DECOMMISSIONING OF UP-1 FACILITY: A CHALLENGING PROJECT (OCTOBER 2004)

C. Volle, L. Destrait
SGN
Etablissement Sud-Est, BP 144, 30204 Bagnols-sur-Cèze, Cédex, France

P. Seurat
COGEMA
Marcoule, BP. 170 30206 Bagnols-sur-Cèze, Cédex, France

INTRODUCTION

UP1 Plant operated separation of Uranium, Plutonium and Fission Products in different chemical dissolution and solvent extraction cells.
These facilities are located in MARCOULE which situated in the southern part of France.

The aim of this presentation is to give a general overview of the decommissioning operations of this plant.

The main aspects pointed out during the session are:

- Industrial organisation,
- Schedule,
- Funding and financial aspects,
- Some technical aspects,
- Current status of the operations and feedback.

Plant Presentation

Some key information about UP1:

- Start up: 1958
- Treatment of 18,600 tons spent fuel mainly issued from Gas Cooled reactors (GCR)
- Shutdown: end of 1997
- 1000 rooms or cells
- Rooms and cells total surfaces: 20 000 m^2


MAR 200
Uranium Nitrate Storage
Building100/MA
Building100/HA

General Background

The main reason which lead to UP1 Shut-Down is an economical reason. Reprocessing contracts ceased when all Gas Cooled Reactors operations have been stopped.

Shut-Down has been decided in 1995.
The following criteria have been taken in account to establish the decommissioning strategy of UP1:

- Local economical impact,
- Environmental aspects,
- Waste management and options available for final disposal,
- Costs.

Impact on the Local Economy

Marcoule is located in the southern part of France. COGEMA is one of the main local manpower employer of this area.
Immediate decommissioning occurs just after the end of operation it allows to keep the teams involved in plant operation in order to benefit from their knowledge.

Radiological Aspect

Compared to **reactor** decommissioning for which, since the dose rate is continuously decreasing after stopping exploitation (the main activation product being cobalt 60), it is interesting to wait until the dose rate reaches a certain level in order to allow intervention in direct contact, it is preferable, for **a reprocessing plant**, to undertake immediately the decommissioning, the plutonium being transmuting into americium which is a more active radioelement, which activity is not balanced by $\beta\gamma$ radiation decrease.

Waste Strategy

Estimation of quantity and characteristics of waste has been done during the early phases of the project. The target was to establish a global strategy for waste management, to identify a waste production schedule, the requirements in term of final and temporary disposal.
For most of all waste categories final disposals were not available. This situation greatly influenced the decommissioning plan.

Cost

Both global cost of immediate decommissioning and cost of delayed decommissioning including maintenance cost have been estimated.

It appears clearly that the cost of immediate decommissioning is lower, since:

- The activity of the installations is lower than if delayed,
- There is no additional cost due to survey of the installations during a long period of time.

French Safety Approach

Decommissioning of nuclear facilities must comply with a decommissioning standard procedure established by the French Safety Authorities.

A Safety Report, issued by the plant owner must be submitted to French Safety Authorities for approval before starting the decommissioning work.

This Safety Report must present the main characteristics of the Decommissioning Program, including a description of the objectives, of the main scenarios and a Program Schedule.

Depending on the installation, it can be requested from Safety Authorities to provide studies about:

- Impact on the environment,
- Economical impact
- Impact on health and safety

This Decommissioning Program, when approved by Safety Authorities, becomes the contractual framework by which the main contractor is engaged toward French Safety Authorities.

The framework applied for decommissioning activities can be described as follows:

1) **Step one: Preliminary assessment**
2) **Step Two: Setting of general decommissioning plan**
3) **Step three: Final shut down phase**
4) **Step four: On site industrial organisation**

Dismantling Strategy

Global Dismantling Strategy

Target of the decommissioning phase

The final objective of the Decommissioning Program is to dismantle the equipment until the radiation level allows to declassify the installation into a non nuclear facility.

Dismantling program

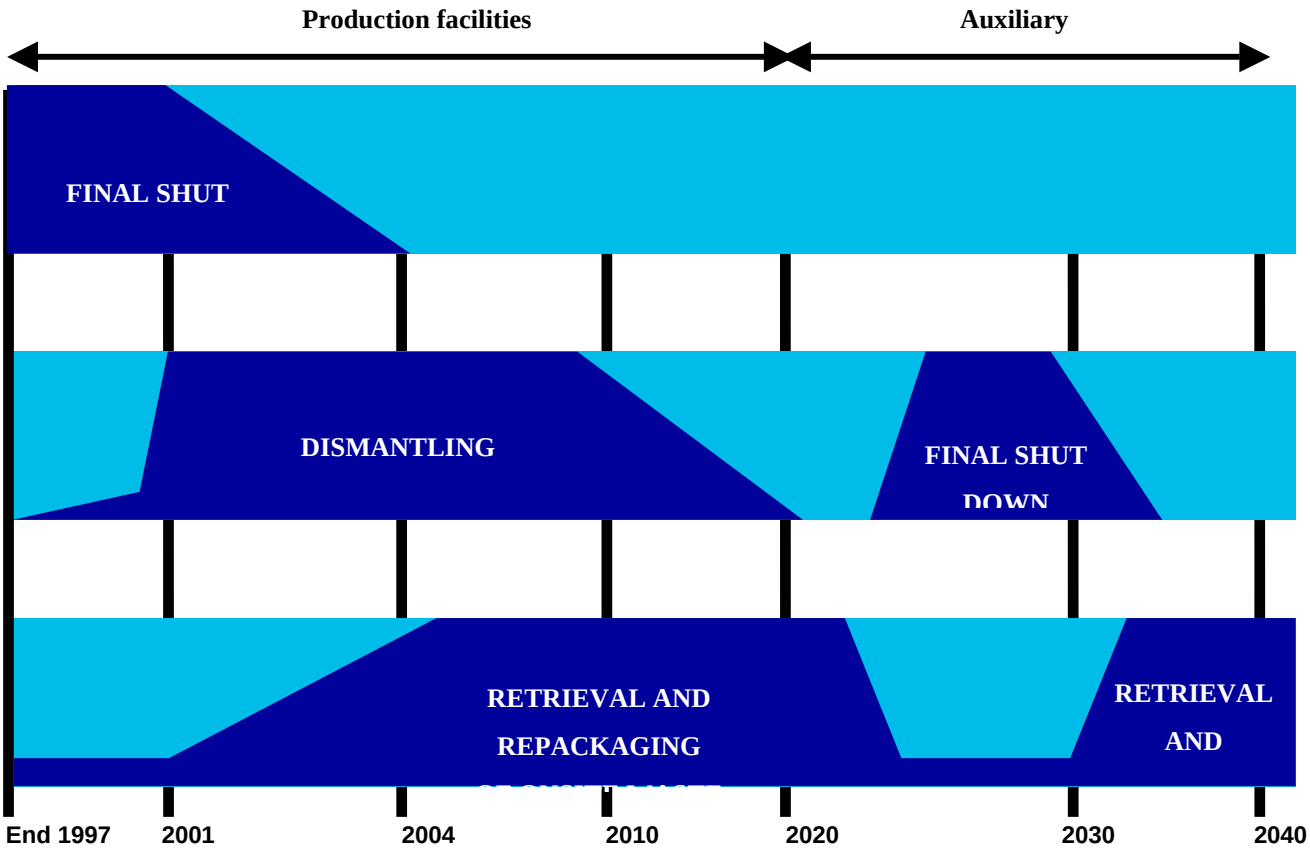
The overall dismantling program has been split into three main phases:

- Final shut down
- Dismantling
- Historical waste recovery and conditioning.

Schedule

The schedule has been established taking in account the following criteria:

- The management of the personnel who remain available on site for a long period of time,
- The budget which is annually allocated,
- The investment which have to be split according to annual budget.



Decommissioning Organisation

A Joint Venture named "CODEM", which is the client from contractual point of view, was created on July 1996. This Joint Venture provides and manages resources requested for organisation, programs and funding.

Participation to CODEM is split into:

- 45 % CEA,
- 45 % EDF and,
- 10 % COGEMA.

COGEMA, as former operator, is the prime contractor which provides the main resources devoted to projects site management.

COGEMA carries out the engineering studied, performs or subcontracts the work and operates the facilities.

In order to perform the engineering studies in compliance with the requested quality and safety standards, COGEMA has subcontracted studies to another Joint Venture created for this purpose in 1996. This Joint Venture is composed of three engineering entities: EDF, SGN and Technicatome.

COGEMA is the site owner and operator and, according to the legislation, is responsible toward the Safety Authorities for carrying out the work according to appropriate Quality and Safety Standards.

The relationship between CODEM (the Client) and COGEMA (services provider) has been defined by a specific agreement.

The financial shares are specified for each contract based on the proportion of services and waste produced during plant operation which can be assigned to each member of the Joint Venture.

Relation between CODEM and COGEMA is based on a comprehensive operating scenario that defines program schedule and cost.

The scenario is revised annually. Validation and funding of a scenario depend on:

- General waste survey,
- Funds available,
- Technical validity of the scenario.

Decontamination Techniques

Decontamination Strategy

Several decontamination techniques have been implemented during Final Shut Down operations. The techniques for decontamination depend on the characteristics of equipment, the environment in which operations have to be performed, the characteristics of the contamination, etc.

Several decontamination processes have been used for decontamination of UP1:

- Chemical rinsing of the process lines,
- Decontamination of surfaces,
- Mechanical scrapping devices coupled with vacuum cleaner, etc.

Decontamination Level Targets of the Final Shut-Down Phase

The following decontamination level targets have been defined. They have not to be considered as mandatory, but more as guidelines.

Contractual radiological criteria

- radiation dose rate below 0.2 mGy/h,
- no hot spot over 10 mGy/h in direct contact measurement,
- residual contamination below 1 DAC (Derived Air Concentration) for all rooms and workshops,
- Non fixed surface contamination must remain below 100 Bq Alpha /cm^2

Contractual rinsing criteria

- Concentration of Pu / U of the chemical solution for each rinsing loop (excluding U process line) below 0.5 mg/l.

Glove boxes

- Residual Pu contamination inside the glove boxes and equipment (including in the Pu line process) below 3.7 1010 Bq.

Chemical Rinsing Process

All process lines have been rinsed using adapted chemical solution. Typical rinsing scenarios can be described as follows:

- Phase 1: Rinsing with conventional reactants described in the Safety Operation Reference List;
- Phase 2: Rinsing with specific reactants adapted to the removal of activity, such as tartaric acid, potassium permanganate, flluorhydric acid, $cerium^{IV}$, described in a new Reference List for Final Shut-Down.

Global Results of UP1 Rinsing Operations

Weight of Pu recovered	9 kg
Weight of U recovered	329 kg
Activity removed	403,109 (Ci)
Liquid waste generated for chemical rinsing	2600 m3
Man x hours since beginning of Final Shut-Down operations	260,000 h

Surfaces Decontamination

Several techniques have been used for decontamination of different types of surface.

Steel or Stainless Steel Decontamination

The main techniques used for steel or stainless steel decontamination surfaces are:

- Ultra High Pressure (U.H.P) water spraying (range of pressure 300 to 2500 bars)
- High pressure spraying with chemical solution (pressure below 200 bars)
- Media (sand or other) blasting is of less frequent use, since this technique generates atmospheric contamination.

Decontamination of Concrete Surface

The decontamination of thin layer of concrete (painted coating for example) is performed by using pneumatic hammer or needle hammer, Concrete scabbing machine, Concrete milling machine (for filter room)

Method Used to Fix the Contamination after Decontamination Process

As preventive measure for avoiding a potential release of activity after decontamination process, coating of the surface can be applied.

Decontamination of Glove boxes

- Vacuum cleaner,
- Small tooling devices used to scrap and wipe the inside part of the glove box,
- Wiping devices used for surface cleaning.

Dismantling

The main purpose of decontamination is to reduce the level of contamination until direct contact intervention becomes possible and cost effective.

ALARA principle is a guideline for identifying whether or not decontamination is relevant.

Both conventional and remote techniques have been studied and used in UP1.

Based on the scenarios defined during the engineering phase, COGEMA has established a strategy for both manual and remote type of intervention.

Most of the tools used for deconstruction work are standard off the shelf tools, which are used in direct contact by the operators.

For Mechanical Cutting:

- Circular saw
- Alternative saw
- Disk Grinding
- Sheers,
- Nibbler machine

For Thermal Cutting:

- Plasma torch,
- Oxy / gas thermal cutting technique

For specific area for which intervention in direct contact was not possible, COGEMA has developed a "Tool box" which include remotely operated vehicle.

Waste Generated during Plant Operation

These wastes will be recovered, conditioned or reconditioned and placed inside a temporary storage facility until final disposal is available.

Studies of this program are in progress.

An inventory of this type of waste is given in the following table:

Waste Produced during Dismantling Operation

Liquid and solid wastes will be generated during UP1 decommissioning:.

Most waste generated during the final shut down phase are liquid waste. Production of liquid waste will no longer be allowed during dismantling phase.

The level of activity is a key criterion for waste characterisation, treatment, temporary storage or final disposal.

The classification of waste is:

- Conventional / industrial
- VLA (very low activity => standard drums)
- A (short life low activity => standard drums)
- B (long life low activity => Bitumen)
- C (long life => Vitrification)

The current situation regarding depositories for nuclear waste in France is the following:

- VLA waste: opening of ANDRA dedicated storage forecast in mid 2003,
- A waste: CSA surface repository, which is under operation,
- For B and C waste, the final underground repository is not yet defined.

Waste has been identified and characterised for each workshop, according to the following procedure:

- Material inventory,
- radiological characterisation,
- research of past incidents,
- identification of modifications.

Based on the information provided by these investigations, a waste zoning of each workshop has been established and has lead to classify waste of each workshop in the following categories: VLA, A, B and C.

Radiation Protection

ALARA approach has been one of the basic criteria taken into account during the development of decommissioning methods and procedures.

Dose estimation, follow up, and assessment criteria have been studied in order to comply with the French Regulations and to optimize operation efficiency.

Estimations of the cumulated dose rate have been established during the first engineering phases of the UP1 decommissioning project. These estimations were based on the radiological inventory available at this time. They have been continuously improved, mainly because radiological status of the installation is getting more and more precisely known.

That allows now, before each decontamination operation, to carry out an accurate evaluation of the expected dose rate, to determine the scenarios of intervention, the allowable time of exposure and the number of operators to be involved.

The intervention time allowed in restricted area is limited to 4 hours per day (divided in 2 hours on morning and 2 hours on afternoon), the integrated dose of personnel is individually monitored and controlled, with an objective of maximum annual dose of 15 mSv (lower than French regulation which is 20 mSv/y for B category workers).

This threshold may be quickly reached and may request high personnel turnover. Consequently overall intervention efficiency is reduced, and cost of interventions for which radiation level requests special clothes and breathing equipment is very high compared to daily work time in normal area.

Two ways are possible to minimize human intervention in contaminated and irradiated areas:

- Use of remotely operated tools
- Reduce as much as possible the contamination and radiation dose rate using process lines for decontamination.

Research and Development

Several techniques for waste treatment, as well as remote intervention and decontamination have been developed by COGEMA.

Most of the decontamination and dismantling techniques mentioned in the paragraph “decontamination” and “dismantling” above have been developed specifically by COGEMA.

Rinsing processes have developed in order to optimize efficiency and to define the relevant concentrations according to the chemical reagents used.

Cost

Costs as well as schedule are parameters which were, at the beginning, very difficult to estimate. Since the decommissioning has started, COGEMA has continuously improved the method used to perform these calculations. This method aims at identifying in a data base the relevant ratios and criteria which impact the cost at all phases of a Decommissioning Project.

Cost Breakdown

As a result of the evaluation method, the table of next page indicates the decommissioning cost ratios for a group of facilities.

CONCLUSION

Knowledge of the past and recent history and detailed analysis of the current radiological and physical status of the installation are critical aspects and must be clearly identified for establishing the global dismantling strategy of nuclear plans.

Phase / Operations	Partial	Total
Final Shut-down		**17 %**
Rinsing	3 %	
Preparation for decontamination	2 %	
Decontamination	6 %	
Effluent treatment	6 %	
Dismantling		**35 %**
Preparation	3 %	
Cutting and cleaning	30 %	
Effluent treatment	2 %	
Waste preparation		**21 %**
Waste treatment (FSD & Dismantling)	11 %	
Incineration and melting	10 %	
Waste shipping and storage		**16 %**
Surface repository	6 %	
B waste	6 %	
C waste	4 %	
Miscellaneous		**11 %**
Radiation protection	3 %	
Operation of safety systems	4 %	
Laundry and other	4 %	

Decommissioning cost ratios of a group of facilities