Dismantling nuclear areas by using milling tools

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Introduction

Decontamination is a key activity in decommissioning.

It is often the case, in nuclear power plants, reprocessing facilities and waste repositories, that surface decontamination requires mechanical milling techniques on concrete, cement or brick surfaces (coated or uncoated). Integrated and compliant techniques for the efficient milling of these surfaces are in demand in a growing decommissioning sector, due to a large number of these scenarios which present challenging geometries.

This is the case for the dismantling of the MAU (Medium Activity Uranium) building which is part of Orano La Hague's UP2400 fuel recycling plant. The end state is to decommission monitored or controlled areas into conventional areas and to decommission nuclear waste areas into conventional waste areas.

Mechanical processes proved to work since facilities are being decommissioned; however, the capability of such applications to fulfill the requirement in term of economics, techniques and environment/social need to be confirmed. Particularly, the speed rate, the strenuous working conditions, the dust collection efficiency, the possibility to obtain a final surface state that allows final surface radiological measurements have often been criticized in the various feedbacks from the work sites. For all these reasons, it seemed necessary to search for new tools and operating modes, which bring sustainability to the D&D operations.

Good association of milling tools

To improve clean-up operations on dismantling sites, Orano DS collaborated with the company Astillo. Specialized in the design and manufacture of machine and tool for the surface removal of pollutants, Astillo benefits from experience in the surface treatment’s sector. Primarily involved in the stripping or decontamination of pollutants (asbestos, lead, PCBs, PAHs, radioelements…), Astillo’s sound knowledge of the work processes, has allowed them to develop technologies based on function and operational performance.

This paper describes the results of the implementation of adaptable tools to manual or semi-automatic machine for floor, wall and ceiling for different thicknesses of milling. Particularly, the possibility to work with no detectable increase in airborne exposures (efficient vacuum attachments), the guarantee that all workers’ exposition to dose is kept as low as possible (semi-remote operation), the potential to accommodate a wide range of surfaces geometries and types by adaptable tools to manual or semi-automatic machines will be described.

Backgrounds

The MAU building was used for the separation of uranium and plutonium and for the purification of uranium.

The final state corresponds to:

- The various cells have been emptied of all their equipment, and the civil engineering has been cleaned, leaving it in place.
- Monitored or controlled areas have been decommissioned to conventional areas and nuclear waste areas have been decommissioned to conventional waste areas.

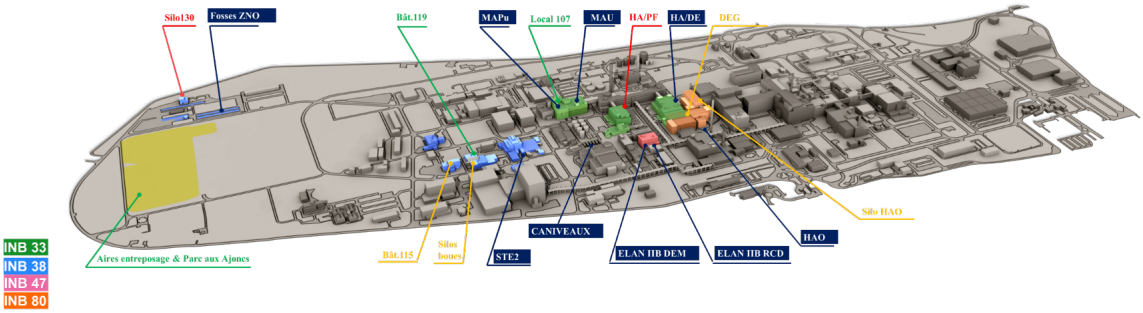

Figure 1: La Hague plant

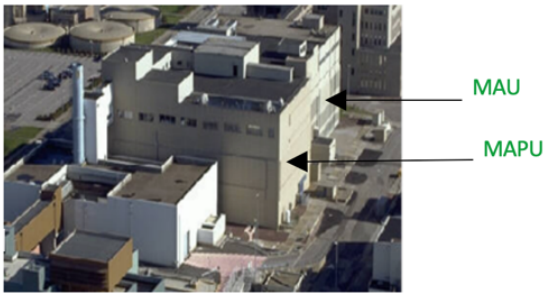

Figure 2: MAU Building

Thus, after emptying the cells of all process equipment, all surfaces must be cleaned in order to pronounce its radiological decommissioning. The dismantling of the equipment in cells “900” started in 2017, their decommissioning started in 2022 and is expected to continue until 2028.
Following the first feedbacks on the 966 and the 967 cells with an equipment conventionally used in France for scabbling operations, some improvements needed to be carried out. Particularly, we needed to be able to:

- Increase the processing rates m^2/hr,
- Improve the ergonomics and to reduce hardship
- Improve the dust collection efficiency. Indeed, efficient dust collection “at source” towards the conditioning cyclone is particularly impactful in an alpha environment (concrete remediation challenges cf [1]).

This paper will describe accordingly the different machines and tools newly used, their implementation on the site and the first feedbacks.

Materials and methods

Astillo is primarily involve in the stripping or decontamination of pollutants (asbestos, lead, PCBs, PAHs, radioelements…);

It is certified by the IFA in Germany (Institut Für Arbeitsschutz, German organization responsible for health and safety at work) for its complete mechanical machine + suction skid system with an asbestos fiber concentration less than 2 fibers/liter in the working area. Its ability to provide adapted, high-performance, low-dispersion asbestos removal processes match our expectations for the treatment of civil engineering in the nuclear sector.

List of machines to achieve the goal:

Machines	Picture	Pass width
Manual milling machine		80 mm
Manual angle milling machine		25 mm
Floor milling machine (A26 BL)		160 mm
Semi-automatic Wall milling machine (AWF26)		160 mm
Ceiling milling machine (ACF26 BL)		80 or 160 mm
Ergonomic stand support (Ergo System)		80 mm

Vaccum – TopVac ®1100		
Filtration and bagging plant EasyBag ®Quattro		
Vacuum Controller		

Figure 3: Selected machines

Descriptions:

Manual milling machine:

For milling machine, the milling cuts directly into the thickness of the material by rotating perpendicular to the surface. This makes it easier to collect dust as it is automatically guided to the suction nozzle (figure 4).

However, for example, for grinders, the disc rotates parallel to the surface: the centrifugal force ejects laterally the dust on 360° and can therefore, despite the presence of covers and flaps, eject the dust outside (Figure 5)!

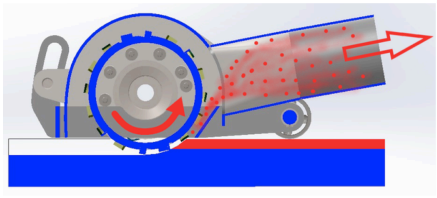

Figure 4: Milling machine

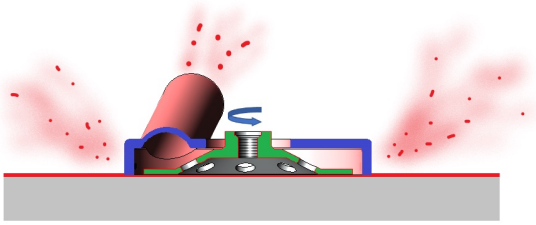

Figure 5: Sanding machine

Semi-automatic machine AWF26 for the treatment of the walls

We have found by testing the equipment in inactive mode that there is no hardship in using this carrier, which can be set up by one person for conventional heights of less than 3-4m. This equipment can reach a theoretical speed of 28 m²/h in 3mm thickness surfacing, without counting the stops and repositioning of the equipment. These rates will be reduced due to our worksite context. They will be consolidated as experience is gained, but the objective of increasing productivity seems quite achievable.

The equipment is detachable into elements allowing the easy passage through doors or other access. It enables:

- To work per 160 mm wide bands up to a working height of 9 m; the carrier trolley is docked in contact with the wall to be treated and then is blocked by a jack on the ceiling of the room. Therefore, no fixing holes are necessary in the active work area,
- To make 4 strips with 5-6mm overlap without moving the carrier. There is an indexing device on the horizontal rail to quickly reposition it (Figure 6)

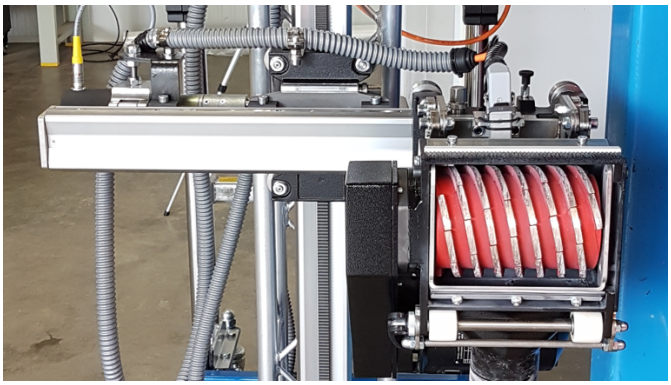

Figure 6**:** Indexing device on the horizontal rail

Ceiling milling machine:
The patented rail system is mounted on a support (scaffolding, etc.). It touches the ceiling by means of an ingenious manual lifting mechanism and then is moved horizontally (Figure 7).
We have found by testing the equipment that the hardship is greatly reduced, the effort is limited to a guided movement throw the extended "arm of force ». As it is possible to lower the arm under the head during ceiling cleaning, that avoids the appearance of cramps over time. The ceiling milling machine can accept both the 160 mm and 80 mm working width tools.

Figure 7**:** Manual lifting mechanism

Ergo system: Ergonomic stand support for moving the manual machine (80 mm).
This tool includes a rotation system that allows 6 strips to be made below and above the tool's translation rail (Figure 8).

Figure 8: Rotation system

Suction system:

An exhaust system is installed “at source” for all stripping equipment to avoid any dispersion of contaminated dust.

The machines are connected to the suction system via a 75 mm hose for tools with a 160 mm milling head and a 50 mm hose for tools with an 80 mm milling head.

The suction system consists of:

- a filtration and bagging unit with integrated H14 filter;
- a suction unit equipped with an H14 filter at the air outlet;
- a vacuum controller.

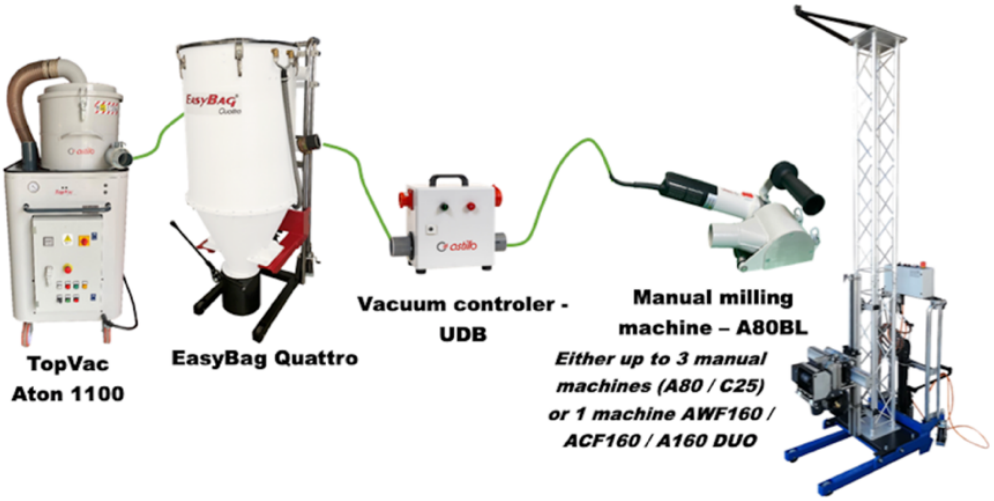

Figure 9: Full system collecting “at source” and waste conditioning

Figure 10: Filtration and bagging plant EASYBAG QUATTRO

Figure 11: 4 cartridges S=12 m^2

The suction unit has filters that are automatically cleaned by compressed air pressure in order to maintain the suction power during the entire operating period. The packaging system allows the installation of airtight bags or drums for emptying the dusts at the foot of the cyclone (Figure 8). The body of the suction unit is attached to a lifting system with a hydraulic actuator to adjust its height according to the packaging used. Inside the "filter" a replaceable martyr plate is fitted to prevent wear and tear where the flow of concrete dust impacts the inlet of the metal housing.

The system is designed for the simultaneous suction of three tools 80 mm wide or one tool 160 mm wide and two tools 80 mm wide.

Tools:

Various milling tools have been developed for abrading coatings on concrete or etching raw concrete, theses tungsten based ceramic type tools have various amounts of diamond powder to adjust the abrasive power. For our applications on very hard concrete, we use the “red Helix”.

Tools of the same width are used interchangeably on all machines.

Tools	Picture
Diamant Polycristallin milling cutter - very aggressive, for hard and impact resistant coatings. Used for first layer removal in the presence of resin or paint P600	
Diamond milling cutter for concrete processing, especially for hard to very hard, high-strength concrete surfaces HELIX	
For angle, all-round diamond tool, robust C25	

Figure 12: Selected tools

Results and discussion

The implementation of the equipment started in October 2022.

For all the equipment, we have adapted "tailor-made" boxes to carry the equipment between the various worksites.

Figure 13: Semi-automatic machine box dimensions (cm)

125 (L); 85 (l) – 175 (H) – Total weight: 330 KG

Despite efficient dust collection at source, we had to install the extraction unit in an airlock. Indeed, nuclear ventilation regulations do not allow us from releasing air, even filtered, from zone 4 into zone 3. We are therefore forced to maintain dynamic containment. This semi-rigid airlock is moved away from the working area because the extraction unit generates heat (about 60°C). This airlock is also equipped with a double ventilation system in order to keep it in depression from the area in which it is located. A set, composed of a fan and double filtration THE (BSS4), is permanently in use with a

second set (ventilation and filters) which is started up only when the milling machine is switched on in order to compensate its discharge in the airlock.

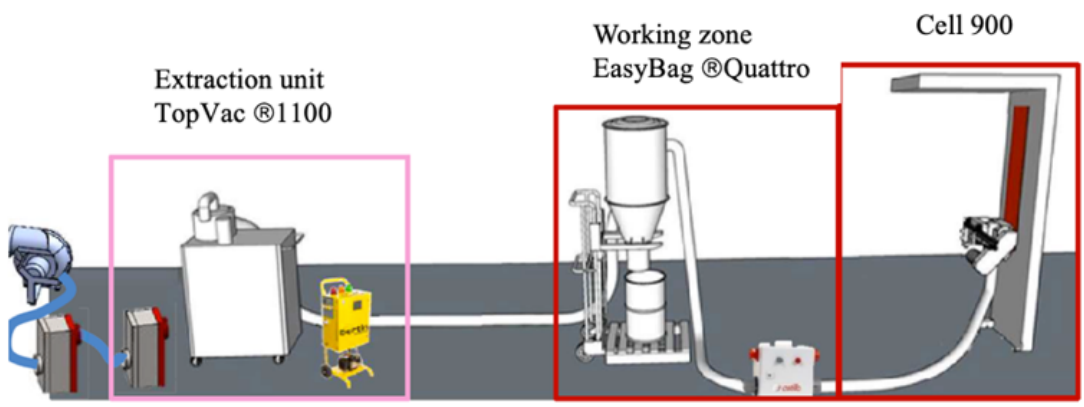

Figure 14: Implementation

Figure 15: Semi-rigid airlock

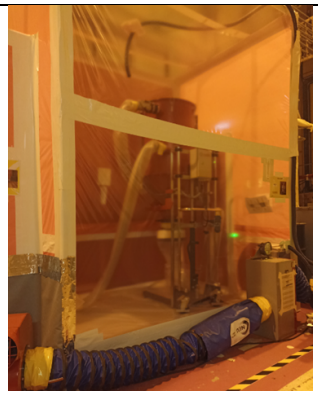

Figure 16: Working airlock

Twenty-eight “900” cells need to be radiologically decommissioned. The Astillo equipment deployed since October 2022 has allowed the treatment of residual hot spots in eight cells (939/940/943/926/922/914/915/921) which are now decommissioned. To date, we are finalising the scabbling operations in cell 913.

During these operations, we haven’t detected any contamination on the downstream side of the EasyBag.

Figure 17: Treatment of a hot spot

Taking into account the migration of the contamination, we have identified the need for 3mm, 6mm, and 10mm depth removal and for some areas the total concrete screed of 30mm need to be removed.

We also have just deployed a second set of equipment on MAPu Building with the decommissioning of cell 931 (the first of 39 cells).

Improvements

A number of optimisation improvements are underway, such as a modification to the Easy Bag pre-filters (cf. Figure 18) to optimise filter changing using a push-push system that evacuates the filters through the lower part of the Easy Bag, thereby limiting the risk of contamination spreading to the upper part of the Easy Bag during filter changing operations.

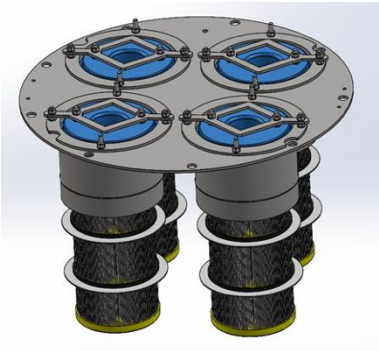

Figure 18**:** Modification of EasyBag pre-filters

Conclusion

The initial results from the use of these machines and tools are highly satisfactory in terms of productivity, ergonomics and reduced hardship.
The results demonstrate the effectiveness of dust collection at source, and future modifications should provide even greater safety and potentially allow the ventilation conditions of the extraction unit to be reduced.