Treatment of G1 Baskets at the CEA Marcoule Site – 12027

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ABSTRACT

In the dismantling program for the first-generation French reactors in accordance with the nonproliferation treaty, the CEA is in charge of cleanup and dismantling operations for the facilities at Marcoule, including the decladding units.
The G1 decladding was built between 1955 and 1957 in order to declad spent fuel elements from the G1 plutonium-producing reactor and prepare them for dissolution. The facility was also used for interim storage of G1, G2 and G3 fuel dissolution baskets, which had been used during plant operation for transfer (from the decladding facility to the UP1 plant) and/or dissolution of spent fuel elements.
One of the cleanup projects involves recovery of the baskets, which will be cut up, sorted, and conditioned in metal bins. The bins will be immobilized with cement grout, then transferred to the onsite solid waste conditioning facility (CDS) and to the repository operated by the French National Radioactive Waste Management Agency (ANDRA).

The project is now in progress, after special safety permits were issued and measurement stations and dedicated tools were developed to handle all types of baskets (which differed according to their origin and use). The disposal of all the baskets is scheduled to last 2 years and will produce 55 metal waste bins.

INTRODUCTION

The G1 decladding facility near the G1 reactor was built mainly for decladding and interim storage of fuel in the uranium store pending transfer to the UP1 plant for dissolution. It was primarily used as an interim storage area for G2-G3 fuel dissolution baskets. The uranium store in the G1 mechanical decladding facility was used for interim storage of spent fuel from various reactors. The fuel was placed in dissolution baskets, which were subsequently transferred to the UP1 plant for dissolution until its shutdown in 1997. The wide range of fuel reprocessed in UP1 led to the use of several types of baskets. Some of were later used to store irradiating waste and miscellaneous waste arising from dismantling the equipment in the decladding units.
The uranium store in the G1 decladding facility is at the center of a series of auxiliary rooms used during plant operation, and which continue to be used as entry or exit points during the dismantling phase. They include the following:

- a handling area providing access to the uranium store via an access hatch on the North side,
- the uranium store containing the dissolution baskets,
- the Suter airlock, a waste exit route.

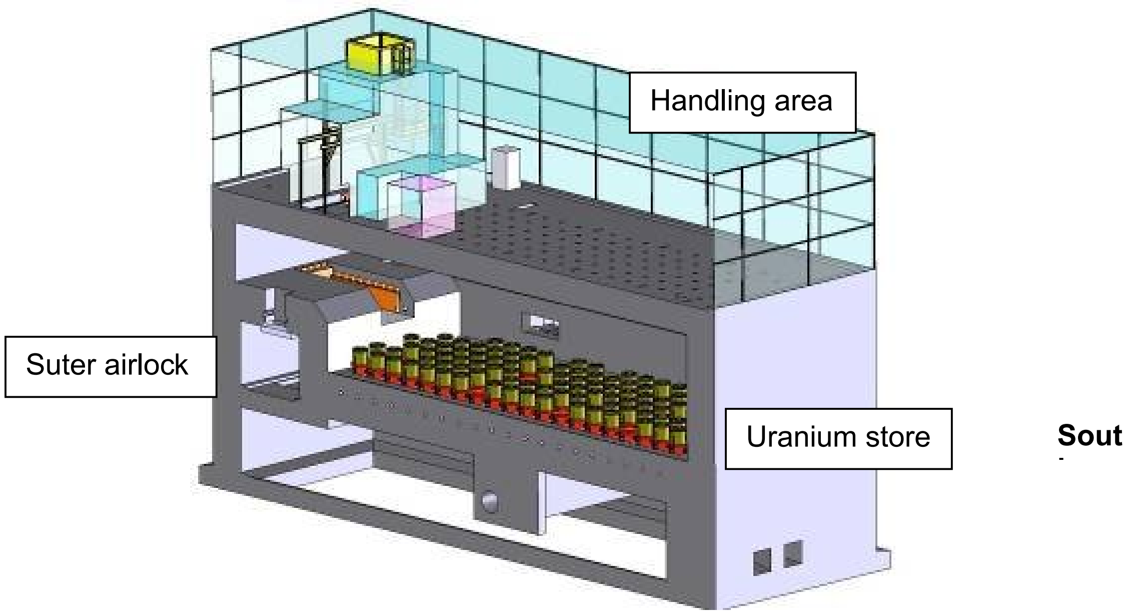


Fig 1. Cutaway view of G1 decladding facility

METHOD

The outside dimensions of the uranium store are 32 m × 10 m × 6.7 m, and the concrete walls are 2 m thick. The store is classified in zone 4 (red). There are 120 storage receptacles (20 rows with 6 receptacles each) with 94 dissolution baskets currently in place.
Each basket is 1840 mm high and 830 mm in diameter, with a maximum empty weight of 286 kg.
During plant operation, the dissolution baskets became increasingly contaminated. The measured dose rates range from a few micrograys per hour to 1 mGy/h.

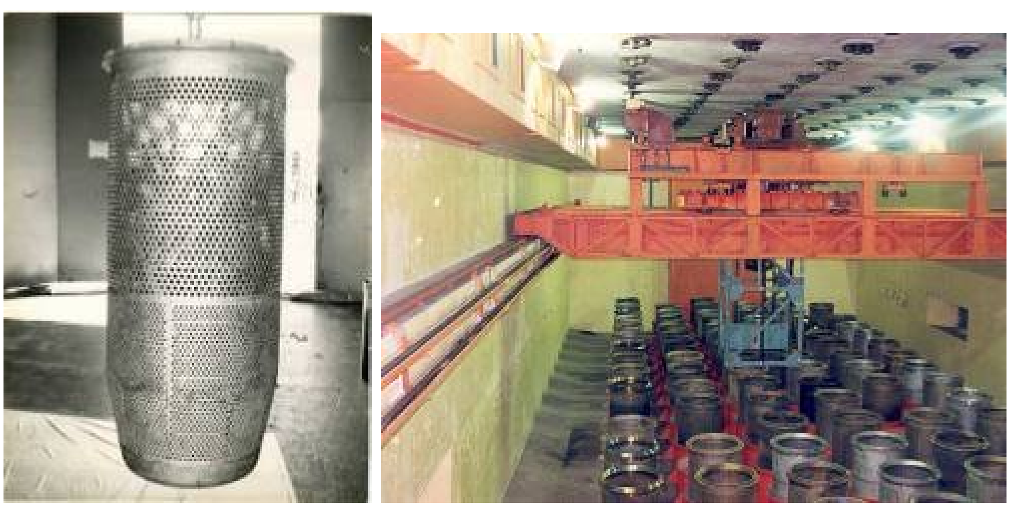


Fig 2. Handling bridge crane in uranium store

The wide range of fuel reprocessed in UP1 led to the use of several types of baskets. Some baskets even contain an internal basket. There are a total of 144 baskets.

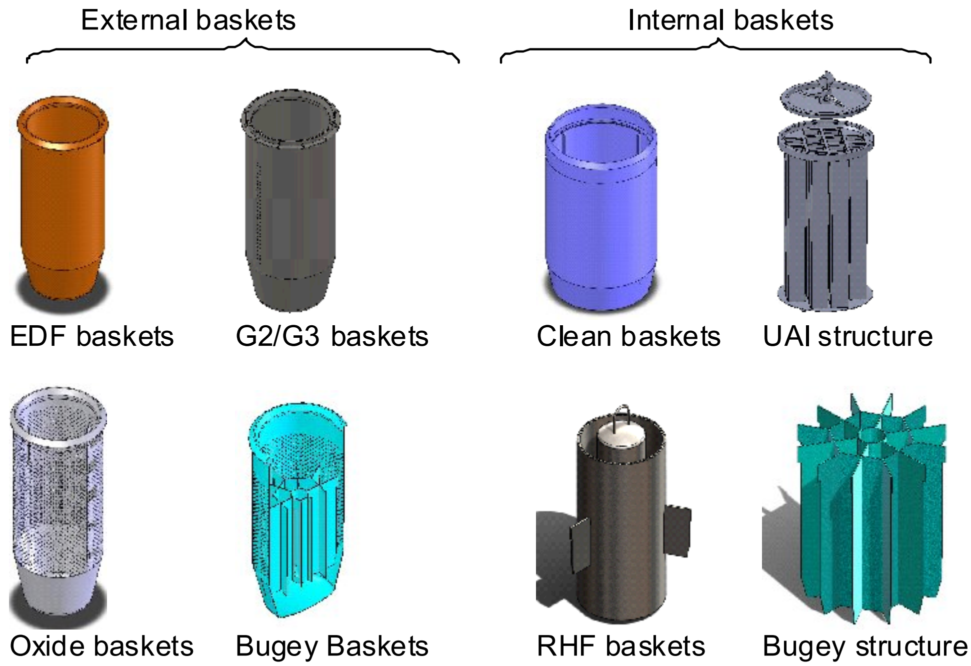
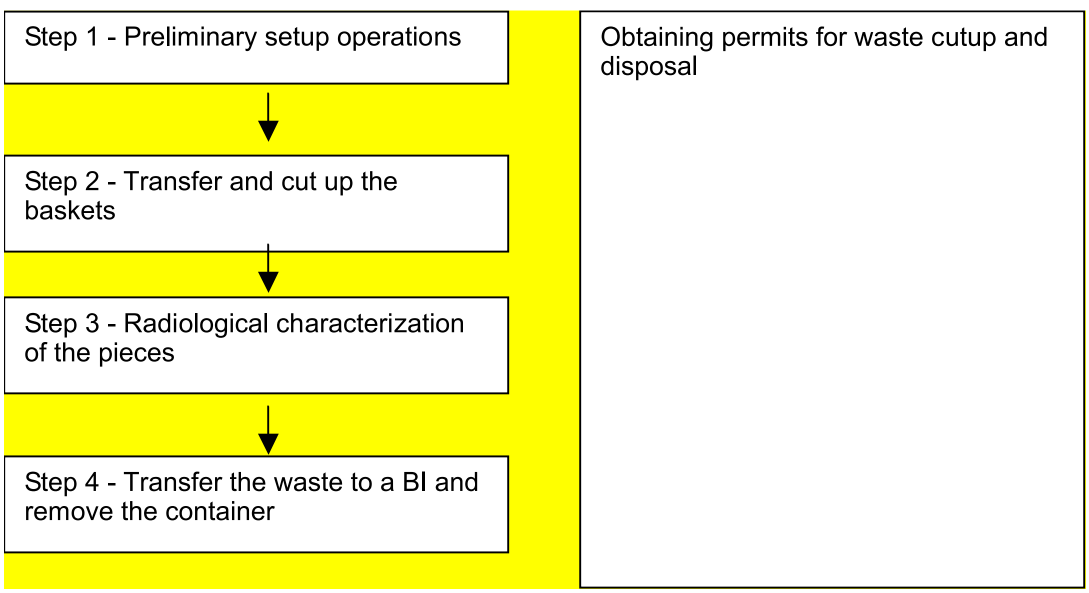


Fig 3. Types of baskets

The objective of the cleanup and dismantling project is to cut up the dissolution baskets, characterize the resulting waste materials and remove them in “intermediate bins” (BI) to the solid waste conditioning facility (CDS) and then to the repository operated by the French National Radioactive Waste Management Agency (ANDRA).

The project studies led to the following scenario:



METHOD

Step 1: Preliminary setup operations

Before the work began, all the baskets were arranged by decreasing dose rate from south to north so the source term was as far as possible from the future work zone. For the same reason, biological shielding was installed between the basket interim storage area and the work zone. A work zone was then set up to accommodate all the equipment necessary for cutting up the baskets; the rows of receptacles at the north end of the store were removed and replaced by a temporary platform.

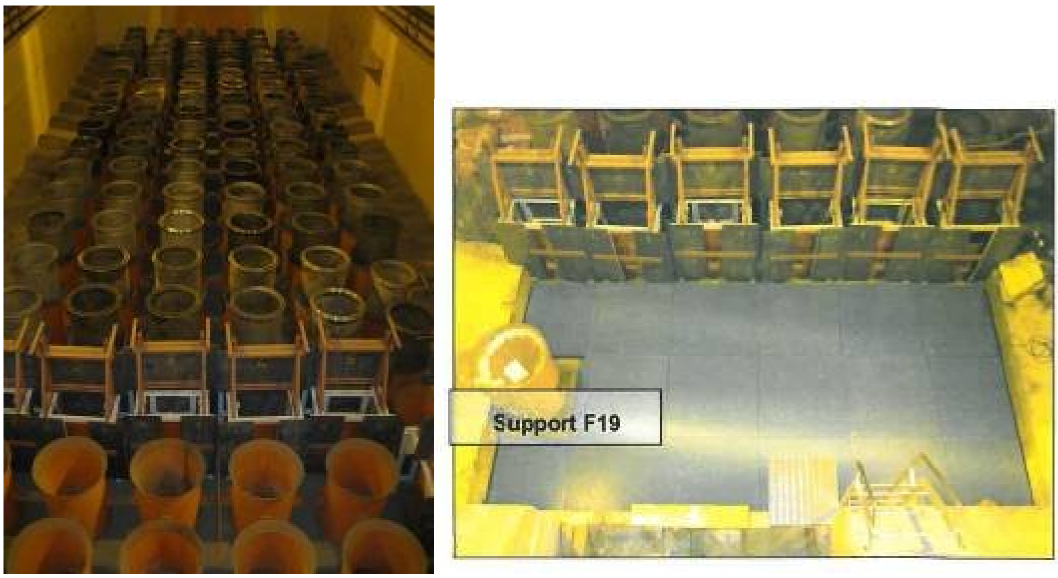


Fig 4. Biological shielding wall and platform at the North end of the store

Step 2: Transfer and cutting of the baskets

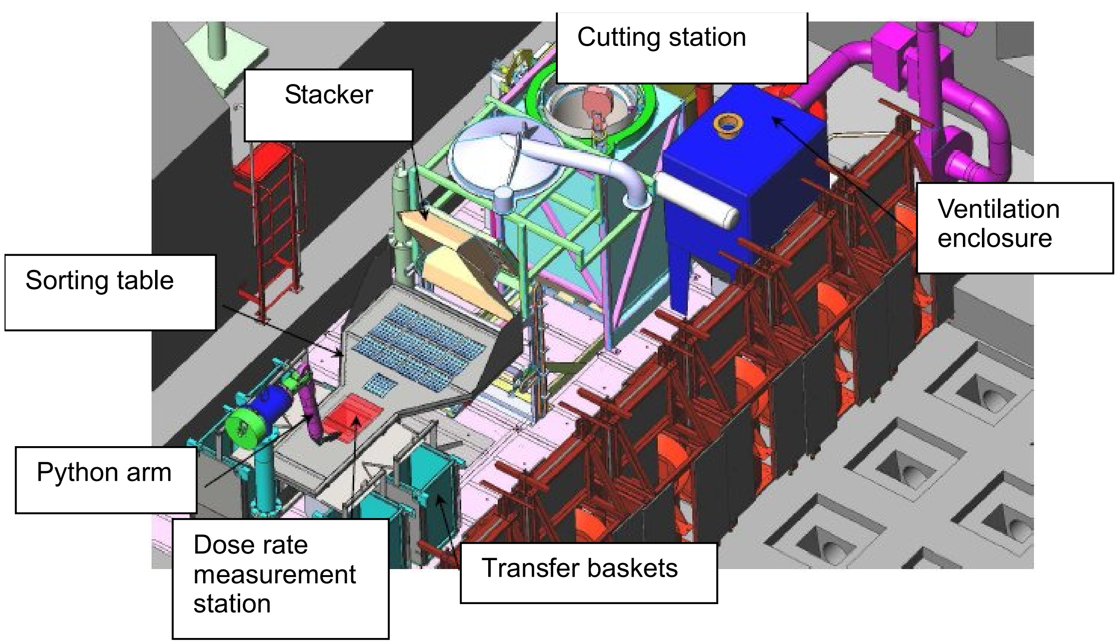


Fig 5. Equipment installed in the work zone

The baskets are cut up one after the other. Each basket is transferred by the bridge crane and placed on the cutting station. The basket is cut up with a plasma torch and a disk grinder, vertically and horizontally to obtain the pieces shown below.
An enclosure surrounding this station ensures exhaust ventilation during cutting.

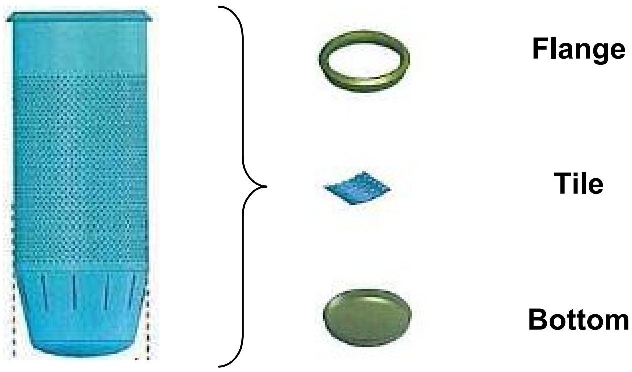


Fig 6. Pieces of the baskets (bottom plate, sidewall tiles, and upper flange)

After each cutting sequence the pieces of the baskets are transferred to the sorting table by means of a stacker.
The waste is sorted after a preliminary dose rate measurement and the tiles are placed in reusable transfer baskets near the table. Four bottom-opening transfer baskets are available for loading the tiles. They are numbered and used to dump the contents into intermediate bins.

Fig 7. Photo of work zone

Once the transfer basket is full (radiologically or physically) its dose rate and activity are measured at the station on the upper level.

Step 3: Radiological characterization of the pieces

The objective regarding the waste materials is to send them to the ANDRA repository. This requires stringent measurements methods at each step in the process. Each waste item must be traced, measured and packaged in accordance with applicable standards. The waste is characterized and the result is used to select the most suitable conditioning route according to the dose rate and activity levels.

Given the highly variable waste dose rate, three types of intermediate bins will be used:
- a standard BI with 0.003 m metal walls and a useful volume of 2800 L;
- a BI with a prefabricated concrete layer 0.21 m thick on the bottom and sides, with a useful volume of 950 L;
- a BI with a prefabricated concrete layer 0.30 m thick on the bottom and sides, with a useful volume of 510 L.

The concrete-lined bins with dose rates exceeding transport standards at Marcoule must be grouted in place, inside the Suter airlock. The bins are then transported to the CDS where they are placed individually in CBFK packages (one BI per CBFK) and grouted before shipment to ANDRA.

Fig 11. Intermediate bin

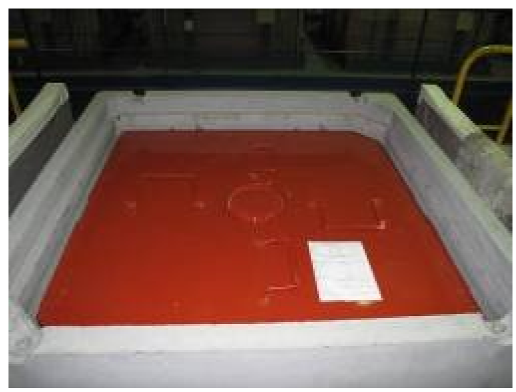


Fig 12. Intermediate bin in a CBFK container

There are three types of waste: bottom plates, tiles forming the basket sidewalls, and basket upper flanges. The following characterization procedure is planned.

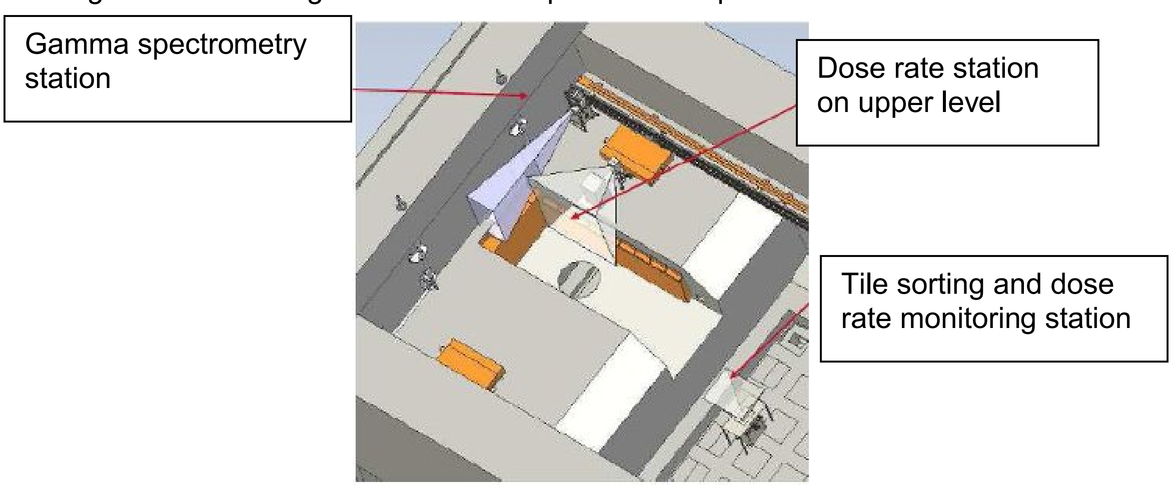


Fig 8. Layout of measurement stations in the work zone

1) Preconditioning. The tiles are measured on the sorting table and preconditioned in transfer baskets according to their destination (each transfer basket is assigned to a different type of BI depending on the type of concrete lining). This preliminary sorting ensures that the final package dose rate will be acceptable (2 mGy/h maximum external contact dose rate). The bottom panels and upper flanges are too large to be preconditioned in transfer baskets.
2) Preliminary characterization. The dose rate of the filled transfer baskets or of the bottom plates and flanges is measured at the upper level work station to confirm their compatibility with a particular type of bin.
   For each type of waste there are maximum dose rate levels per intermediate bin (standard, 0.21 m, 0.30 m). Each wasteform is therefore conditioned in the type of bin corresponding to its dose rate. If the bin in the Suter airlock is unsuitable, the waste items are placed in a dedicated buffer storage zone for removal when a compatible bin is in place. Traceability is ensured both by computer and by manual records.

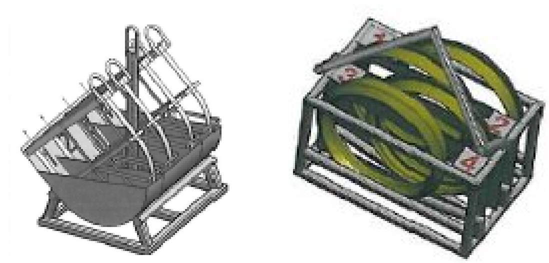


Fig 9. Racks for temporary buffer storage of bottom plates and upper flanges

3) When the type of bin in the airlock corresponds to the dose rate of the waste to be packaged, a gamma spectrometry measurement is performed at the station on the upper level to determine the waste activity. The total activity of the bin corresponds to the sum of the activity levels measured for each waste item. The total activity complies with the acceptance limits imposed by ANDRA to determine the contents of the bins.

The measurements are controlled by software specially developed for this project, which informs the operators of the proper procedure for each wasteform. For each waste item the software records the measured values to ensure monitoring and traceability.

Step 4: Transfer the waste to a BI and remove the container

If the waste is compatible, it is dumped into the bin docked in the Suter airlock.

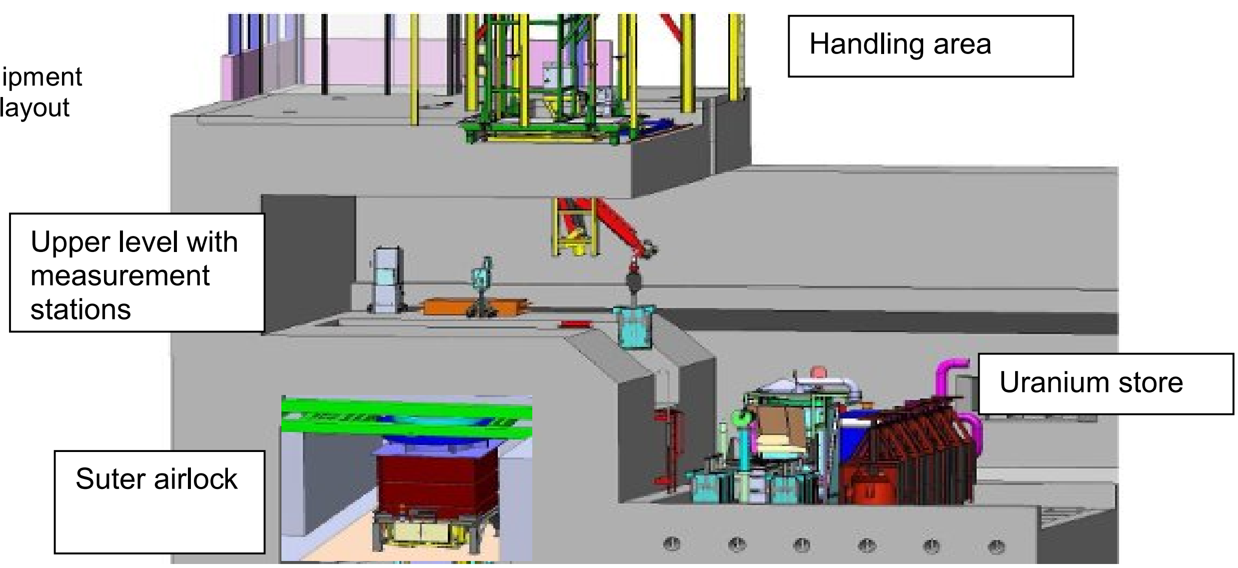


Fig 10. Equipment installation layout

When the bin is full, it is grouted in place if necessary, then transported to the Solid Waste Conditioning Facility (CDS) to be inserted in a cubic fiber-reinforced concrete container (CBFK). The package is then grouted and shipped to the ANDRA repository.

RESULTS AND DISCUSSION

Safety requirements and waste removal

Two permits were requested from the French regulatory authorities: one related to the safety of the basket cutting operations inside the facility, and the other from ANDRA for acceptance of the waste in intermediate bins. The safety issues related to this project mainly concern contamination and irradiation of the baskets, the plasma torch cutting method, and the ventilation during the operations. To avoid any risk of dispersal of radioactive materials between zones (handling area and Suter airlock in green zone 2b and uranium store in red zone 4) several changes were implemented:

- In the handling area, a rigid airlock and flooring were designed to form a containment barrier. The floor panel will be opened only to allow personnel and equipment into the uranium store.
- In the Suter airlock, a rigid airlock was set up to ensure confinement. The bin is docked against the hatch (a hopper between the Suter airlock and the uranium store) with an airtight seal to maintain the negative pressure gradient in the ventilation system; the hatch is opened only when necessary to fill the bin.

For the ventilation system the main problem is the use of a plasma torch and grinder to cut up the baskets. To avoid any risk, cutting is performed inside a “cutting enclosure” equipped with its own exhaust system complying with very specific airflow characteristics.

CONCLUSION

The project studies began in 2008, and at the present time not all the permits have been granted. All the equipment has been installed, and an initial safety clearance was obtained to cut up a basket in order to qualify the three measurement stations. The qualification procedure lasted five months.

Before continuing, the project is now awaiting approval by ANDRA for packaging and acceptance of the waste, as well as the other safety permits. Once the permits have been obtained, the project to dismantle and package 143 baskets is expected to last 18 to 24 months.