

Sharing Experiences within AREVA D&D Project Portfolio: Four Illustrations - 13049

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ABSTRACT

Over the past ten years, AREVA has performed D&D operations on a wide range of nuclear sites, such as Marcoule and La Hague recycling plants, to Cadarache MOX fuel fabrication plant or Veurey and Annecy metallic Uranium machining plants. Each site is different from the other but some lessons can be shared through this D&D portfolio. In that respect, knowledge management is one of AREVA D&D Technical Department main missions. Four illustrations demonstrate the interest of knowledge share. Waste management is one of the key activities in D&D; It requires a specific characterization methodology, adapted logistics, and optimized waste channels, all of which have been developed over the years by AREVA teams on the site of Marcoule while they are rather new to La Hague, whose main activity remains fuel reprocessing despite the launch of UP2 400 D&D program. The transfer of know how has thus been organized over the past two years. Plasma cutting has been used extensively in Marcoule for years, while prohibited on the site of La Hague following questions raised about the risks associated with Ruthenium sublimation. La Hague Technical Department has thus developed an experimental protocol to quantify and contain the Ruthenium risk, the result of which will then be applied to Marcoule where the Ruthenium issue has appeared in recent operations. Commissioning and operating fission products evaporators is a rather standard activity on UP2 800 and UP3, while the associated experience has been decreasing in Marcoule following final shutdown in 1998. When the French atomic Energy commission decided to build and operate a new evaporator to concentrate rinsing effluents prior to vitrification in 2009, AREVA La Hague operators were mobilized to test and commission the new equipment, and train local operators. Concrete scabbling is the final stage prior to the free release of a nuclear facility. In the context of Veurey and Annecy final cleanup and declassification, large scale concrete scabbling operations were conducted, and lead to the industrialization of the process and qualification of a new process, NiThrow™ scabbling technology, developed by AREVA. This experience has now been injected into La Hague D&D scenario and has allowed a significant gain in time and cost for scabbling operations. In short, the variety of experiences and sites under the responsibility of AREVA D&D teams present significant challenges, and yet provide a unique opportunity to innovate and qualify new tools and methods which can then be shared throughout the sites.

INTRODUCTION

Dismantling and legacy waste retrieval has been a recurrent activity on AREVA sites for a number of years, as part of AREVA legal obligations as a nuclear operator. The oldest facilities were built in the early sixties (Marcoule UP1) and have been operated for over 30 years. Final shutdown decisions and large scale site closures have been starting around the year 2000, and

generally followed by immediate D&D in conformity with France generally adopted approach. The wide range of a activities covered by AREVA, alone or as site operator for the French Atomic Energy Commission (CEA) has lead to a very diverse experience building in the field of D&D, ranging from the rehabilitation of former Uranium mines, to dismantling conversion and enrichment plants (Pierrelatte), fuel fabrication plants (Veurey & Annecy), Reactors (Germany& US), as well as Recycling plants.

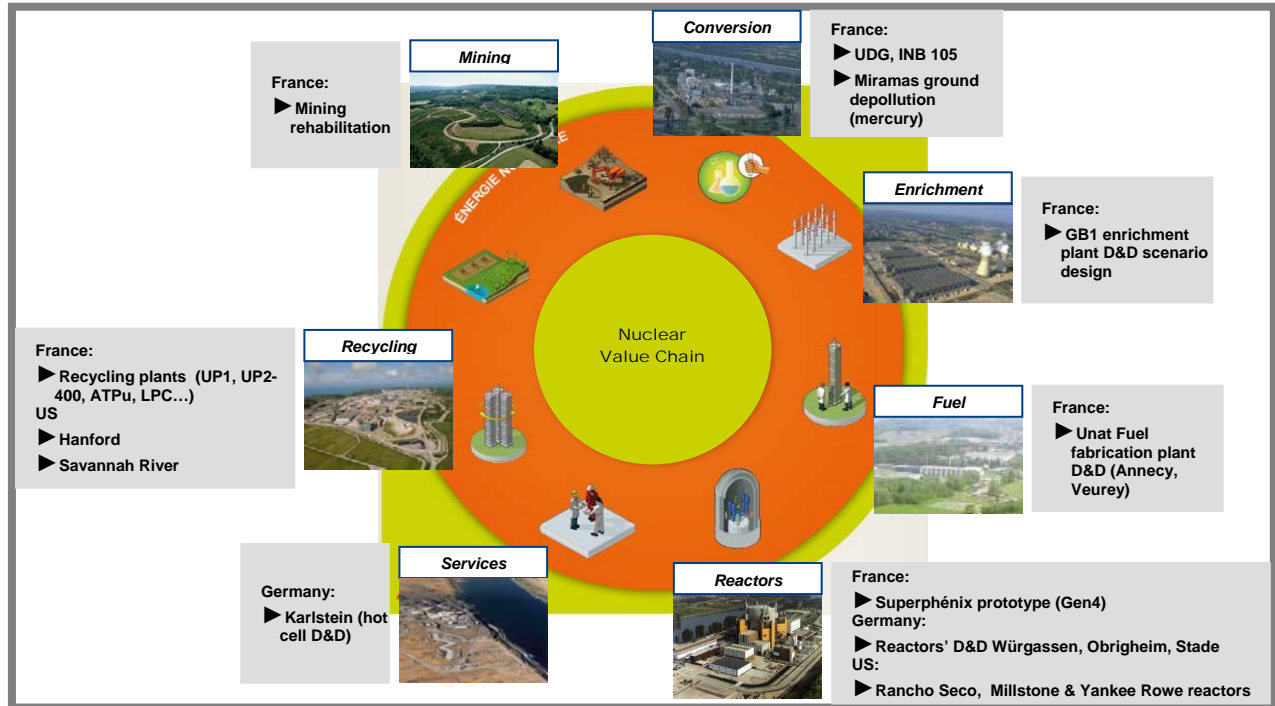


Figure 1: AREVA D&D portfolio

Such a diverse portfolio represents a unique asset provided that the knowledge acquired can be capitalized and shared between actors. In 2008, AREVA created the D&D Business Unit with the missions to manage the whole of AREVA D&D portfolio, industrialize the operations and develop the activity towards other customers. One of the first priorities of the newly created Business Unit has been to strengthen and formalize the capitalization and sharing of experience from one operation to another and thus generate value for the Business Unit. Experience capitalization in D&D can be applied to any aspect of the activity: From the techniques and tools used for decontamination and dismantling, to the organization of specific activities such as waste management or facility operation, and relations with external stake holders such as the safety authority. The paragraphs below illustrate four aspects of actual experience sharing between AREVA operated sites under D&D.

FOUR ILLUSTRATIONS OF EXPERIENCE SHARED

D&D Waste management.

When nuclear facilities are operating and performing their standard activity, be it enrichment, electricity production or recycling, they produce nuclear waste as a consequence. This waste is sorted, collected, treated and re-conditioned into final waste packages which are then sent to adequate interim storage facilities or repositories. However, waste production is not at the core of the activity, although the minimization of waste production is an important factor of performance.

In D&D or legacy waste retrieval, on the other hand, waste packages are the main product of the activity rather than a consequence, although the main purpose of the activity remains to provide decontaminated facilities. Scenarios are designed to minimize the amount of waste produced, specific waste channels are created in order to optimize the densification, and the vast majority of the logistics is related to the characterization, collection, evacuation and storage of nuclear waste packages. The entire waste production and evacuation chain must thus be designed for the activity.

The final shutdown of UP1, Marcoule, was pronounced in 1998 and covered the entire plant perimeter. The facility then shifted progressively from a production mode to a D&D mode, while a vast program was established. Decladding facilities were the first candidates for D&D while support facilities such as effluent treatment, laboratory, solid waste packaging and vitrification facilities remained in operation in support of the D&D activities. In 2008-2009, D&D had reached industrial production levels, as the dismantling of decladding facilities was well advanced, while key operations on process equipment in the chemical plant were being conducted. The site had evolved from a reprocessing facility with isolated dismantling operations into a dismantling organization maintaining buildings in order to facilitate D&D. This of course was the result of a 10 year technical and organizational transition process. With respect to waste management, several key evolutions had occurred over the years, from radiological characterization to new waste channels and adapted logistics.

Comprehensive characterization of physical and radiological initial state is a key activity for D&D operation, and a major contributor to the final cost of operations. It requires specific equipment for in situ gamma spectroscopy or or material identification, but also adapted characterization approaches based for example on geostatistics. D&D characterization also generally involves the chemical and radiological analysis of a very large number of diverse samples, on a wide range of materials. Such tools, approaches and methodologies are non existent during the operating life of facilities, or limited to exceptional maintenance operations. Marcoule laboratory staff developed a range of tools and approaches over the years, which are now being applied for the characterization of UP2 400 cells and equipment.

In terms of waste channels, an operating facility does generate induced waste, but it does so on a rather limited scale, except during large planned or exceptional maintenance operations .The

types of waste produced are generally well known, adequately characterized, with pre-defined waste channels adapted to the mode and flow of production. D&D is a rather different activity in the sense it produced waste packages in a very large quantity over a relatively limited period of time. Furthermore, D&D being conducted on ageing facilities, the operations often recover historical or “exotic” waste which are not encountered in significant amounts on recent, operating facilities. Contaminated asbestos or oil could be two illustrations of such exotic waste. Consequently, D&D required industrial waste channels in order to optimize the packaging of the large amounts of waste produced, and diversified waste channels to accommodate the exotic waste encountered at acceptable costs. Again, La Hague teams are now adapting their waste channels to the D&D flow, based on Marcoule experience.

Plasma cutting during dismantling operations

Apart from decontamination and deactivation, D&D operations involve primarily metal cutting, handling, and concrete scabbling. The industrialization of cutting techniques on contaminated or activated surfaces is thus an important performance factor. During the dismantling of former chemical plants or laboratories, cutting operations are often applied to capacities or large surface metal surfaces such as cell cladding, in often confined environments with limited manoeuvring space.

In such environments, plasma cutting appears to be a rather practical technique and it has been extensively used during D&D operations in UPI Marcoule, mostly in the decladding facilities. Plasma cutting presents a wide range of advantages compared to other manual techniques. It is rather inexpensive, provides high cutting rates in the range of five to 10 meters cut per hour of work compared to one meter per hour for tools such as grinders, and low physical stress on the operator. Its major disadvantages are related to management of the fire hazard and fumes.

Over the years, Marcoule teams have developed a significant experience in the proper handling of plasma cutting during D&D operations, on equipment which did not present any contamination by Ru-106, a fission product which has the property of turning into gas at temperatures as low as 60 degrees Celsius in the form of RuO₄ and has a half life of one year. On the other hand, La Hague teams have developed a qualification process for decontamination and dismantling tools, products and techniques to ensure that any new process identified as a candidate for D&D operations will be formally qualified in all aspects prior to being deployed on operations. Until recently, plasma cutting was not qualified as an approved technique, following negative experiences of its use in past decades.

Considering its potential for D&D, in 2011 AREVA La Hague D&D teams proposed to qualify Plasma cutting following the standard procedure. The standard procedure developed in Marcoule served as a reference, and the experience built with respect to the management of the fire risk proved to be helpful in qualifying the process. However, the management of RU-106

immediately appeared to be an issue, this fission product being more common in UP2 400 than it is in UP1. Literature review revealed no prior quantified experiment on the sublimation of Ru-106 and thus provided no clue as to the proper handling of this risk. La Hague D&D technical Department thus conducted an experimental test in order to determine the transfer function of RU-106 sublimation and subsequent re-deposition, quantify the risk and qualify possible means of mitigation. The tests were conducted in the presence of French safety authorities in charge of instructing AREVA cases and the results are now being incorporated into the plasma cutting standard.

Those results will in turn be available to Marcoule UP teams for future operations involving significant quantities of Ru-106 deposits.

Commissioning new evaporators

In 2006, the French Atomic Energy Commission (CEA) who owns UP1 Marcoule site decided to run an extensive rinsing program on the fission product tanks in order to extract and vitrify the largest possible amount of activity and potentially allow for hands on dismantling of some of the tanks subsequently. However, such a program could only be considered if operational evaporating and vitrification capabilities were available on site. The vitrification facility which had been commissioned in 1974 remained fully operational in 2005-2010. However, evaporating capabilities had been lost following the obsolescence of UP1 evaporators and the launch of D&D operations on the chemical plant equipment.

Therefore, in 2006, the CEA opted for the construction of a new evaporation facility, to be located within an available unused cell in the vitrification facility perimeter. AREVA D&D who has been in charge of the management and operation of UP1 D&D program since 2005 was contracted to design, build and operate the evaporator for the expected duration of three years. Detailed design, supply and construction were conducted between 2006 and 2009, based upon the design of evaporators built in La Hague for UP2 800 and UP3. Active commissioning began in the Spring of 2009, at which time an unexpected foaming mechanism was detected during the first tests and threatened to reduce the expecting efficiency of the evaporator and delay the vitrification program.

At this time AREVA mobilized process experts and evaporating operators from the site of La Hague in order to solve the issue, restore the evaporator efficiency, and train Marcoule personnel in the operation of this new evaporator. Following the commissioning of UP3 and UP2 800 in 1988 and 1990 respectively, La Hague plant has been recycling over 1100 metric tons of spent fuel per year, and producing around 600 glass canisters per year. Its recycling experience at all stages of the process thus remains fully operational over the years, and can be made available to other sites should the need arise.

The task force mobilized from La Hague successfully commissioned the evaporator, which ran until April 2012 and concentrated 500 cubic meters of highly active effluents which were

subsequently vitrified. The evaporator has now been shutdown and rinsed for subsequent dismantling.

Large scale Concrete Scabbling

The sites of SICN Veurey and Annecy were fuel fabrication plants located within the cities of Annecy and Grenoble. The plants were shutdown in 2002 and dismantled immediately. Complete decontamination and subsequent declassification of the facilities were a major objective for the D&D Division, both technically and in terms of public acceptance. The dismantling of those two plants was completed in 2011. Following the removal of all process equipment, the major task consisted in bringing civil works structures to a residual level of beta gamma surface contamination not exceeding 0.4 Bq/cm² and a residual of alpha contamination not exceeding 0.04 Bq/cm² as required by French regulators. Concrete scabbling of all buildings and cells thus represented a total surface of 100 000 square meters to be decontaminated. The operation lasted for 2 years and produced a total of 16 500 cubic metres of very low activity



Figure 2: Wall scabbling with Nithrow™

concrete waste.

A variety of scabbling and confinement methods have been used and experimented over the period.

Those operations have lead AREVA to qualify and industrialize the innovative NiThrow™ scabbling technology, which combines maintenance-free pressurized liquid nitrogen spray gun

and efficient capture of contaminated concrete dust generated during the scabbling operation.

The technology has the advantages of providing interesting surface decontamination ratios in the range of five square meters per productive hour, as well as being versatile in the sense that the same tool can be used for large surface shallow scabbling as well as localized hot spot decontamination. UP2 400 D&D program involves a large concrete scabbling program towards the end of operations, covering the entire plant. Rather evidently, the experience acquired in Veurey and Annecy has been transferred to UP2 400 and NithrowTM has been selected as the reference technique for large surface concrete scabbling prior to declassification.

CONCLUSION

Over the Years, each of the D&D projects managed by the AREVA has brought specific issues and challenges; which have been overcome and turned into experiences. The creation of the Business Unit in 2008 was in part intended to federate and organize the capitalization of knowledge, in order to create added value for future projects. The four illustrations presented above demonstrate the relevance of the concept.