

**UP2 400 High Activity Oxide Legacy Waste Retrieval Project Scope and Progress-13048**

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**ABSTRACT**

The High Activity Oxide facility (HAO) reprocessed sheared and dissolved 4500 metric tons of light water reactor fuel the fuel of the emerging light water reactor spent fuel between 1976 and 1998. Over the period, approximately 2200 tons of process waste, composed primarily of sheared hulls, was produced and stored in a vast silo in the first place, and in canisters stored in pools in subsequent years. Upon shutdown of the facility, AREVA D&D Division in La Hague launched a thorough investigation and characterization of the silos and pools content, which then served as input data for the definition of a legacy waste retrieval and reconditioning program. Basic design was conducted between 2005 and 2007, and was followed by an optimization phase which lead to the definition of a final scenario and budget, 12% under the initial estimates. The scenario planned for the construction of a retrieval and reconditioning cell to be built on top of the storage silo. The retrieved waste would then be rinsed and sorted, so that hulls could subsequently be sent to La Hague high activity compacting facility, while resins and sludge would be cemented within the retrieval cell. Detailed design was conducted successfully from 2008 until 2011, while a thorough research and development program was conducted in order to qualify each stage of the retrieval and reconditioning process, and assist in the elaboration of the final waste package specification. This R&D program was defined and conducted as a response and mitigation of the major project risks identified during the basic design process. Procurement and site preparatory works were then launched in 2011. By the end of 2012, R&D is nearly completed, the retrieval and reconditioning process have been secured, the final waste package specification is being completed, the first equipment for the retrieval cell is being delivered on site, while preparation works are allowing to free up space above and around the silo, to allow for construction which is scheduled to being during the first semester of 2013. The elaboration of the final waste package is still undergoing and expected to be completed by then end of 2013, following some final elements of R&D required to demonstrate the full compatibility of the package with deep geological repository. The HAO legacy waste retrieval project is so far the largest such project entering operational phase on the site of La Hague. It is on schedule, under budget, and in conformity with the delivery requirements set by the French Safety Authority, as well as other stakeholders. This project paves the way for the successful completion of AREVA La Hague other legacy waste retrieval projects, which are currently being drafted or already in active R&D phase.

## INTRODUCTION

The High Activity Oxide facility (HAO) was commissioned in 1976 as part of the UP2 400 complex, in order to reprocess the fuel of the emerging light water reactor spent fuel, while the plant had initially been built for the reprocessing of natural uranium, gas cooled reactor fuel. The facility contains cooling pools, as well as shearing, dissolution and clarification process capabilities, which are then connected to the original UP2 400 process line for extraction and subsequent stages of the recycling process. It operated for a period of twenty five years, shearing and dissolving over 4500 metric tons of spent fuel from French and foreign reactors. It was then replaced by UP3 and UP2 800 commissioned in 1998 and 2000 respectively. During that period, the Hulls and end pieces resulting from the shearing and dissolution process were stored in a silo within the facility in the absence of an existing process for their final conditioning. Today, hulls and end pieces resulting from the recycling process are compacted at la Hague Hull Compaction facility (ACC in French) which came into operation in the Year 2002. 1536 tons were produced, the first 800 tons were stored in a vast silo while the rest was subsequently packaged in 5000 stainless steel drums stored in dedicated pools. Furthermore, approximately 30 tons of resins and sludge recovered from filtration systems were also stored within the silo, pending retrieval and final conditioning. This bulk storage of mixed hulls, end pieces, resins and sludge would later generate constraints on the definition and qualification of the retrieval process, while the arranged storage in stainless steel canisters appeared to significantly ease future retrieval. Figure 1 and 2 below presents a sectional view of the facility.

Comment [m1]: Which silo?

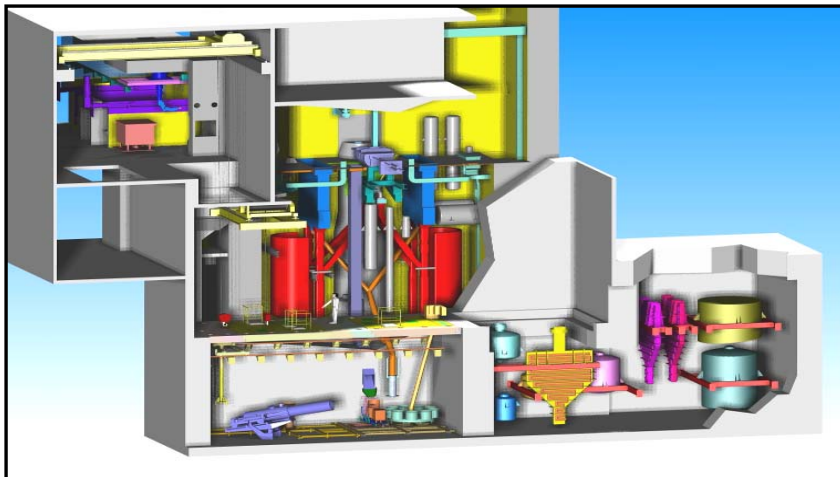


Figure 1: HAO Shearing and Dissolution functions, sectional view.

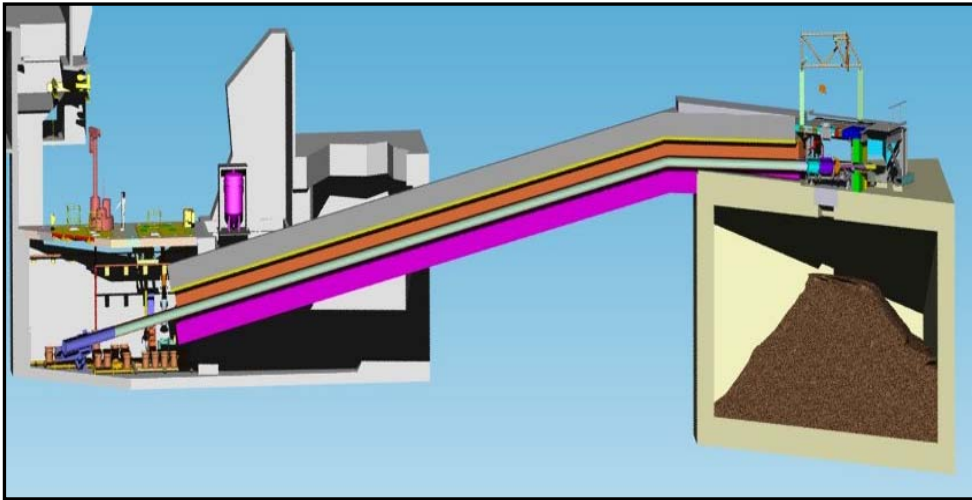


Figure 2:HAO hull transfer and storage function, sectional view

## PROJECT DESCRIPTION

### Characterization

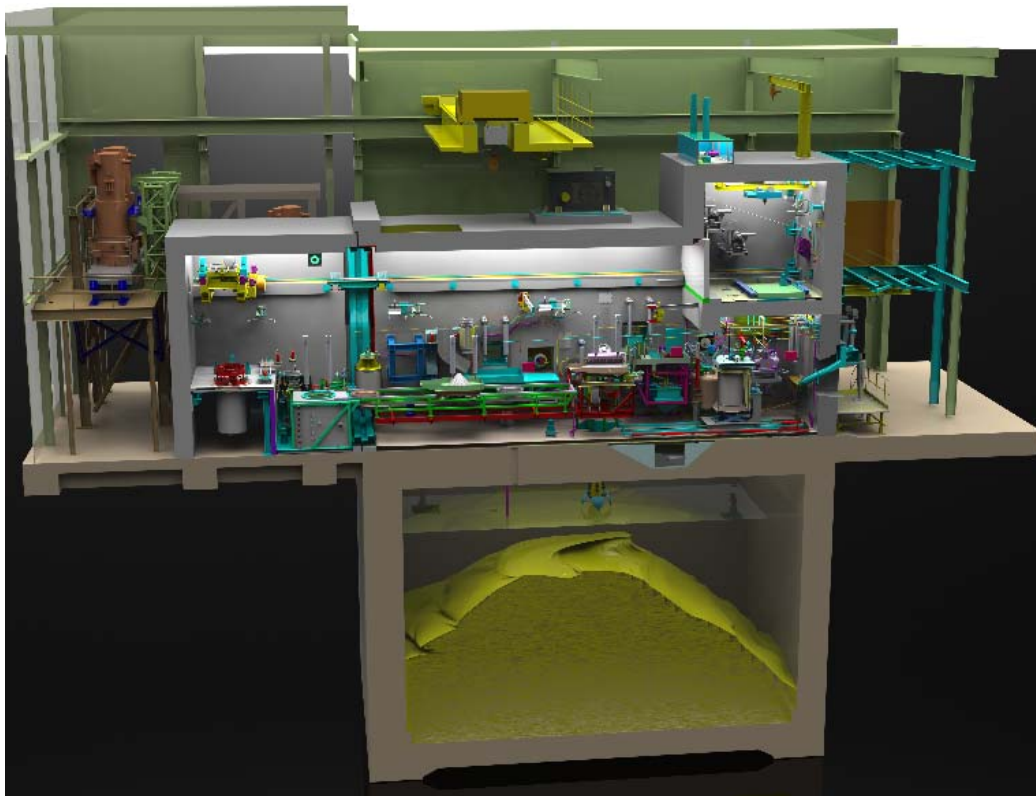
Upon shutdown of the facility in 1998, AREVA D&D teams launched an exhaustive waste characterization program, completed by the analysis of production archive. The waste stored in stainless steel canisters did not present any particular difficulty in the sense that during production and packaging, hulls had been segregated from end pieces, and no additional waste had been added to the content of canisters. The traceability and content of each canister was thus easy to assess. The waste stored within the silo presented a rather different situation, with the mixture of a variety of waste categories, stacked in bulk and unsorted. It soon appeared necessary to elaborate a stacked 3D modelization of the silo content, as an input for the elaboration of the retrieval and reconditioning scenario and for the elaboration of the final waste package specifications.

From this characterization it also appeared that the retrieval scenario would imply some sorting capacities, and different waste channels for the different types of waste encountered within the silo. Finally, the amount of nuclear material to be expected within the hulls and within the sludge and resins needed to be evaluated precisely as a further input to the scenario. The waste contained within the silo can be described as follows: 800 tons of hulls and 16 000 end pieces, 14 tons of fines from shearing and dissolution, 38 tons of resins from pool water filtration, 31 tons of aluminum covers (from the canisters used for the transfer of hulls to the silo after dissolution).

### Scenario building

The choice of reference scenario resulted from the analysis of several factors, which ranged from the characterization of the waste, to the configuration of the HAO facility, as well as the evaluation of the potential use of existing facilities and workshop on the site of la Hague. The first function to be performed consisted in the ability to safely recover the content of the silo, which lead to the decision of building a retrieval cell immediately above the silo. In addition to retrieval, the cell would allow for a characterization of each waste batch retrieved, segregation and sorting, as well as packing of each waste type in an suitable container for further treatment.

The reference solution for the final conditioning of hulls and end pieces rather evidently appeared to be compaction at UP3 “Hulls Compaction facility”, commissioned in 2002 and



**Figure 3:HAO legacy waste retrieval Cell sectional view**

producing over 1600 high activity stainless steel packages every year. However, such an option implied several hypotheses, the first of which being the ability to safely transfer hulls and end pieces to the facility.

The HAO facility being located in the vicinity of the R1 facility (which replaced HAO in 2000 for shearing and dissolution of light water reactor fuel), design teams opted for the construction of a transfer tunnel between the HAO retrieval cell and the R1 facility. The second requirement

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imposed by the transfer of hulls to the compaction facility, was the ability to separate hulls from fines and resins, which are not compatible with the subsequent compaction process and resulting deep repository waste package. This specific requirement generated an additional constraint on the process which had to be addressed in subsequent stages and implied the installation of a sorting function within the retrieval cell.

Being segregated from hulls and end pieces, fines and resins needed an adequate conditioning mode, immobilization being a rather standard and proven method provided the hydraulic matrix presents adequate characteristics. In order to minimize the risks associated with the transfer of very active sludge from one location to another, and minimize the project costs, it was decided to install the cementation function within the retrieval cell. Finally, the less active aluminum canister covers had to be retrieved, rinsed and segregated for final conditioning as low activity surface waste.

The initial scenario, process and retrieval cell design was completed by the end of the year 2005. It led to the elaboration of a safety case which was submitted to the French safety authorities for analysis and approval. The elaboration of the scenario was completed by a thorough risk analysis which led to the definition of a research and development program which covered the following area: Waste retrieval and segregation function-waste rinsing and sorting function-hydraulic matrix specification-lost stirred immobilization function.

This phase was accompanied by the definition and specification of the preparatory works needed in anticipation of the future construction of the retrieval cell. Indeed, the construction of the retrieval cell required prior dismantling of a significant number of equipment located above and in the vicinity of the silo the completion of which needed the elaboration, instruction and approval of a safety case by French safety authorities.

The project defined here above represented an overall budget in the range of 300 million euros, the production of nearly 3000 compacted hulls high activity waste packages, as well as 100 cemented drums. The construction and commissioning time for the cell was estimated at a duration of 5 years, for over 10 years of subsequent operation. Considering the scope, volume and complexity of the project, an optimization initiative was initiated upon completion of the basic design in order to reduce the overall time schedule and budget. The initiative covered all aspects of the project, from the design of the retrieval cell to the operation of the facility and optimization of the final waste packages. This initiative led to a gain of around 12% in the project cost and a two year reduction in the time schedule. Following the optimization initiative, design resumed and led to the project presented in figure 3 below:

## **PROJECT PROGRESS**

The completion of basic design followed by validation by AREVA stakeholders of the project scope, budget and schedule, triggered the launch of the detailed design phase and associated research and development program, in 2009. In the same year, the authorization for preparatory

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dismantling works was obtained from the authorities. By the end of 2011, detailed design was nearly completed while R&D was well advanced and confirming the options retained earlier. Preparatory works had begun and were on good progress. In particular, the major risks associated with the inability to segregate the hulls from surrounding fines and resins, as well as the formulation of the immobilization matrix, had been lifted. AREVA stakeholders thus validated the go for the following stage, which triggered the launch of procurement, and construction of the retrieval cell.

## **CONCLUSION**

The High activity oxide legacy waste retrieval program is one of the four largest programs scheduled on the site of La Hague, together with the historical sludge retrieval project, the Magnesium and Graphite retrieval program, as well as the resins and fines retrieval program. Each of those programs is subject to legally binding milestones set by French Safety authorities with respect to the beginning and completion of works. Furthermore, they represent significant budgets on AREVA Dismantling provisions, and are thus a key contributor to the group performance. The HAO project is on schedule, under budget, and represents the first large scale illustration of AREVA LA Hague D&D team capabilities. No doubt it will be a benchmark for coming projects.