

CENTRALIZED TREATMENT FACILITY FOR LOW LEVEL RADIOACTIVE WASTE
PRODUCED IN BELGIUM

THE CILVA PROJECT

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1. INTRODUCTION

1.1. Purpose of the facility

The Belgium Nuclear Waste Management Agency, ONDRAF/NIRAS is intended by law with the safe management of all radioactive waste produced in Belgium.

The radioactive waste comes from :

- ▶ The seven nuclear power units (PWR) of Doel and Tihange;
- ▶ The former reprocessing pilot plant of EUROCHEMIC nowadays the BELGOPROCESS site in Mol-Dessel where decontamination and dismantling activities are going in;
- ▶ The two fuel fabrication plants of Mol-Dessel site (FBFC and BELGONUCLEAIRE);
- ▶ The production of radioisotopes in IRE (Charleroi-Fleurus);
- ▶ The nuclear and medical research in CEN/SCK of Mol and at universities;
- ▶ The use of radioisotopes in medicines and industry (small producers).

Due to rather limited amount of waste produced and the small size of the Belgian territory ($30 \cdot 10^3 \text{ km}^2$), ONDRAF/NIRAS strategy aims at centralizing treatment, conditioning and storage of radioactive waste produced on the site of its subsidiary company BELGOPROCESS at Dessel.

As the installations used up to now have become obsolete and out-of date, ONDRAF/NIRAS has decided to set up a new infrastructure : *the CILVA Unit*.

The CILVA facility, focused on the supercompaction and the incineration treatment, is an answer to the problems specific to Belgium. The general conceptual study of the CILVA unit has been performed by BELGATOM partners in 1989 and 1990 (TRACTEBEL Energy Engineering and BELGONUCLEAIRE) at ONDRAF's request.

BELGATOM is an architect and consulting engineering company providing a wide spectrum of nuclear engineering services. BELGATOM's contribution to the Belgian nuclear programme was of utmost importance, as the architect and consulting engineer for all nuclear power plants built in Belgium as well as for fuel fabrication, fuel reprocessing, plutonium recycling, radwaste management, treatment, storage and disposal.

1.2. Description of waste

The low level nuclear waste considered in the CILVA design are β, γ waste generalised by the above-mentioned activities. The β, γ radionuclides concentration in the collected waste packages is generally smaller than 5 GBq/m^3 ($0,1 \text{ Ci/m}^3$). Waste with a small amount of α emitters (limited to 50 m Ci/m^3) is accepted, if only preconditioned, to be treated directly by supercompaction and immobilized with mortar.

The waste are prepared in conformity with the criteria imposed by ONDRAF/NIRAS in technical specifications requiring, in particular, the sorting according to categories and the use of standardized packing. The main waste categories and the annual quantities to be treated are given as an indication :

- ▶ Combustible solid waste 1200 m^3
(from which 600 m^3 are precompacted to about 300 kg/m^3 in the NPP);
- ▶ Compressible solid waste 1150 m^3
- ▶ Various waste 80 m^3
- ▶ Liquid waste 60 m^3 .

Liquid waste are spent oils, organic and aqueous solutions. In general, the producers prepare the waste in a primary packing and these primary packages are transported by means of 210 l drums or of 1 m^3 s.s. container.

Large fraction of the waste originating from nuclear power plants has been preconditioned at the power plants : solid combustible waste and part of non combustible waste are shredded and precompacted, mainly to reduce the volume to be stored and transported.

The transport packing contact dose rate is, generally, lower than the authorized limit of 2 mSv/h (200 mrem/h).

2. THE CENTRALIZED TREATMENT CONCEPT

The project of the centralized treatment / conditioning infrastructure is partly represented on the simplified schema in figure 1, and on the lay-out drawing in figure 2.

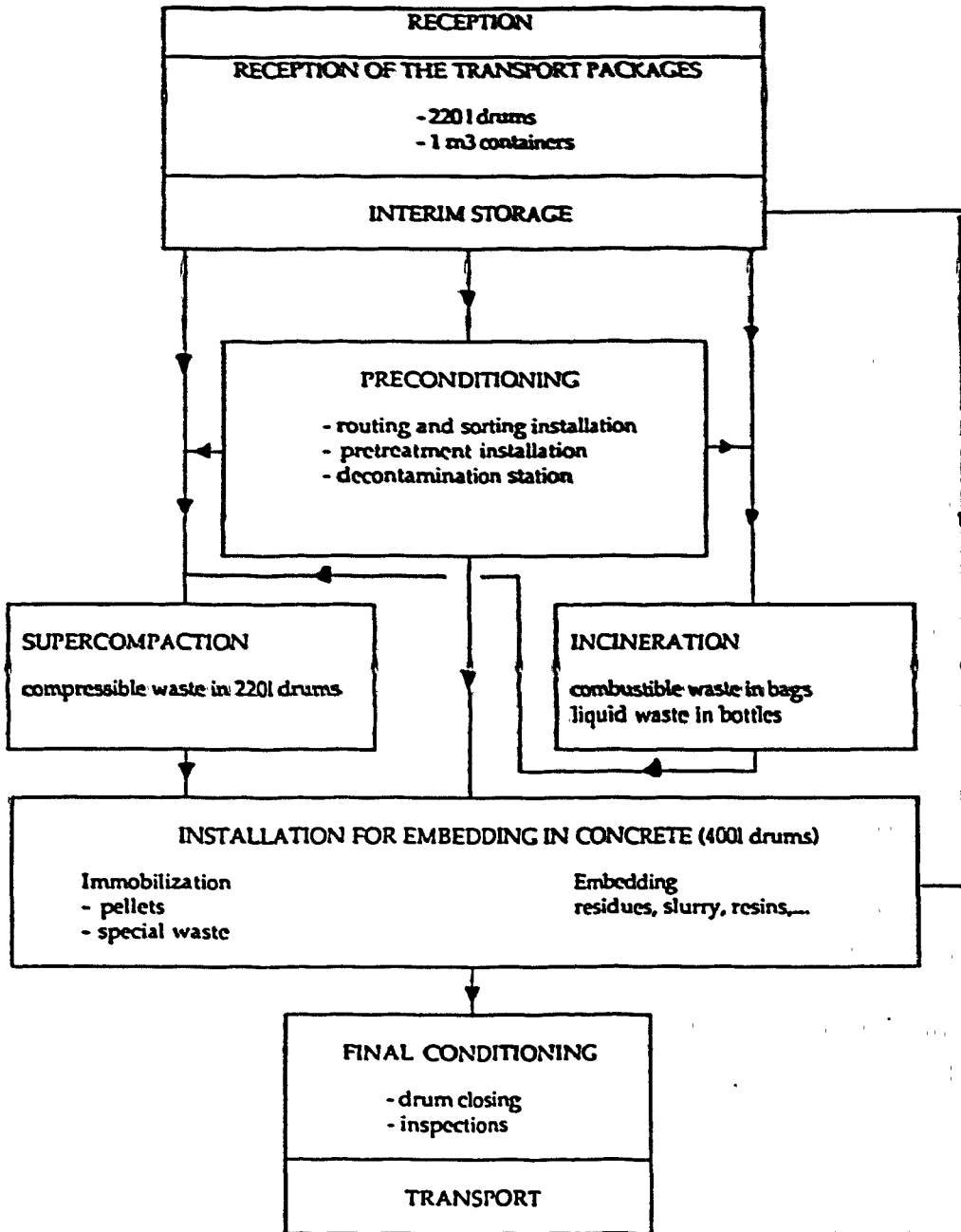


Figure 1 - Simplified functional scheme

The main installations of the project are :

- ▶ a reception, storage and distribution unit for the waste packages and for the necessary empty packages (210 l or 400 l drums);
- ▶ a waste preconditioning unit, including routing, sorting, precompaction and dismantling;
- ▶ a supercompaction unit;
- ▶ an incineration unit;
- ▶ a conditioning unit.

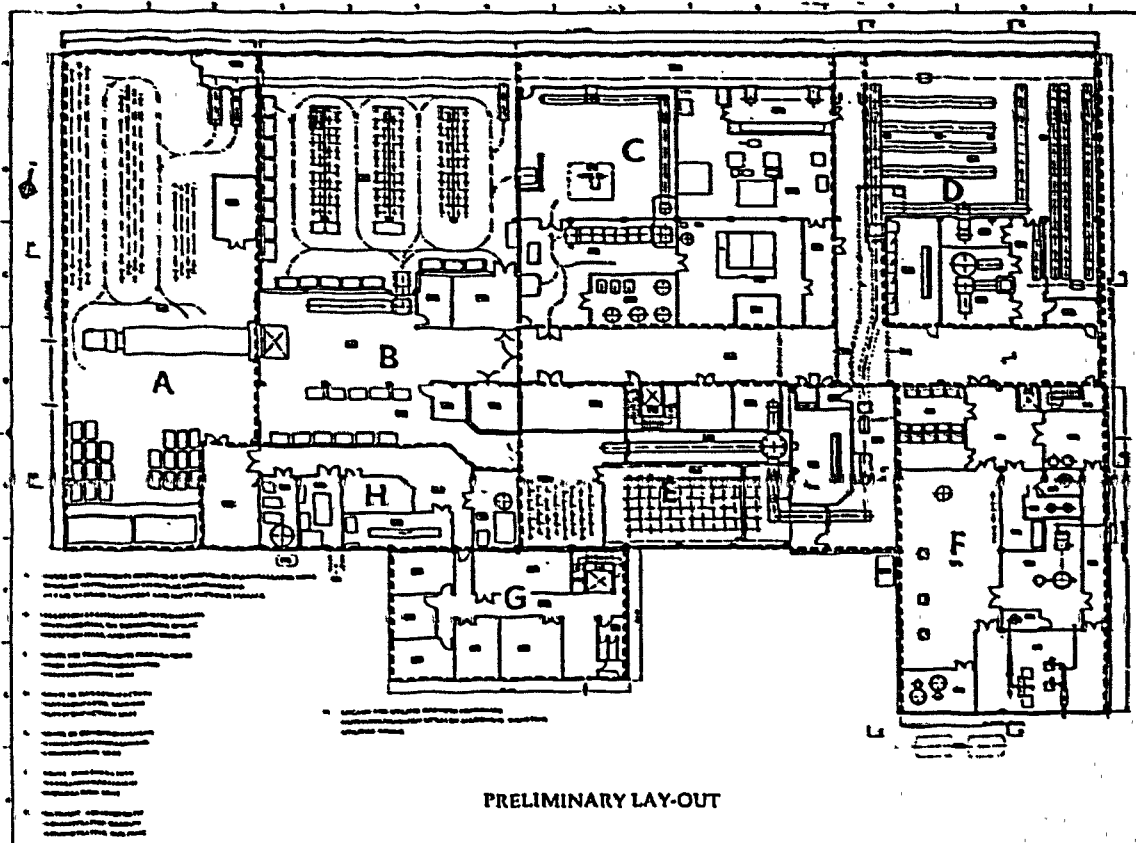


Figure 2 - lay-out

2.1. Reception / storage / distribution unit

A road transport reception hall and a waste package reception hall are enclosed in this unit. After administrative formalities are performed, the packages are unloaded and presented at the storehouse entry. In a room specially designed for that purpose, the operator can perform inspections not requiring opening of the packages (radiological measurement β and γ , and weighing).

After conformity checking the transport packages are identified and marked by application of a bar code with optical scanning to assure their follow-up and traceability during all the treatment in the CILVA facility. The operator has access to the computerized database collected by ONDRAF/NIRAS.

The transport packages (1 m³ containers and 220 l drums) are placed in the warehouse by a handling device. A 3 weeks production storage capacity is foreseen.

According to demand, the waste packages are removed from the warehouse and transferred by the handling device to the treatment units.

2.2. Waste preconditioning unit

Most of the waste has been prepared in advance by the producers in respect with the categories and criteria imposed by ONDRAF/NIRAS. These waste can be transferred directly to the main treatment unit. However, to allow periodical inspections, and the preconditioning of waste that is not in compliance with the criteria, CILVA comprises both a routing and sorting installations and a pretreatment installation.

In the routing and sorting installation, the transport packages are emptied, the primary package can be opened. The waste is then reassorted and repacked in function of the treatment required.

A pretreatment installation is designed to prepare the special waste e.g. ventilation filters that cannot be directly incinerated or introduced in a drum for supercompaction. Several techniques and tools have been planned : cutting up, precompaction, hydraulic shearing, and so on.

The waste that can be neither incinerated, nor treated by supercompaction is drummed in preparation for embedding in concrete.

The preconditioning unit comprises a decontamination station by pressurized steam allowing treatment of contaminated elements of the CILVA unit.

2.3. Supercompaction unit

The supercompaction unit reduce the volume of preconditioned waste by compression of the 210 l standard drums to pellet with a constant diameter using a 2000 T hydraulic press. The pellets are then piled up in a 400 l overpack drum.

Waste in the drum to be compacted are :

- ▶ metals, glass, concrete;
- ▶ prefilters and HEPA filters;
- ▶ charcoal filters;
- ▶ ashes from the incinerator;
- ▶ plastic material and so on.

The installation is fully automated and is composed of :

- ▶ an upstream storage area comprising roller conveyors transporting waste drums (210 l) to be compacted and empty overpacks drums (400 l) equipped with centring device;
 - ▶ the supercompaction cell including :
 - a drum inlet conveyor;
 - the supercompaction of 2000 T with an integrated piercing unit.
- This unit is designed to treat drums with small amount of α emitters. A special confinement with ventilation collect aerosols and dust during the compaction operation;
- the pellet unloading on an 8 positions turn-table with height measurement;
- ▶ the filling overpack cell for introducing the pellets into the 400 l overpack drum via an airtightness door avoiding any external contamination.

Its management system allow the optimization of the drums. It chooses one pellet from the 8 pellets stored on the turn-table in order to reach the maximum filling of the overpack drums.

After drum filling, the pellets are blocked by a special device combined with the pellet filler and the cover is put again on the overpack drum.

- ▶ a downstream storage area, comprising roller conveyors gathering the filled overpack drums to be transported to the conditioning unit where the pellets will be immobilized by mortar.

The capacity of the supercompaction unit is designed to treat at minimum 8 drums of 210 l per hour including :

- ▶ 210 l drum transfer from the upstream storage area;
- ▶ drum identification before compaction;
- ▶ compaction itself and pellet storage;
- ▶ 400 l overpack drum filling;
- ▶ transport of the filled overpack drum to the downstream storage area.

2.4. Incineration Unit

The incineration unit is designed to achieve :

- ▶ complete combustion of all burnable materials;
- ▶ appropriate flue gas cooling and cleaning (chemical pollutants, radionuclides) in compliance with the required emission limits;
- ▶ adequate radiological protection for operation crew and population;
- ▶ satisfactory control, measurements and recording of all significant operation parameters;
- ▶ as little as possible secondary waste production.

The capacity incineration is about 100 Kg/h for solid waste and 20 l/h for liquid waste. The main solid waste, in bags, are loaded into internal carriers adapted to the automatic furnace feeder. Biological wastes are frozen and stored in refrigerators before incineration.

Liquid waste is pumped to the incinerator, either directly from the transport packages or after having been mixed in an intermediate storage.

The offgases system assures the dry cooldown of the combustion gases. Filtration or smoke washing take care of carbon elimination, retention of dust particles, noxious elements and aerosols. Finally the gases pass through HEPA filters. The purified gases are released after dilution with the release of the extraction of the building ventilation.

The incineration ashes are collected in 210 l drums, in view of a following treatment by supercompaction in order to reduce their volume by a factor 2.

The design of the system, its control, the choice of its components, the provided safeties and redundancies must reduce the possibility of abnormal operating conditions occurrence.

Furthermore, if abnormal operating conditions occur due to internal or external causes, or in case of severe accidents, the design of the incineration systems allows a safe shut down of the plant without any risk to the operation crew and without unacceptable radioactivity release to the environment.

2.5. Conditioning unit

Conditioned waste produced in the CILVA facility must comply with Belgian acceptance criteria. This implies that all kind of waste have to be immobilized or embedded in the standardized 400 l drum used in Belgium power plant.

The conditioning unit is composed of two installations : one for immobilization and embedding and another for final conditioning.

Immobilization and embedding installation :

The installation includes a mortar preparation unit (reception, storage, dosering of cement and sand, mixing) for :

- ▶ waste immobilization in mortar of supercompaction pellets, special incombustible, incompressible waste.
- ▶ homogeneous waste like ion exchange resins, sludges, ... are embedded in a cement matrix, the resulting mixture is conditioned in drums.

Final conditioning installation :

After mixing solidification, a metal lid is shrunk on the conditioned waste drum.

An automate system inspect all the drums, check the absence of surface contamination, determine the main radiological characteristics, weight the drums and input these data in a computer management system before their evacuation. Then, the drums are evacuated by van, either to the interior storage building or, later, to the final storage site.

3. WASTE TRACEABILITY

In the CILVA building, the waste traceability is assured by a centralized waste management system which collects the information from the decentralized management systems that are located within the treatment units. This management is handled by personal computers. Bar code scanners allowing the identification of each package, are linked to the PCs in the treatment units. Each drum or package is provided with a bar code.

The full management of the waste is achieved from the centralized monitoring room.

The units having a management PC are :

- ▶ the reception, storage and shipment unit, and the passages;
- ▶ the preconditioning unit;
- ▶ the supercompaction unit;
- ▶ the incineration unit;
- ▶ the conditioning unit.

This centralized management is permanently linked to the units of the CILVA entity and the BELGOPROCESS computer centre.

4. PROJECT SITUATION

For the realization of the project, ONDRAF/NIRAS has entrusted BELGATOM with the assignment of Architect engineer covering essentially the programming of the files for the invitation to tender, the consultation and selection of instructions, the overall project management including management of the functional contracts, establishment and execution of the package interfaces functional test procedures, follow-up of fabrications, coordinating and supervision of the site activities, tests and other industrial commissioning activities.

The facility has been broken down into eight different functional package. The investment budget of the CILVA Facility may be estimated at about $1.2 \cdot 10^9$ BEF.

At this moment, all the functional packages have been ordered. The building is achieved, and the erection of the equipments is in progress in order to start the first test end of 93. The final commissioning is scheduled middle of 94.