COMMISSIONING AND START-UP TESTS
OF ALPHA-CONTAMINATED SOLID WASTE SORTING, CEMENTING,
AND INTERIM STORAGE FACILITIES
AT BELGOPROCESS (BELGIUM)

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ABSTRACT

The alpha-contaminated solid waste generated in Belgium results from past activities in the fuel cycle (R & D + Reprocessing and MOX fabrication pilot plants) and present operation of BELGONUCLEAIRE’s MOX fuel fabrication plant.

After the main steps in the management of alpha-contaminated solid waste were established, BELGONUCLEAIRE, with the backing of BELGOPROCESS and ONDRAF/NIRAS, started the design and construction of the T & C and interim-storage facilities for this alpha waste.

The accumulated solid alpha radwaste containing a mixture of combustible and non-combustible material will be sorted. After sorting, both the accumulated and recently-generated non-combustible alpha waste will be embedded in a cement matrix.

The erection of the sorting and cementing units which include glove-boxes and the interim storage building for conditioned packages was completed at BELGOPROCESS, at the beginning of year 2002.

Start-up operations for both facilities have been performed. Operating tests of the sorting and cementing units were completed in July 2002 and inactive operation campaigns were started in August 2002. The results of the tests and inactive campaigns are given. Overall testing of the storage building supervised by the Safety Authorities was successfully performed at the end of 202 after completion of the operating tests on the equipment.

The present paper summarizes the main information collected during the tests and campaigns, some of which has led to modifications of the equipment originally installed.

INTRODUCTION

The alpha-contaminated waste generated in Belgium results from past activities in the fuel cycle (R & D + Reprocessing and MOX fabrication pilot plants) and present operation of BELGONUCLEAIRE’s MOX fuel fabrication plant.

EUROCHEMIC, a pilot reprocessing plant, was operated till 1974 and generated alpha solid waste. The decommissioning programme of this plant, which started after its closure, also generated alpha-solid waste.
Research and Development in the fuel cycle and the operation of a MOX fabrication pilot plant erected on the site of the Belgian Research Centre (SCK•CEN) have also contributed to the production of alpha-solid waste.

Presently the main producer of alpha waste is BELGONUCLEAIRE’s MOX plant in operation since 1972 and back fitted in 1985 to increase the capacity to 35 tHM/year.

**RADIOACTIVE WASTE TO BE TREATED**

The Pu Contaminated Solid Waste (PCSW) is normally generated inside the glove-boxes in which it is sorted by category and put into small packets (a few litres) packaged in welded double PVC bags.

In the past, the initial small packets obtained were packaged in 30-l canisters. The solid suspect alpha waste was placed in the free spaces in these 30-l canisters. Later, the small packets were packaged in a 220-l drum without adding any further suspected solid waste.

Between the beginning of solid alpha waste production (in the 70’s) and the end of 1998, the way to package and to sort by type (combustible or non combustible) at the producer’s site has evolved. The specifications, which are now imposed by ONDRAF/NIRAS, are now fixed. As a result, a significant amount of waste (≈ 400 m³) generated before the end of 1998 must be re-sorted in order to meet the present specifications.

The solid suspect alpha waste placed in the free space of the 30 l canisters will be removed after inspection of the small welded packets (contaminated alpha waste).

The small packets in the 30-l-containers and the 220-l drum will be sorted into non-combustible and combustible waste.

The non-combustible waste will be placed in 400-l drums, embedded in a cement matrix and transferred to an interim storage building.

The combustible waste will be placed in 220-l drums prior to further conditioning.

**DESCRIPTION OF THE FACILITIES**

**Sorting and Cementing Facilities**

The sorting and cementing facilities are installed in an existing building at BELGOPROCESS, which has been refurbished.

The layout of the sorting and cementing facilities is given in Fig. 1.

Automatic monitoring of the facilities is performed using a process controller with three operating modes:
1) automatic sequences
2) manual servo-driven operation is possible outside the automatic operation sequences but automatic safety systems are maintained
3) intervention (all operations can be carried out without the safety devices).

% Sorting Unit

The sorting unit consists of 4 glove-boxes equipped for the safe introduction of 30 l and 220 l packages of mixed waste, for their handling, their inspection (surface contamination, metal detection) and their sorting into suspect waste, combustible and non-combustible contaminated waste.

The 30-l containers are introduced into the glove-box GB1 via a hatch equipped with a lock system.

The 220-l drums containing the mixed waste are placed on a tipping system, which, after rotating through 135° brings the drum to be docked to glove-box GB3.

The lid is grasped by suction cups fitted to a gasket seal and packets slide by gravity into glove-box GB3.

An inflatable gasket ensures the leaktightness of the docking of the drum to the glove-box.

The suspect waste is collected in a 220-l drum, which is docked to a glove-box. An empty 220-l drum with a lid is brought on a conveyor wagon to the docking position under GB2. The design of this docking system is identical to that for GB3. After filling and off-docking, the 220-l drums are transferred to existing treatment and conditioning facilities at BELGOPROCESS.

The contaminated waste contained in small packets is transferred from GB3 to GB4 where it is sorted into combustible and non-combustible waste.

A metal detector placed around the tunnel between the two glove-boxes detects the packets that contain metallic parts.

Included with the waste for cementation are a series of 400-l drums enclosing 220-l drums containing non-combustible waste. Glove-box GB4 is fitted with a system that can drill a hole in the lids of the 220-l drums placed within the 400-l drums thereby enabling introduction of the cement.

The non-combustible waste is placed in 400-l drums developed for long-term storage. Each drum, which is equipped with an internal basket and a double lid, is a sheet metal worked drum. This standard fabrication necessitated the development of a coupling system permitting safe docking and off docking to a glove-box (alpha tightness).

After measurement of the Pu content by NDA (Non-Destructive Analyses : active and passive neutron alpha measurement), the 400-l drum is transferred to the cementation unit.

% Cementation Unit

The cementation unit consists of an embedding glove-box (GB. 5) and a cement preparation and transfer system (closed loop).

% Embedding glove-box
The 400-l drum to be cemented, which is fitted with an internal lid, is placed on a Flip-Flop type two-position roller conveyor, which transfers the drum to the coupling position of the GB5 glove-box. The latter is similar to that of GB4.

A cementation funnel is activated by a jack fitted with a camera and ultrasonic (US) level detectors. The cementation tube (pipe) is motorised and can be locked in either of two positions: operating or idle.

Cement Preparation

The preparation is performed in a cold zone. After preparation, the cement is introduced in a closed loop fed by a pump.

Cement Filling and Monitoring

After preparation, a qualified pre-defined amount of cement is introduced into the 400-l drum. Monitoring of the cement level is ensured by US detection in the presence of an operator. After a cementation campaign, the secondary waste (liquid and solid) resulting from emptying and downwashing is collected and recycled.

After filling, the drum, which is equipped with an internal lid, is off-docked and transferred to a room for the cement to harden (2-3 days). It is then fitted with a second lid and monitored for any potential surface contamination. The transferable alpha surface contamination must be less than 0.04 Bq/cm².

Interim Storage Building for the Conditioned Alpha Radwaste

In order to store the 400-l drums, an interim storage hall facility is foreseen at the BELGOPROCESS site. This building is mainly intended for the interim storage of the following two categories of conditioned waste.

LAGA-L category: low activity alpha-contaminated conditioned waste.
RAGA-L category: low activity radium-contaminated waste. This waste results from processing and conditioning operations carried out in the BELGOPROCESS facilities.

BELGATOM was awarded a contract by ONDRAF/NIRAS to design and to ensure the follow-up at the manufacturing subcontractor’s premises and during erection at the BELGOPROCESS site. The building has two separate halls for each category (LAGA-L / RAGA-L), technical rooms and a reception/unloading hall (see Figs. 2 and 3). The capacity of this building is about 4000 m³, 2000 m³ of which are for the LAGA-L category.

It is an engineered facility built to last for a period of at least 70 years. The stored waste must remain fully retrievable with a view to subsequent transportation and disposal.

The reception/unloading zone is located on one side of these two halls, the other being left free to allow for future extension of the storage halls. The 400-l drums are stacked four high. A space of 0.05 m is left between the packages and a corridor, at least 0.8 m wide, is left clear around each stack.
The packages are lifted from their transport vehicle by means of a 30 kN overhead travelling crane in the reception hall and put on a wagon. The wagon transfers each package, via an air lock to a roller conveyor, which acts as a buffer storage. This operation is automated by means of a process controller located in the control room, which has three operating modes (automatic, manual servo-driver and intervention). From this conveyor, a 30 kN overhead crane with telescopic arm takes the package to storage. A room for inspection of the package is provided. The technical rooms include ventilation, electrical equipment and a control room.

COMMISSIONING AND START-UP TESTS OF THE SORTING AND CEMENTING UNITS

The commissioning and start-up test phase started at BELGOPROCESS in January 2002.

This phase followed the in-workshop erection and leak-tightness testing of the glove-boxes as well as a series of operating tests aimed at checking the basic performances of the most important sub-units.

The equipment was then re-assembled at BELGOPROCESS and the same tests were performed. A cold test phase aimed at testing the entire facility under normal operating conditions is now in progress.

Leak-Tightness Tests

Leak-tightness tests were performed for GB 1 to 4 and GB 5 with a depressurization of 1000 Pa. The measured leak rate was less than $10^{-3}$vol/h.

No special problems were encountered during the tests.

Operating Tests

These tests were successfully performed on the sub-units and in some cases led to introducing improvements.

220-l docking unit test

Two 220-l docking units are foreseen for the sorting facility. Removal of suspected waste from GB2 and introduction of the waste to be sorted into GB3 using a standard 220-l drum. From the transfer wagon (GB2) and from the tipping system (GB3) the coupling operations were tested in automatic mode. The gripping suction cups for the lid of the drum were strengthened to attain the necessary wrenching strength. 6 extra suction cups were required to reach a maximum wrenching strength of 600 kg.

400-l docking unit test

Two 400-l docking units are foreseen for the sorting and cementing facilities: removal of contaminated non combustible waste from GB4 and the cementing of the 400-l drum from GB5.

The 400-l drum of standard fabrication fitted with its internal lid is placed on the transfer system.
The transfer system is comprised of a Flip-Flop type roller conveyor (2 drums awaiting cementation) and a lifting table fitted with centring air cushions.

Once the drum is positioned on the conveyor, the transfer and coupling operations are carried out in an automatic sequence.

The gripping system for the internal lid which was initially comprised of a ball grapple has been replaced by a six-finger peripheral gripping mechanism operated by a ring gear motor. The internal lid fitted with a gasket seal is applied to the door. This system has proved to be very reliable during the tests.

The cementation funnel is fitted to the coupled 400-l drum using jacks. It is fitted with a camera and a level detector. The feed pipe which was operated manually during the initial tests has now been motorised. Cement filling of the drum and monitoring of the levels (low, normal and high) and automatic shutdown of the valve at high have been demonstrated.

COMMISSIONING AND START-UP TESTS ON THE INTERIM STORAGE FACILITY

The Civil Works of the building started in March 2001 and completed in June 2002. The commissioning and start-up tests of the interim storage equipment at BELGOPROCESS started in June 2002. This phase was preceded by in-workshop operating tests on the equipment.

- Overhead Cranes

The overhead cranes in the reception/unloading zone and in the storage halls have been assembled. Tests on these cranes operated from the control room were started in mid-August.

- Transport Wagon and Roller Conveyor

The transport wagon and the roller conveyor have been assembled. Tests were started in September 2002 and have been concluded with an operating test of the entire system. The following sequential tests programmed by a process controller have been checked (automation, safety and performance) for each storage hall:

- opening of the air lock door,
- removal and transfer of the drum onto transport wagon by means of the reception overhead crane,
- opening of the door of the roller conveyor and transfer of the drum,
- stopping and centring of the drum in the removal position by the crane in the storage hall.

Overall testing of the storage building supervised by the Safety Authorities was successfully performed at the end 2002 after completion of the operating tests on the equipment.

CONCLUSION

The tests carried out so far have shown that both facilities meet the design criteria.
Modifications of the equipment originally installed in the sorting and cementing units have led to introducing improvements particularly the docking system to glove-box.

Active commissioning of both facilities is scheduled for 2003.
Fig. 1 - Layout of sorting and cementing facilities
Figure 2.  Lay-out of building
Figure 3    Section of building 155
A3X : Sorting Unit  General View

Building 155 : Storage Hall