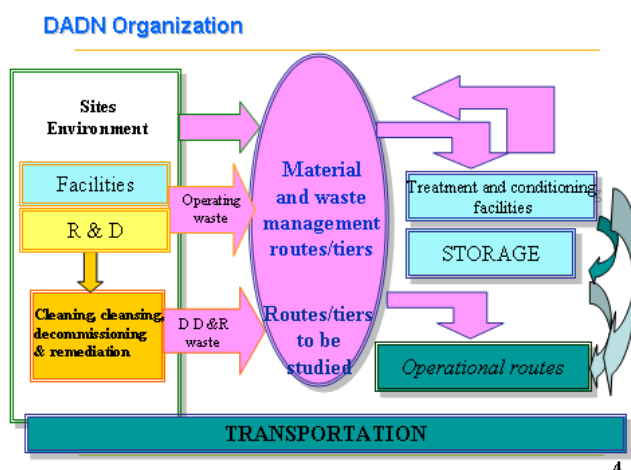


Fig. 1. Radwaste management

CARAIBES RDMS

The CARAIBES database was initiated in 1999 after a violation of one of the French final repository acceptance specifications which led to a temporary stop of transfers between one CEA center and the low activity surface repository. This violation concerned the fact that the radioactive activity attached to one waste package was impossible to trace. The information had been lost at one step of the process and such a mistake could not be accepted.

Therefore, CARAIBES was designed to:

- assist people in the process of creating waste packages (with manual and/or automatic controls at every step) in order to guarantee its acceptance to a surface repository,
- provides a fully adaptable on demand software application that can be used by all kind of facilities (production, radwaste treatment, intermediate storage, final repository shipment, ...),
- Homogenized the rad waste management practices and level of characterization (same control/validation steps for each kind of waste package).

All the data, ranging from the physical characteristics of the waste to the more than three hundred efficiency curves necessary to assess the activity of the radio-nuclides measured by gamma spectrometry, are embodied into the framework of a RDMS in order to centralize and guarantee the coherence of the collected data. This approach allows a precise traceability of the waste in space and time from its creation to its final disposal.

It is presently used by all the nuclear research centers of the CEA.

CARAIBES RDMS contains the characteristics of more than 100,000 radwaste packages, is organised as a group of 16 different applications each dedicated to a specific aspect of radwaste management ie:

- Radwaste producer,
- Radwaste disposal,
- Radwaste treatment processes,
- Radwaste "checked fit for final repository"...

The traced data are:

- Physical matters data such as composition, weight, volume...
- Radiological data such as radionuclides (RN), activity/weight, RN spectrum/nuclear facilities, dose rate, surface contamination level...
- Localization data such as intermediate storage, transportation, storage place, final repository shipment...
- Control data such as acceptance limits, pooling simulation (one of the software application allows to simulate the pooling of primary packages in order to create a final package fit for final depository and optimised in terms of radiological activity), completed check-list...
- Process data such as type of treatment, timing, operator in charge, measurement device used...
- Cost-control and radwaste management data such as internal and external invoicing, radwaste production flow data....

This framework is closely linked to the release approval, integrating the activity thresholds calculation early in the life cycle in order to choose the proper orientation for every waste package. The results coming out of this RDMS guarantee the radiological activity to the French final repositories for all the radwaste packages produced in a CEA facilities and the stored data have already been used to select some specific packages for a better radiological disposal pathway (for i.e. from Intermediate Level to Very Low Level). Those results contributed to a fast return on investment of its development.

Moreover, it facilitates the elaboration of synthetic reports on radwaste production:

- production of the research facilities,
- production from decommissioning or updating projects,
- in/out ratio of the radwaste treatment facilities,
- filling of the temporary storages,

in order to anticipate radwaste management in all research centres of CEA by providing accurate input data (radwaste produced between 2000 and nowadays) for INFLUVAL.

INFLUVAL DATABASE

INFLUVAL constitutes a reference database about radioactive wastes, spent fuel and spent radioactive sources. The data are collected and shared by all the CEA radioactive waste management community. The data collected concern radioactive wastes stored today in CEA facilities and also radioactive wastes that will be generated in the future.

INFLUVAL serves as reference:

- To produce reports and inventories requested by French regulation authorities ;
- To estimate the radioactive waste treatment cost and to include it in the project management tools.
- To study the suitability between CEA resources (waste treatment units and storage units) and current and future needs.

In addition, INFLUVAL enables to simulate scenarios of waste management by manipulating the data in the program, for example by modifying treatment chronicles or treatment processes. The simulating functions leans on inventories data but are used in a separate module. The general process is described in Figure 2.

The results will serve to direct the studies and possibly to engage actions with the aim of optimizing means and costs.

INFLUVAL is available through the cea intranet network. according to their profiles, users will be able to consult inventories, establish their forecasts and simulate scenarios. **Figure 3** shows the forecast for **Very Low Level Waste (VLLW)**.

The current version of INFLUVAL is available since 2009. Improved database will be implemented in 2011. To conclude, INFLUVAL is an indispensable tool to the radioactive waste management strategy established by the CEA Clean-Up and Decommissioning Division.

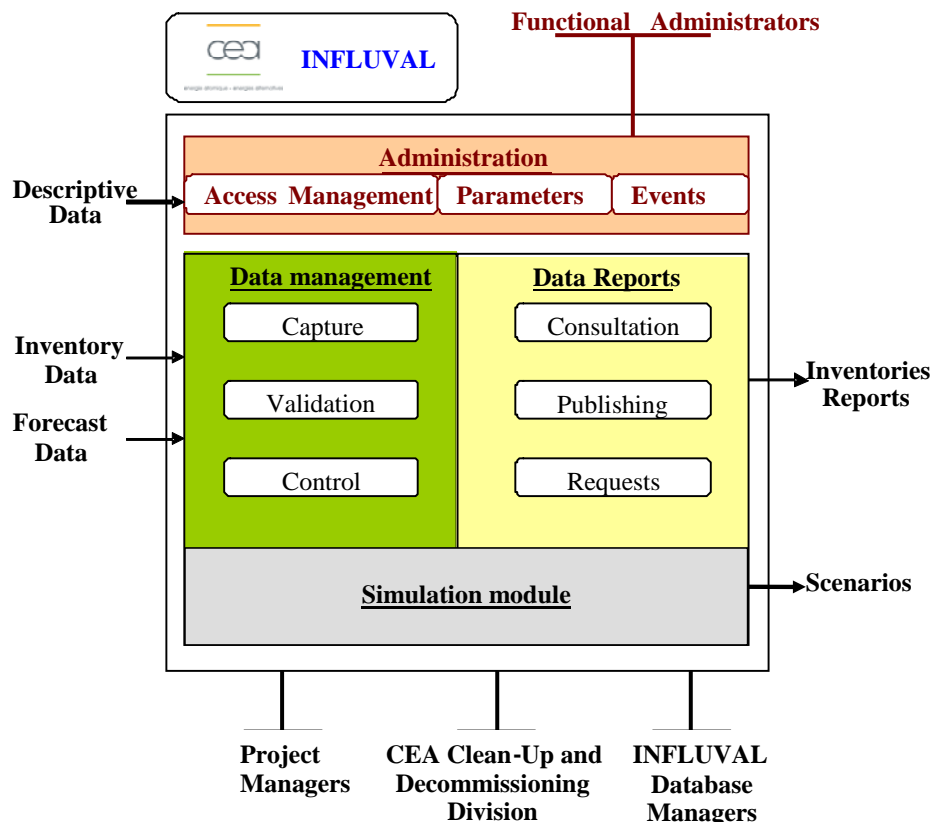


Fig. 2. INFLUVAL global process

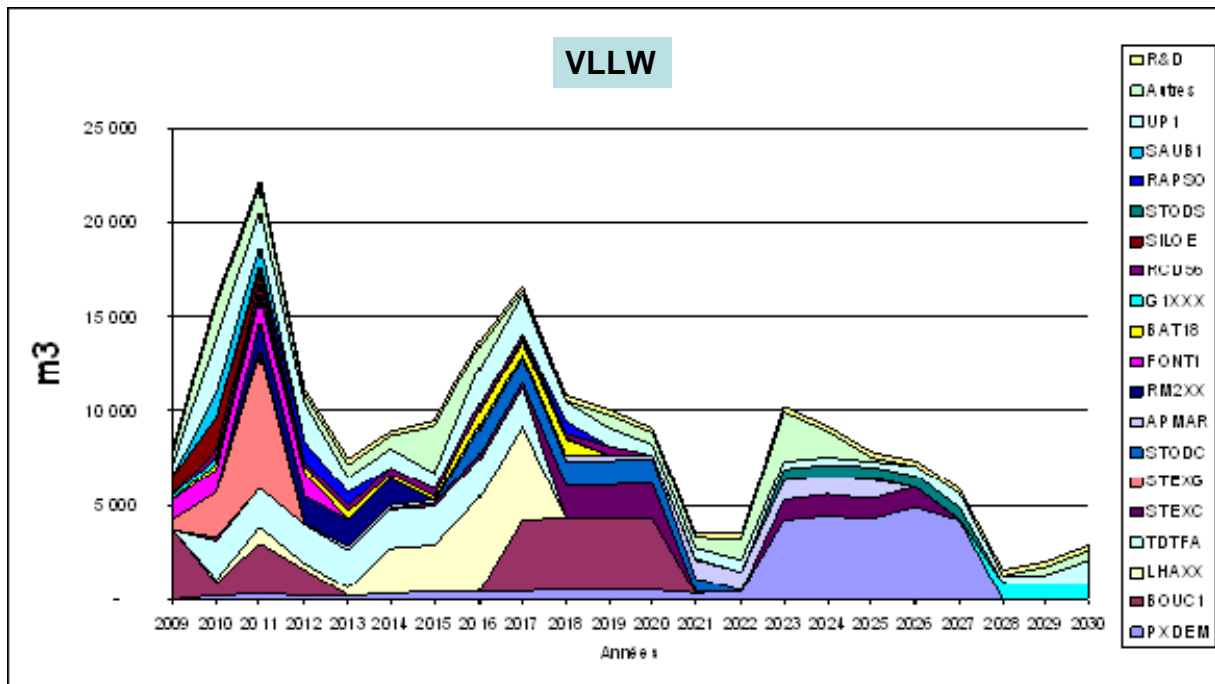


Fig. 3. INFLUVAL Very Low Level Waste Data

INVENTORY: SEVERAL LEVELS OF NEEDS

Due to the variety of wastes, dedicated disposition pathways are needed comprising appropriate solutions for retrieval, recycling[3],[4] treatment, repackaging, interim storage, transportation and final repository.

Those tailored solutions have to avoid the risk of oversizing new facilities, as well as the risk of having insufficient capacity. Oversizing has to be limited as far as possible. It might lead to inappropriate investment -from excess of performance to unnecessary investment - and is only acceptable as a response to a residual uncertainty. Shortage in sizing or in designing might have an even greater impact; it might lead to extended schedules with a cost increase, maybe to modify facilities when already in operation, or in the worst case to build other new facilities.

Thus a strategic analysis is necessary, ideally combined with a consistent and reliable waste inventory. The ultimate detail is useless for that purpose. But the data have to be sufficient to represent all the cases in order to establish realistic scenarios and calculate the related costs with an appropriate reliability.

Even if systems and facilities are properly sized, technical solutions may be more or less efficient depending on the ability to cope with detailed characteristics of waste which turn to be of importance for the process involved.

Thus, there is a need of another level of data for engineering purpose. Those data have to be more precise to avoid errors in designing, construction and operation. Those data are naturally collected and used in the frame of the studies and of operation management. For this reason they are out of the scope of this paper.

CONCLUSION

The CARAIBE and INFLUVAL tools allow CEA to effectively manage and forecast radioactive waste streams. The combination of these tools has allowed CEA Clean-up and Decommissioning Division to honour the following objectives :

- Consolidation of stock and expected flows,
- Evaluation of reference costs
- Help for dimensioning and investment decision for facility programs (storage, waste conditioning facility,...)
- Validation of waste cost ratio.

This strategy will go on in 2011, with the definitive RDMS INFLUVAL in operation.

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