CEA Decommissioning & Clean-Up Activities
Legacy Waste Management and Lessons Learned – 15506

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ABSTRACT

The CEA has generated radioactive waste in both liquid and solid form for more than 50 years within the scope of its R&D, clean-up and dismantling programs. The vast majority of the waste produced is transferred to disposal centers in approved waste packages. Nonetheless, a large quantity of legacy waste still remains in ageing facilities in which the storage conditions are sometimes no longer satisfactory with respect to the safety requirements that are constantly evolving.
As part of a broad clean-up and dismantling process focusing on these ageing facilities managed by the CEA, the top priority is to shut down nuclear activities on two symbolic sites: Grenoble and Fontenay-aux-Roses, which are both located in a dense urban environment.
After about ten years of dismantling, the nuclear facilities on the Grenoble site are on their way to be completely decommissioned in the regulatory sense of the term. Furthermore, the radwaste issue on this site has raised no specific problems, though it did require developing innovative and sometimes costly waste outlets.
The older Fontenay-aux-Roses site is where the first experimental research on minor actinide separation took place. The facilities on this site have reached a stage in dismantling which necessitates the recovery of irradiating legacy waste containing alpha, beta and gamma emitters. The transfer of this waste to interim storage centers more than 600 kilometers away is a decisive factor in reducing the site's nuclear source term and in ensuring the satisfactory progress of the dismantling operations.
This paper details the issues raised by the recovery of legacy waste, which requires greater characterization to better understand its radiological and chemical status. This waste also requires better characterization to meet the storage requirements of new sites designed for storage periods exceeding 50 years prior to its final disposal in a deep geological repository.
The issue of transporting waste on public roads is specifically covered, along with the strategy defined to securely transfer all legacy waste resulting from the CEA's very diverse R&D programs.
Emphasis is placed on finding the right balance between collecting the necessary data on the waste to be transported, ensuring the reconditioning of this waste so it can be transported safely, and maintaining an efficient industrial-scale waste transfer process to limit the lead times and costs related to legacy waste recovery operations.

INTRODUCTION

In 2006, Act No. 2006-686 of June 13, 2006 on nuclear safety and transparency and its application decree set the current regulatory framework relating to the dismantling and decommissioning of licensed nuclear facilities.
At the same time, Act No. 2006-739 of June 28, 2006 on the sustainable management of radioactive materials and waste defines the general orientations for the management of radioactive waste with respect to:

- Future deep geological repositories for high-level waste (HLW) and long-lived intermediate-level waste (LL-ILW)
- Waste management based on recycling and the optimization of operational disposal facilities containing very-low-level waste (VLLW) and short-lived low- and intermediate-level waste (SL-LILW)

- French national waste inventory which is updated every three years, together with the French national radioactive material and waste management plan (PNGMDR) which defines the French general strategy for nuclear waste management.
- Securing the financial assets of nuclear operators so they have the means to dismantle their facilities in the short, medium and long term, as well as retrieve the waste produced for disposal.

Since 2006, numerous regulations resulting from the French Waste Act define the requirements applicable to the conditioning, interim storage and disposal of waste packages, so as to ensure:

- Operational safety while the current disposal sites are being filled and the safety of the future deep geological repository which will operate on a centennial scale from 2025.
- Environment conservation and public protection requirements during the final disposal phase in compliance with the French public health code, which requires understanding the long-term behavior of the waste packages placed in deep geological storage.

The vast majority of the waste produced is transferred to operational disposal centers in approved waste packages. Nonetheless, a quantity of legacy waste still remains in ageing facilities in which the storage conditions are sometimes no longer satisfactory with respect to the safety requirements that are constantly evolving.

The retrieval of legacy waste is therefore a major issue for the CEA and is as important as the dismantling of its nuclear facilities. The recovery of legacy waste is often a prerequisite before being able to dismantle the facility in which it was produced and/or stored, thus representing a major milestone on the critical path of any dismantling project.

In the case of CEA legacy waste which is essentially classified as LL-ILW, the specifications for its acceptance into the deep geological repository are currently not finalized. Draft specifications were drawn up in 2014 but they are certain to evolve right up to publication of the licensing decree for the deep geological repository expected in 2017. The specifications will only be validated from 2025 during the site commissioning phase.

The technical and economic stakes at hand are considerable considering that existing and future waste packages may not be accepted into this repository owing to the constantly evolving acceptance criteria.

The CEA is faced with this very uncertain situation seeing that a fraction of its LL-ILW is qualified as having low (FI) or intermediate (MI) dose rates FI (as opposed to waste with high dose rates HI). This (FI and MI) wastes are transferred to LNF No. 37 on the CEA Cadarache site to be conditioned either in 500 L packages for intermediate dose rates or in 870 L packages for low dose rates. They are then temporarily stored on site pending the commissioning of this deep geological repository.

These packages comply with pre-defined requirements that have been approved by ANDRA, the future operator of the repository. They may, however, prove insufficient once the safety examination (currently underway) has been completed by the French Nuclear Safety Authority (ASN).

In the case of highly irradiating LL-ILW which is not authorized in LNF No. 37, the CEA has decided to store this waste in special containers in an interim storage facility called DIADEM for a period of about 50 years.

Following this storage period, the CEA intends to condition this waste and send it either to a surface disposal site or to a deep geological repository. This will depend on the type of radionuclides in the waste, its level of residual activity and its radioactive decay.

It is within this context that the waste produced or to be produced at the Grenoble and Fontenay-aux-Roses sites has been integrated into an overall clean-up and dismantling process concerning all old CEA facilities.

This paper provides an overview of the situation at the two sites, together with their historical context and the prospects of retrieving waste that will eventually be stored in the DIADEM facility at the Marcoule center.

The transfer of this waste to the MARCOULE interim storage center more than 600 kilometers away is a decisive factor in reducing the site's nuclear source term and in ensuring the satisfactory progress of the dismantling operations.
After having described the means needed to carry out these waste conditioning, transport and interim storage operations, this paper details the issues raised by the recovery of legacy waste, i.e. the radiological and chemical status of such waste and its interaction with the interim storage containers. This waste also requires better characterization to meet the intermediate storage requirements of the DIADEM facility. The issue of transporting waste on public roads is also covered.

Emphasis is placed on finding the right balance between collecting the necessary data on the waste and maintaining an efficient industrial-scale waste transfer process to limit the lead times and costs related to legacy waste recovery operations.

Grenoble and Fontenay-aux-Roses Centers

Both the Grenoble and the Fontenay-aux-Roses centers are located in a dense urban environment.
Nuclear materials intended for industrial nuclear power plants have been developed in particular at the Grenoble center. Numerous experimental irradiations were conducted in the Mélusine, Siloette and Siloe reactors, which have all since been completely dismantled.

The Fontenay-aux-Roses center was home to experiments and developments related to the reprocessing of spent fuels and the separation of minor actinides. This research foreshadowed the R&D facility called Atalante at the Marcoule center, as well as the industrial-scale spent fuel reprocessing facilities (UP1) on the same site and the Areva facilities (UP2 and UP3) at La Hague.

Grenoble Center

After about ten years of demolition, the nuclear buildings are now totally dismantled (three pool reactors, a hot laboratory and an effluent and solid waste treatment station). The Grenoble nuclear site is on the way to be completely decommissioned in the regulatory sense of the term. Four licensed nuclear facilities have already been decommissioned and decommissioning of the waste treatment building is expected in 2015.

Figure 1: View of the Grenoble center

Nuclear waste with low and intermediate dose rates (200 m3, i.e. 280 bins) produced during the operation of the reactors and the dismantling of experimental devices in pools has been removed and transferred to the Cadarache center (LNF No. 37).

A very small quantity (60 bins) of highly irradiating waste was produced when reactor internal structures (core support grids, etc.) and the parts of experimental devices subjected to high neutron fluxes were dismantled. They could not be accepted into LNF No. 37 owing to their high dose rates so they have been transferred to the Saclay center pending their storage in the new DIADEM facility.

The waste produced generally tends to be metallic. The quantity of waste containing alpha-emitting radionuclides is very small and raises no specific problem in terms of criticality and radiolysis phenomena since there are no organic compounds.

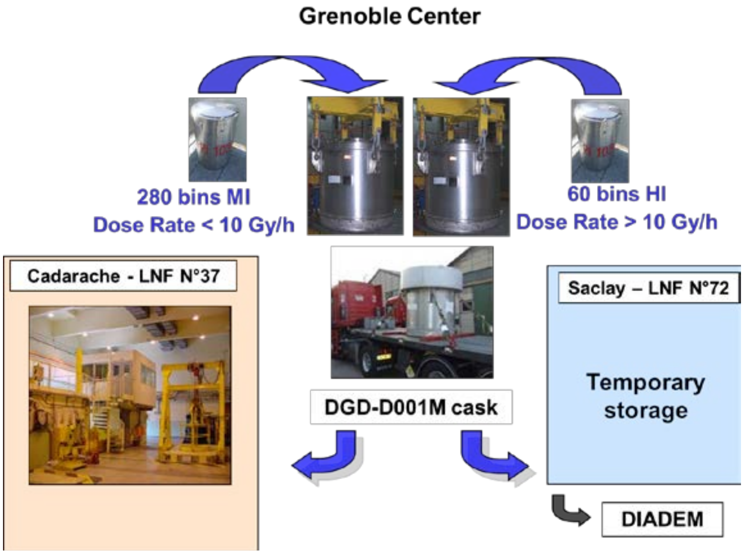


Figure 2: GRENOBLE LL-ILW routes

The type and quantities of waste are not comparable to those produced by fuel cycle facilities such as those at the Fontenay-aux-Roses center.

Fontenay-aux-Roses Center

The Fontenay-aux-Roses CEA center is located 7 km south of Paris. Created on March 25, 1946, it was the first CEA center to host France's first atomic pile called ZOE (licensed nuclear facility No 11).

In addition to ZOE, the following second-generation facilities were built in the late 50s and early 60s: the critical mockup called MINERVE (LNF *12*), the pool pile called TRITON (LNF *10*), and a number of radio-metallurgy (LNF *58 and 59*), radiochemistry and chemical engineering facilities for the reprocessing of spent fuel (LNF *57*), not to mention facilities for the treatment and interim storage of solid and liquid waste (LNF *34 and 73*) which were required in order to continue the research programs.

The TRITON pile and the plutonium metallurgy facilities (LNF 58 and 59) were the first facilities to be shut down and dismantled in the eighties. The pool and the hot cell structures of TRITON were demolished so the building could be used for other purposes. The glove boxes in NLF 58 were transferred to another facility at the CEA Cadarache center. LNF 59 (*RM1 and RM2*) underwent phased dismantling. The research equipment and shielded cells in Building 52/2 (part of RM2) used for examining spent fuel were cleaned up and then dismantled in the 90s. The structural concrete of the cells in this facility is currently being dismantled as part of the CEA-FAR Licensed Nuclear Facility decommissioning program. As for RM1, the premises were re-used as offices after clean-up.

Clean-up of the equipment in LNF 57 (*Building 18*) began once the research and development work had been completed (*June 1995*). The goal of the clean-up was to reduce the radiological and chemical hazards during the dismantling work and minimize the amount of high-level waste produced. These operations involved: treatment and packaging of radioactive material, removal of radioactive sources, pumping out, treatment and removal of aqueous and organic effluents, decontamination of tanks, piping and containment vessels, and removal of waste and mobile equipment.

After production, solid wastes were placed in interim storage in Buildings 58 (part of NLF 73).

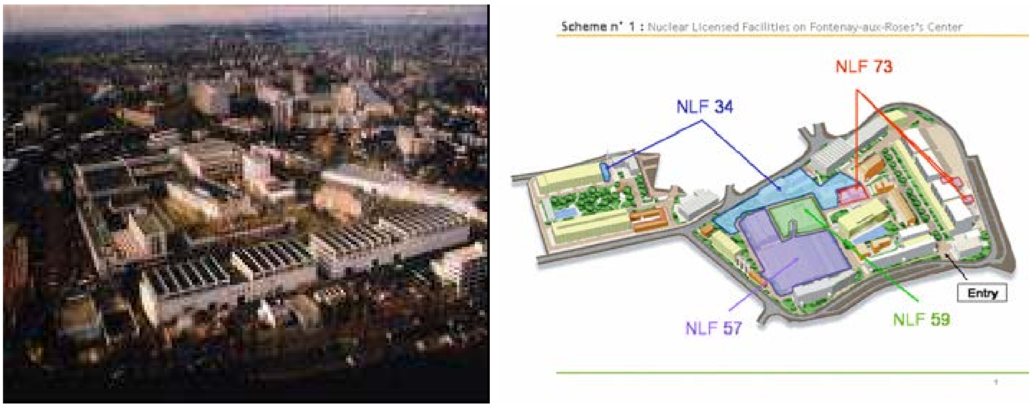


Figure 3: Aerial view and schematic diagram of the Fontenay- aux-Roses center

Issues and Outlets for Legacy Waste from Fontenay-aux-Roses

There are three different sources of radiation-emitting waste at the Fontenay-aux-Roses center.

The first source is located in Building 58, where around 1,200 50L drums containing radiation-emitting legacy waste are stored in wells.Today, in order to be able to dismantle this building, the legacy waste first has to be removed and transferred to a specific interim storage facility.

The second source is the waste produced from the ongoing dismantling of the shielded lines in Building 18. It will generate around 600 *La Calhène* containers (PLC) of irradiating alpha-beta-gamma waste from 2014. Up to now, the process involves transferring the PLCs into Padirac casks and conditioning them in Building 10 in 50 L drums with polyurethane centering devices and epoxy plugs to avoid the spread of radioactivity. These drums are then transferred to Building 58 for temporary storage. Acceptable drums (depending on their content and radioactivity level) are sent to LNF 37 at the CEA Cadarache center. Around 80 drums a year are produced and shipped to LNF 37.

The third source will result from the dismantling of the PETRUS shielded line located in Building 18. This project will be particularly challenging and will produce around 1,000 more drums.

Globally, 50% of the inventoried waste from the Fontenay-aux-Roses center cannot be accepted by LNF 37 at the CEA Cadarache center. Legacy drums in Building 58 will not be acceptable due to an excessively high level of radioactivity and the ill-defined contents of these drums. Approximately 200 drums from the dismantling of PETRUS will not be acceptable due to their excessively high level of radioactivity, despite the fact that their contents will have been clearly specified for the needs of intermediate storage.

Significant Means Devoted to the Retrieval, Transfer and Interim Storage of Legacy Waste from the Fontenay-aux-Roses Center

The new means to be deployed are significant both from a technical and a financial viewpoint:

- A process for recovering waste using a measurement and conditioning device (MCD) will be installed at the Fontenay-aux-Roses center and commissioned in 2018
- A new transport cask is currently being developed and will be commissioned in 2015
- The licensing procedure is currently underway for an irradiating waste interim storage facility, expected to be commissioned in 2018 at the Marcoule site in the south-east of France.

Measurement and Conditioning Device (MCD) at the Fontenay-aux-Roses Center

The current conditions for producing waste packages that can be transferred to LNF No. 37 are based on old techniques that were elaborated during the last series of R&D programs and specifically developed for small quantities of waste produced annually. A special device has been designed to optimize the volume of waste which will be sent to both the CEA Cadarache center and to the DIADEM temporary storage facility at Marcoule, while complying with the ½ DIADEM containers acceptable for both the DIADEM facility and LNF 37. This device is expected to be commissioned in Building 58 in 2018. This measurement and conditioning device (MCD) will be used for the radiological characterization of waste, as well as for waste volume optimization and conditioning into containers.

The MCD device will be designed to receive 50 L drums directly. The conditioning stage in Building 10 will be eliminated, which was time-consuming in container production.

The device will therefore be designed to:

- Receive waste: 50L drums from Building 58
- Radiologically characterize drums
- Open and recondition waste into ½ DIADEM: volume optimization will reduce approximately five 50 L drums to one ½ DIADEM
- Store containers before transfer
- Load containers into transfer casks.

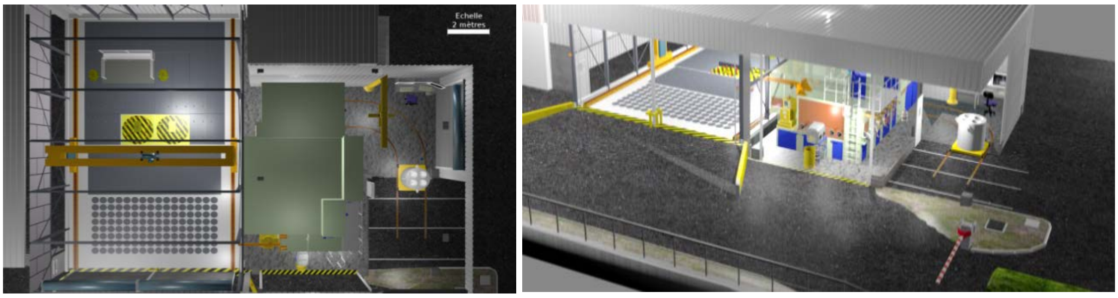
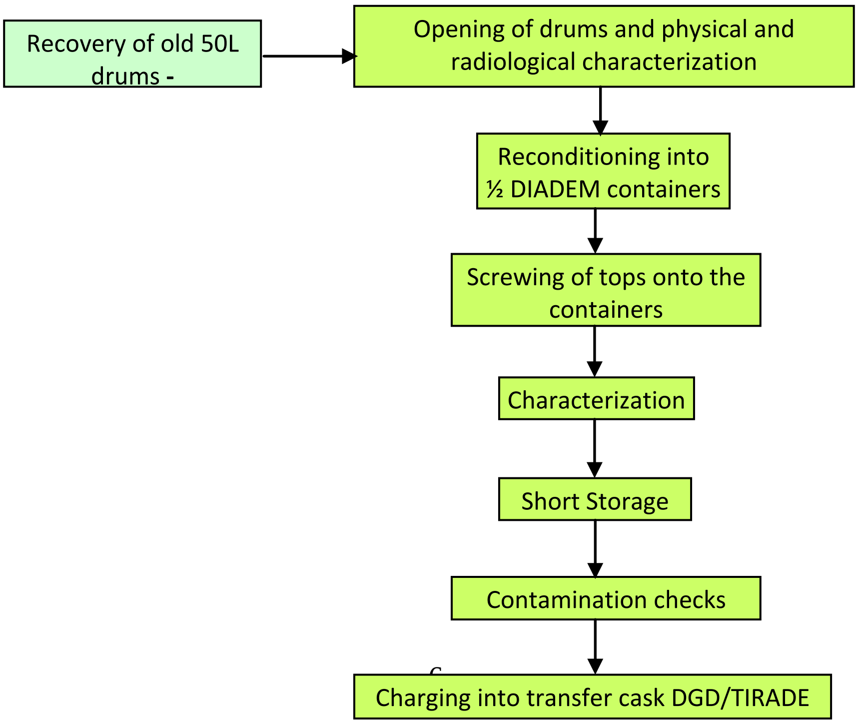


Figure 4: Schematic diagram of the MCD device + storage area

The removing of legacy waste from Building 58 is expected to be finished around 2023.

The functionalities are presented below:



New Cask Designs and Transportation

Transporting the waste 600 kilometers to the dismantling center is a key issue for the success of the CEA's projects. The CEA has therefore designed, licensed and manufactured a wide range of nuclear transport packages to cover its own varied needs.
With respect to the Fontenay-aux Roses dismantling activities, multiple radwaste transport operations have been carried out using the DGD-D001M cask with the final destination being the CEA Cadarache center (LNF No. 37).
The DGD-D001M cask was designed to transport technological waste containing radiolysable materials (organic material such as polyvinyl chloride, cellulose, etc.) resulting from hot cell and dismantling activities.

Figure 5: View of the DGD-D001M cask

To transport this type of waste, the application for cask approval requires a complete and thorough safety demonstration in which flammable gas generation mechanisms like radiolysis have become a major issue. The DGD-D001M was commissioned for the first time in 2006. As the conceptual design of this cask did not include this demonstration at the time, this cask is limited in terms of the waste quantities (only three drums) and decay heat levels to avoid radiolysis issues. Moreover, this cask is used with an inert gas atmosphere.
To resolve issues associated with the transport of legacy waste, the CEA designed a number of packages and primary containers capable of withstanding mechanical stress in the event of an internal explosion.
The CEA is also currently developing a new cask called TIRADE, which better meets the safety requirements:

- Design based on a primary container able to withstand mechanical stress resulting from an internal explosion caused by radiolysis gas (safety demonstration with real tests including pressure load measurements)
- Possibility to transport larger waste quantities with significantly higher decay heat levels (up to 5 drums compared with 3 in the DGD-D-001M cask)
- Improved radiation protection measures to enable the transport of higher-level radioactive waste
- TIRADE can adapt to various internal arrangements offering the possibility to transport waste in 50 L, 60L or ½ DIADEM and DIADEM drums
- Two different loading processes are possible, which means that many facilities can use TIRADE.

Figure 6: Views of the Tirade cask and basket

The CEA also developed a multi-facetted approach based on improving knowledge of both hydrogen gas generation and oxygen consumption in waste materials. The CEA launched a number of experimental studies to collect gas generation data specific to the various types of transportation conditions. The type of waste under investigation was alpha-bearing waste containing organic material such as polyvinyl chloride or cellulose. The alpha particles emitted in alpha-bearing waste were simulated by high linear energy transfer particles. The data was then used to demonstrate that flammable conditions inside casks can never be reached during transportation.

DIADEM Interim Storage

The CEA decided to build an interim storage facility for alpha, beta and gamma waste with intermediate to high dose rates in 2008. This facility called DIADEM will be built on the CEA Marcoule site. This choice of location lies in the fact that most of the irradiating waste to be stored will actually be produced at the Marcoule site (dismantling of the Phenix fast reactor and the APM fuel dissolution workshop). A considerable proportion of the waste will also come from the Cadarache center which is only 150 km away. This waste will result from the dismantling of the Rapsodie fast reactor prototype.

The DIADEM facility is designed to receive up to 460 m3 of conditioned waste. The amount of waste requiring storage is estimated to represent about 2,000 containers, i.e. about 90% of DIADEM's maximum capacity.

Figure 7: Waste sources

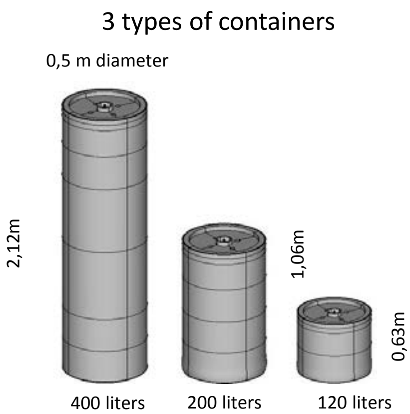


Figure 8: DIADEM containers

Location and Description of the DIADEM Facility

DIADEM will be built in the north-east of the CEA Marcoule site. The facility will comprise a single-block building that will be 19 meters high and cover a surface area of 52 by 58 meters. It will be divided into 3 zones: 1) Truck unloading area, 2) ventilated storage cell (260 storage racks with a height of 10.20 meters and cooled by air) and hot cell, and 3) service rooms (Figure 4).

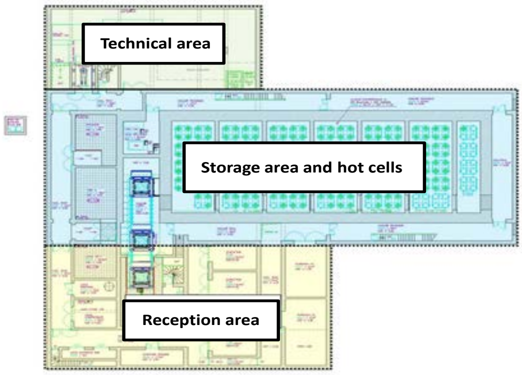


Figure 9: Schematic diagram and floor plan of the DIADEM facility

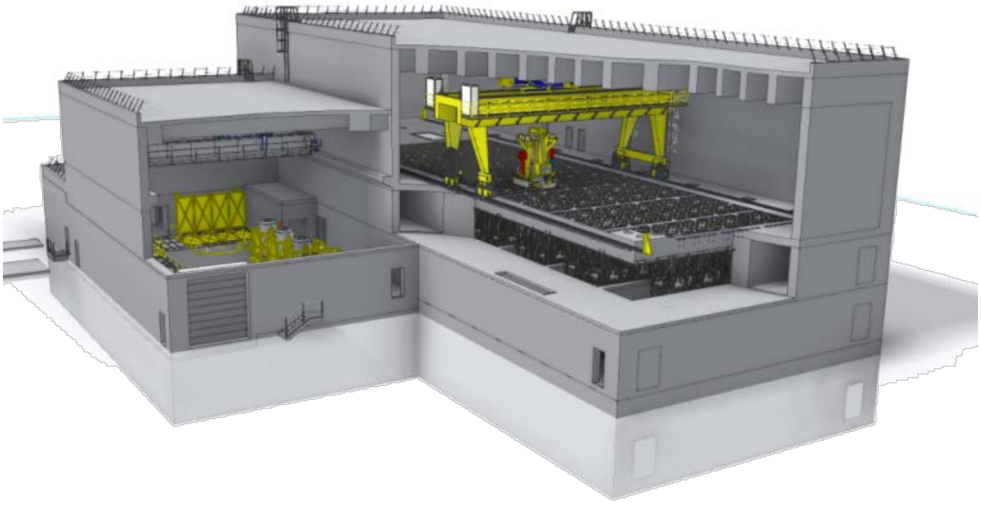


Figure 10: DIADEM description

Waste Conditioning and Acceptance Specifications

The waste will be conditioned in stainless steel leaktight cylindrical containers with a thickness of 8 mm and a diameter of 50 cm. The lids will be welded onto the containers in the DIADEM facility before storage in the case where this has not already been done by the dispatching facility. Three types of containers will be used by waste package producers:

- ½-size DIADEM containers that are 0.625 m high
- Full-size DIADEM containers that are 1.06 m high
- A4 containers that are 2.12 m high.

Legacy waste from Fontenay-aux-Roses will be conditioned in ½-size DIADEM containers and may contain up to 100 g of radioactive material (U, Pu, etc.), which is much higher than the actual estimated quantity. The storage facility is designed so that the risk of criticality is always under control regardless of the conditions (normal, incident and accident conditions).

The level of external contamination on the containers must be as low as possible and in any case less than or equal to 100 Bq/cm² at any point for beta and gamma emitters, and less than or equal to 10 Bq/cm² for alpha emitters. The contact dose rate of these containers must not exceed 680 Gy/h.

According to a provisional inventory of the waste to be stored in DIADEM, the total radioactivity in the storage cell will be below $1.3.10^{16}$ Bq for alpha emitters and $7.4.10^{17}$ Bq for beta-gamma emitters.

Operation of the DIADEM Facility

The following operations will be carried out for each container delivered to the DIADEM facility:

- The casks will undergo acceptance and inspection
- The containers will be conditioned for storage and checked for contamination, with decontamination and lid welding operations performed where necessary
- The containers will be placed in storage and monitored
- Container integrity will be maintained throughout the interim storage period
- The waste will remain traceable.

The facility is also designed so that containers can be removed from any location in the storage cell at any moment for inspection. A limited number of racks will be left vacant on a permanent basis for the purpose of such inspection operations. Compensatory measures will be applied in the event the inspection results are unsatisfactory. The container in question may be sent to another facility nearby for assessment and conditioning in an extra container.

During its operational phase, DIADEM will manage any effluents and radioactive waste (small amount) it produces, such as;

- Liquids possibly containing condensates from the storage cell recovered at the base of the stack. These liquids will be collected and dispatched to a treatment facility on the CEA Marcoule site
- Gases from the facility ventilation system which may entrain radioactive products in the event the first containment barrier (a container) fails. These gases will be filtered and checked
- Solids from the conditioning cell. They will be sorted according to their radiological characteristics.

During its operational phase and depending on the flow of waste packages, this licensed nuclear facility will employ about ten people. There will be four different operational periods during the lifetime of this facility:

- T0 to T0+5 years: filling phase with a high flow of waste packages arriving at the facility, thus requiring a full team of about 10 people working 2x8 hour shifts
- T0+5 to T0+10 years: filling phase at nominal flow, thus requiring a full team working normal hours (1 x 8 hours)
- T0+10 year to start of waste removal: filling phase with a low flow of waste packages arriving at the facility, thus requiring a smaller team (5 or 6 people) working normal hours.

The waste cask arrival rates have been analyzed in depth to avoid any impact on the removal programs for waste produced by the dispatching facilities. The acceptance of 200 casks per year corresponds to the facility's maximum capacity with a full team doing shift work. This should meet the storage requirements associated with legacy waste retrieval and waste produced during the dismantling of various facilities.

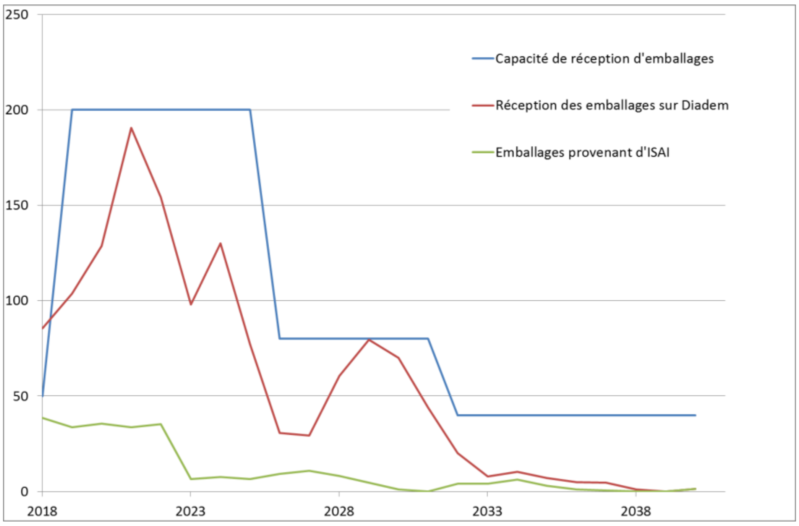


Figure 11: Estimated cask deliveries to the DIADEM facility

The budget allocated to the construction and commissioning of the DIADEM facility is €80 M, which will employ 50 to 100 people.

Legacy Waste and Key Issues

An important issue arising from the aging of the drums stored temporarily in Building 58 is the uncertainty on the exact and detailed nature of the different contents that need to be known to ensure waste traceability: alpha-beta-gamma composition, chemical components, no liquid components, etc. In this particular case, these uncertainties make it impossible to transfer these drums to the DIADEM interim storage facility.

The waste removal operations necessitate relatively sophisticated studies to establish safety cases and collect the information necessary to obtain the authorizations required by law.

We have to demonstrate that retrieving 50 L drums from wells in Building 58 does not represent an unacceptable risk due to any hydrogen produced by radiolysis or an explosion hazard due to the presence of products containing nitrocellulose. The demonstration will be extremely challenging and mainly based on traceability, the historical data of drum production, the destructive analysis of drums, and the analysis of hydrogen in the wells.

To manage the risk of hydrogen excursions during operations, active safety systems utilizing ventilation or inert gas blanketing may be employed if feasible.

The process of removing waste from wells represents a number of new hazards which may even exacerbate the existing hazards. It must be accepted that there may be a relatively short-term increase in risk due to the hazards introduced by the processes and engineering changes involved. In principle, this is considered acceptable due to the overriding requirement to remove the inventory from the plant as soon as practicable.

Generally, many hazards associated with waste retrieval can ultimately lead to a loss of the old containment system, with the potential spread of radionuclides and an increased dose for operators. This must be minimized though placed within the context of the urgency in removing the inventory.

It is essential to be able to characterize waste before it is placed in a DIADEM container. Radiological characterization by means of gamma measurements is needed to determine the gamma-emitting radionuclides in the waste. It is also important to determine the quantity of plutonium in the waste based on the content of americium-241 which is itself a gamma-emitter, and the nuclear spectra that represent the years of research having been carried out in these facilities.

The measurement and conditioning device (MCD) will be used to sort legacy waste during the reconditioning phase, thus making it possible to limit the quantity of organic compounds (polyethylene, polyvinyl chloride, etc.) placed in the waste bins during clean-up in the old facilities.

This sorting process will help eliminate any liquids contained in the waste. There is still some uncertainty on the level of moisture considered acceptable in the waste to be conditioned.

The transport of legacy waste likely to generate hydrogen due to the hydrolysis of organic compounds has led us to develop a special transport cask whose primary container design is capable of resisting any hydrogen explosion or leakage.

As part of its explosion risk analysis for the storage of DIADAM containers, the CEA assessed the radiolytic yields of the organic compounds potentially found in the containers. The assumptions applied in particular to the energy of the alpha radiation deposited in the materials at risk of radiolysis led to a calculated hydrogen maximum production rate of 800 mL/W/day, which is reasonably conservative.

The containers designed to hold waste with a risk of radiolysis are equipped with 4 filters made from sintered metal to allow for the release of hydrogen.

The storage of DIADEM containers for long periods is possible on the condition that any corrosion phenomena likely to occur are minimized by using 316L stainless steel. Despite the sorting process, all waste conditioned in DIADEM containers may still contain small quantities of cellulose, plastic and resin whose decomposition under irradiation is capable of producing chlorides and fluorides, thus resulting in the risk of corrosion by pitting due to the moisture.

In the case of the gaseous hydrochloric acid, the gas will diffuse towards the four sintered metal filters equipping the container lid. The presence of condensed hydrochloric acid in the filter is capable of causing material corrosion and partially blocking the filters, which would thus lose their hydrogen removal function.

Legacy waste is capable of containing cerium, manganese, graphite and sliver in small quantities owning to the different R&D programs conducted over the years. If solubilized in the moisture, these elements can generate powerful oxidants that can increase the risk of corrosion and lead to pitting or even local intergranular corrosion.

Before commissioning the DIADEM facility in 2018, the CEA must first define and qualify a program to monitor the risk of corrosion of the stainless steel containers, as well as the risk of blockage in the sintered metal filters equipping the container lids.

CONCLUSION

Cleaning up the CEA's historical sites such as those in Grenoble and Fontenay-aux-Roses is a top priority owing to the close proximity of its nuclear facilities with densely populated urban areas.

The entire clean-up of the Grenoble site was completed in 2012. ILW are located at Saclay center in a temporary storage.

The ILW from Grenoble and Fontenay aux Roses centers will be sent to the Marcoule site from 2019. The storage conditions in the DIADEM nuclear facility will comply with the most recent safety standards while meeting the post-Fukushima requirements defined after the stress test performed in 2014.

Before operating the DIADEM facility in 2018, the CEA must first define and qualify a program to monitor the risk of corrosion by pitting of the stainless steel containers, as well as the risk of blockage in the sintered metal filters equipping the container lids.

The waste sorting operations from Fontenay aux roses center intended to collect as much information as possible on the waste, should make it easier to subsequently compile the final waste packages for disposal in a deep geological repository. Nevertheless, as progress is made on defining the specifications for the deep geological repository, the feasibility of using a cementitious hydraulic binder to condition the waste should be assessed at regular intervals.

Our ultimate aim during the second half of the century will be to develop and produce a waste container suitable for final disposal in deep geological storage.