QUESTIONNAIRE ESTABLISHED FOR THE BRAZILIAN INVENTORY OF LOW AND INTERMEDIATE LEVEL RADIOACTIVE WASTE

Júlio T. Marumo[1], Fábio Silva[2], Antônio Juscelino Pinto[3] and Gérson L. S. Taveira[4]

[1] Instituto de Pesquisas Energéticas e Nucleares (IPEN – CNEN/SP)
Av. Professor Lineu Prestes 2242
05508-000 São Paulo, SP
jtmarumo@ipen.br

[2,3] Centro de Desenvolvimento da Tecnologia Nuclear (CDTN - CNEN/MG)
Campus da Universidade Federal de Minas Gerais
Av. Antônio Carlos, 6627
31270-901 Belo Horizonte, MG
[2]silvaf@cdtn.br; [3]ajp@cdtn.br

[4] Engenharia de Produção Civil – Bolsista de Iniciação Científica
Centro Federal de Educação Tecnológica de Minas Gerais
Belo Horizonte, MG, Brasil.
gersonluizst@gmail.com

ABSTRACT

The Nuclear Technology Development Center (CDTN), an institute of Brazilian National Commission of Nuclear Energy (CNEN), is responsible for the technical coordination of the Brazilian Repository Project (RBMN), for Low and Intermediate Level Radioactive Wastes. To establish the inventory of the low and intermediate radioactive level waste to be disposed in the national Repository, a questionnaire was elaborated to be filled on line, via WEB, exclusively to registered users, which involved CNEN's institutes, ELETRONUCLEAR, INB and CTMSP. Based on all standardized information received from questionnaires, an easy use database to inventory the radioactive waste was created in Microsoft Access® that supported the calculation of the volume of radioactive waste treated and non-treated, stored and generated presently in Brazil. In addition, from this database it will be possible to establish some disposal procedures and the necessary area of construction. The objective of this work is to present this database and some general information about the radwastes in Brazil.

Key words: Repository, questionnaire, data base management system, radioactive waste.

1. INTRODUCTION

The implementation and operation of a radioactive waste repository generates a large amount of records that need an appropriate and robust system for its efficient organization and retrieval. The information about the inventory of wastes received and stored, the safety analysis reports, the administrative and operational procedures, research reports and studies, processes, environmental and radioprotection data, among other, are part of these records.

The management and control of these records are part of the Quality Management System (QMS), whose role is critical for both the maintenance of the entire plant until its closure, and to meet regulatory compliances [1].

Since 2008, Brazilian Commission for Nuclear Energy, CNEN, has been working in the Project of Repository for Low and Intermediate Level Radioactive Wastes, (RBMN Project) and the Centre for Development of Nuclear Technology (CDTN) is responsible for the technical coordination of this project. Among activities under development, the survey of National radwaste inventory must be firstly concluded since it is a requirement for the project cost estimation [3].

Decisions about National radwaste inventory must be made based on reliable data regarding amount, characteristics and history of the collected wastes. In this way, an electronic questionnaire was created to collect all information necessary to obtain the volume of the treated and non-treated waste, presently stored in Brazil [3].

According to Brazilian Regulation CNEN-NE 8.01 (CNEN, 2014), inventory control and registers related to the storage of the waste must be kept up-to-date and over the entire life of the installation.

Based on all standardized information received from questionnaires, an easy use database to inventory the radioactive waste was created in Microsoft Access® that supported the calculation of the volume of radioactive waste treated and non-treated, stored and generated presently in Brazil. In addition, from this database it will be possible to establish some disposal procedures and the necessary area of construction. The objective of this work is to present this database and some general information about the radwastes in Brazil.

2. METHODOLOGY

2.1 Information System for Repository and Database Manager System

Information system is a set of interrelated components, which collects, processes, stores and distributes useful information for decision-making, coordination and control of an organization or project. The information system is one of the most important tools in the implementation and operation of the repository [2].

To support the implementation of a repository for radioactive waste it is necessary to develop and mainten a system of records that is adequate, robust and organized. The following data are part of the records, information about the inventory of waste received and stored, the safety analysis reports, administrative and operational procedures, studies, procedures, data, environmental radiation protection and all other information necessary for the operation of the repository, to the regulatory bodies and for the maintenance of the entire facility until its closure [1].

A database is a collection of interrelated stored data, that meets the needs of multiple users within one or more organizations. The motivations for using databases instead of files are: increased availability for a diverse set of users, data integration for easy access, updating of complex transactions and less redundancy of data. It is usually handled through a software system known as Database Manager System (DBMS). A DBMS allows a logical view (schema, subschema); physical sight (access methods, "Clustering data); definition language and data manipulation and important utilities, such as transaction management, concurrency control, and data integrity and recovery and security flaws [2].

Currently the most widely adopted data model is relational. $^®$Access is a relational database in which information are organized in tables. The $^®$Access software considers as the basis of the activities of database: objects, queries and reports. It is a tool that allows access to relational database and converts it to Structured Query Language (SQL) the various forms of input, especially the queries in Query By Example (QBE) [2].

The inventory control of wastes and all records associated with the storage is a requirement of the regulatory body and an integral part of the safety analysis, so this recordset must be available throughout the life of the installation.

2.2. Definition of the Questionnaire Content and Migration to online version

To create the questionnaire, first a brainstorm was performed with the team engaged in the process. The goal of this brainstorm was to collect all relevant information that must be addressed with the questionnaire answers. The questionnaire was planned to gather the amount of treated an non treated radioactive waste currently stored in Brazil, and some features of these material, as physical state, nature (organic or inorganic), matrices in which they are immobilized, and so on [3].

In this first step, the main topics concerning those information were elected, thus the questionnaire was based on six principal sections: Information about the institute/company, Generic information about radioactive waste, Information about the inventory control: radionuclides and their characterization methods, Information about treatment process: process applied to treat each kind of waste, Inventory of non treated waste and Inventory of treated waste.

After the definition of the information that had to be collected, a questionnaire was drafted in spreadsheet application. This initial version was converted into an online version.

The electronic version was planned to be as easy as possible to fill out. The previously planned questionnaire had to be modified and some fields were simplified in order to make it faster to be processed. The software adopted did not have enough tools to manage all information as we planned.

Once the questionnaire was available electronically, the responders were registered as users, and could access the questionnaire and fill it out online. The form was firstly distributed only to the Institutes of CNEN. Altogether, the questionnaire has seven pages, whereas the last

page is a summary of the answers. The information of the summary page can be transferred to any spreadsheet program to facilitate the data analysis [3].

2.3.   Preliminary system: database and forms

The methodology adopted includes the implementation of a database, applying the object-oriented DBMS, associated to the radioactive waste management. Interactive operation mode was planned and implemented for an easy manipulation integration of the data, modules management, standard report issues, meeting the security requirements [2].

Based on the information collected from the questionnaires [3] a preliminary database about Repository was developed using on Microsoft Access software. Tables were created with information of the questionnaire [2].

3. RESULTS

The database was created to be kept and accessed by means of the management system, the waste inventory form composed of one data entry module and report issue with filter.[2]. For these modules, tables named "Waste", "Generator", "package" and "Waste type" were created to store the available information. Data entry form and subforms were created to show the data.

It was also created standardized consultation, predetermined or by search (selection of related parameters), with reports that describe and sumarize these information. An username and password form, "Login" page (Fig.1) was created to access the system and it defines the main flow.

The operation mode occurs by means of the "Menu" form, presente in Fig.2, which allows the access to the Radioactive Waste Inventory. It contains command buttons for to view the forms and logoff the system. The command button "Filter Reports" allows the search with filter (Fig. 3), and the button "Radioactive Waste Entry Form" allows the access to the form "Registration, Edition, Change and Exclusion of data" (Fig. 4).
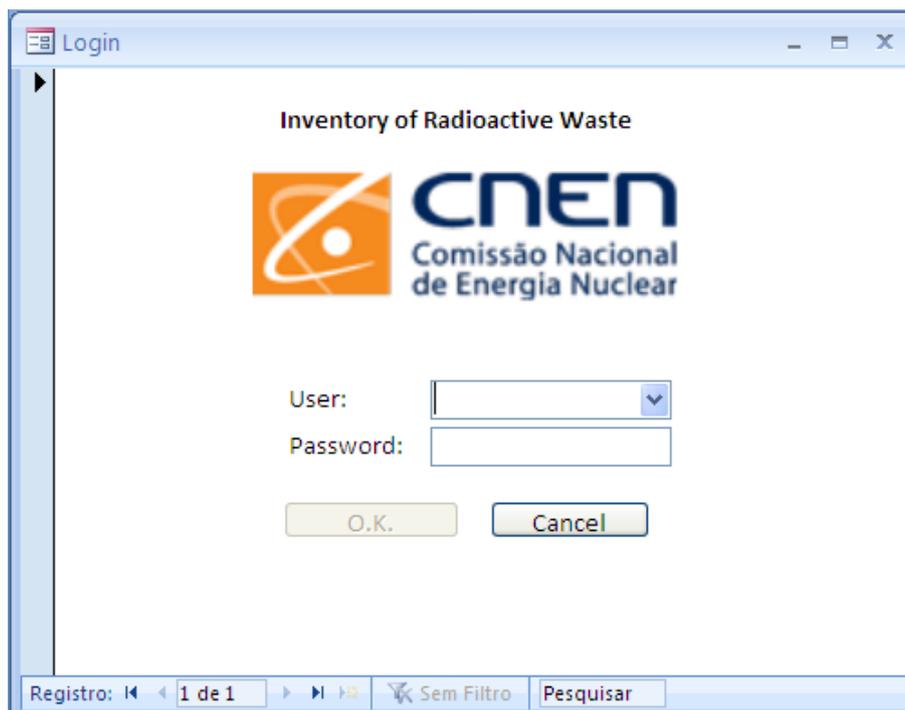
Figure 1: Overview of the Data Base user the Inventory of Radioactive Waste

Figure 2: Overview of the Menu of the Inventory of Radioactive Waste

Figure 3: Overview of the Entry Form Data of Radioactive Waste

Figure 4: Overview of the Search Results of Radioactive Waste

In general, several types of reports with preconfigured dimensions should be issued based on the request by CNEN and its Institutes. Reports issued after "search with filter" should be configured as shown in Fig. 5.

Figure 5: Overview of the Search Model Results of Radioactive Waste

In Figure 6 ~~is~~ shows the "Overview of the previous page of the old electronic questionnaire" on the seven pages of the questionnaire, whereas the last page is a summary of the answers. The information of the summary page can be transferred to any spreadsheet program to facilitate the data analysis.
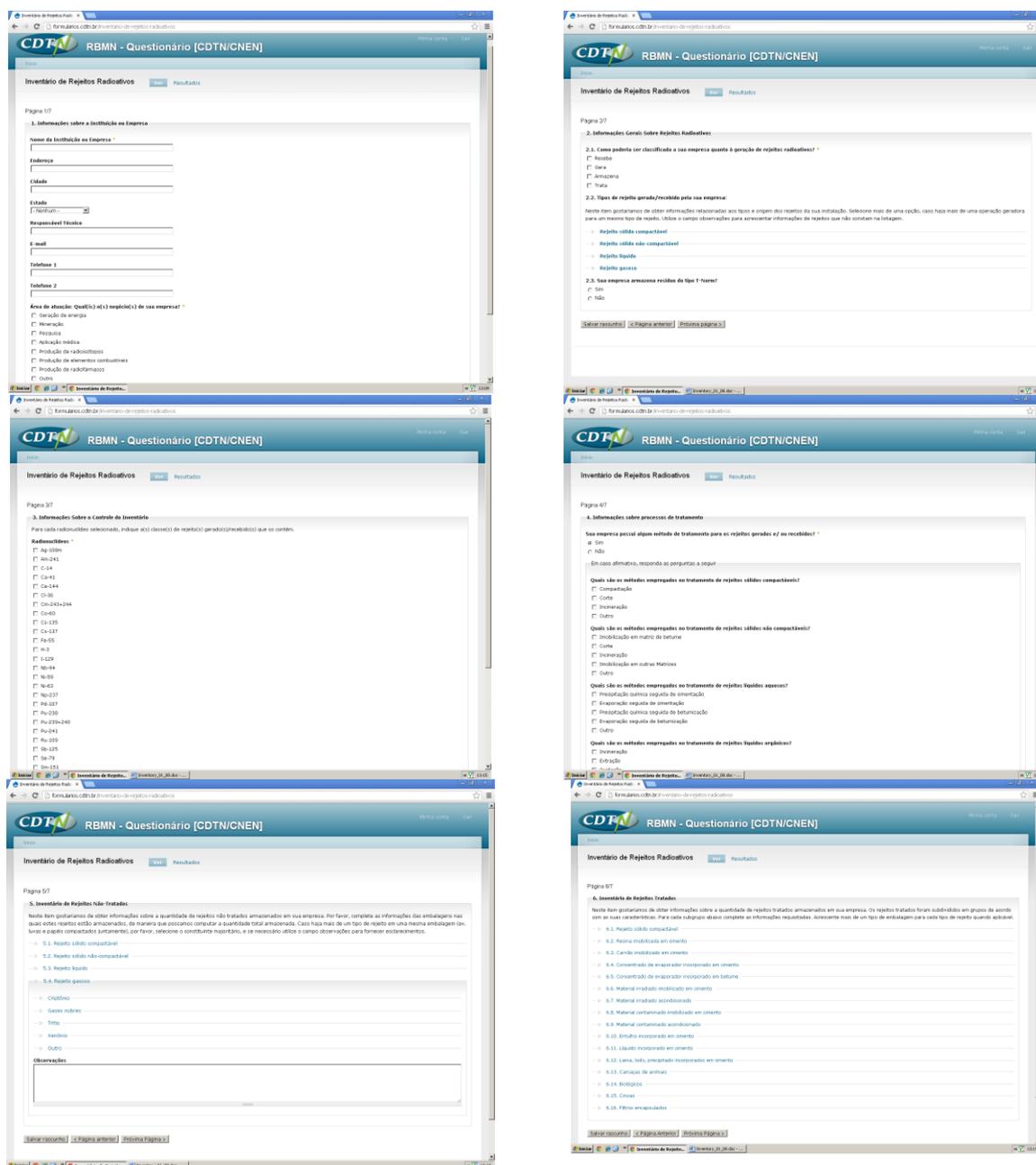
Figure 6: Overview of the previous page of the old electronic questionnaire.

All information collected using the questionnaire ~~waste~~ was transferred to the database and grouped according to volume and type of package, presented in Tables 1 and 2. It is possible to see that the volume of waste stored at the CNEN's Institutes is much lower than NPP (Nuclear Power Plant) and other institutions and there is a considerable volume of untreated waste that could intervene in the final dimension of the repository. The main type of package adopted is the 200-liter drum, but there are still different types of boxes, metallic packages and VBA (Drum concrete - Verlorene Betonabschirmung).

Table 1: Volume of waste by generator (treated and non treated)

Generator	Volume (m3) treated	Volume (m3) non treated
CNEN	37406	489
NPP and other institutions (incluir INB e CTMSP)	45282154	20278

INB (Brazilian's Nuclear Industries); CTMSP (Navy Technological Center)

Table 2: Types of packages

Generator	Type of package	Quantity
CNEN	Metallic box (1000 liters)	80
	Metallic drum (200 liters)	1694
NPP and other institutions (incluir INB e CTMSP)	Mettalic box (2500 and 1248 liters)	608
	Metallic drum (200 liters)	6634
	VBA	302
	Metallic cylinder	218

4. CONCLUSIONS

The database under development to manage the low and intermediate level wastes inventory of RBMN Project, was tested with the information obtained from the electronic questionnaire filled out by the radioactive waste generators and it has been an useful tool to evaluate the inventory. This system is composed of four forms: access page with username and password; options menu; waste register; and search page. The last one with record filters such as generator, type of package and waste. The functions introduced in the system allows the manager to easily obtain detailed and organized reports.

ACKNOWLEDGMENTS

REFERENCES

1. Comissão Nacional de Energia Nuclear. *CNEN-NN-8.01:* "*Gerência de Rejeitos Radioativos de Baixo e Médio Níveis de Radiação*", CNEN 2014, Rio de Janeiro, Brasil (2014).
2. F. SILVA, C. C. O. TELLO, Sistema de Gestão Integrada Para Dados de Repositórios de Rejeitos Radioativos (SGI3R). *Revista Brasileira de Pesquisa e Desenvolvimiento,* Rio de Janeiro, Brasil, Março 2012, Vol. 14 n 1, pp.1-14 (2012).
3. J.A.A. CALABRIA, J.T. MARUMO, M.H. TADDEI, F. SILVA, "Elaboration of a questionnaire dor establishment of the Brazilian inventory of low and intermediate level radioactive waste", Proceedings of *International Nuclear Atlantic Conference, INAC 2013,* Recife, 24-29 nov. 2013, CD (2013).
4. J.A.A. CALABRIA "*Consolidação Questionário Institutos 3*". Planilha de Trabalho, CDTN, Belo Horizonte (2014).
5. International Atomic Energy Agency. "*Retrieval, Restoration and Maintenance of Old Radioactive Waste Inventory Records*", IAEA, Viena, Áustria (2007).