UP3 PLANT FIRST REPROCESSING CAMPAIGNS

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ABSTRACT

The UP3 plant start up has been achieved in two successive steps. The first one, from November 89 to April 90, involved all the facilities but T1, the head-end facility. During that period, shearing, dissolution and the first cycle extraction operations were performed in UP2 plant. 100 tons of fuel have been reprocessed that way.

The second step began in August 1990, with the T1 facility start-up and the reprocessing of the resulting active solutions in the rest of the plant. This second phase involving the entire UP3 plant continued until the end of January 1991. At that time, 160 tons of fuel have been completely treated in UP3 plant.

INTRODUCTION

At the end of 1988, the UP3 reprocessing plant project was in its final phase of realization. However, it appeared that the necessary exchange of Zirconium equipments in T1 facility would involve a 9-month delay for its potential active start after that of the other facilities.

The decision was then taken to start the UP3 plant without its head facility, feeding it from UP2 400.

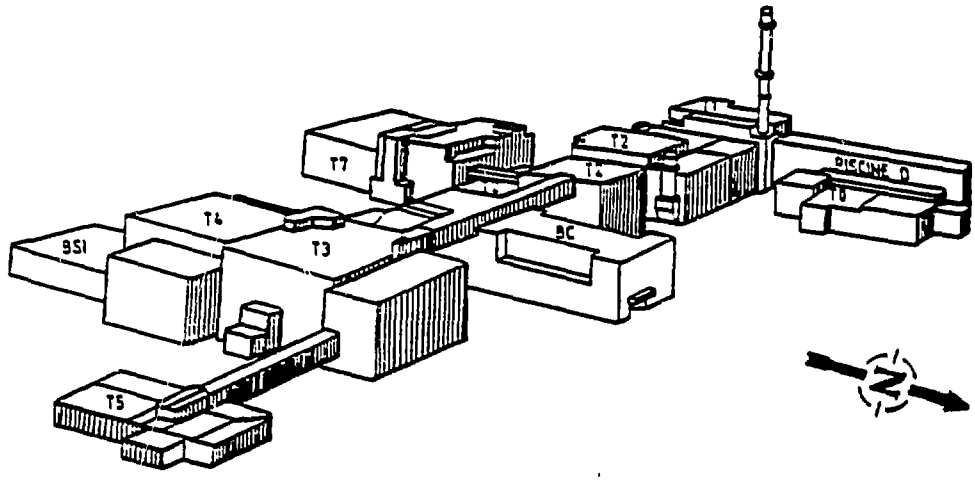
Fuel elements were sheared and dissolved in the UP2 head-end : the HAO facility, the resulting solutions came through first decontamination cycle in the HA/DE workshop of the UP2 plant, then they were transferred to UP3, through a 700 meters long connecting pipe.

This strategy made possible to maintain a motivating schedule for the active commissioning of the "chemical" facilities :

- T2 (first cycle of purification, uranium/plutonium, fission products storage) ;
- T3 and T5 (final purification and storage of uranium) ;
- T4 (final purification and conditioning of plutonium),

and the BSI (Pu storage) building (see Figure 1).
It also offered the opportunity to initiate active operations in UP3 with uranium and plutonium but without any fission products, making easier possible adaptations in the active areas.
On the other hand, the UP2 plant worked well in 1989. Having completed its own reprocessing programme in October, it was available to feed UP3 in due time.

Figure 1 · UP3 Plant - LA HAGUE



1. FIRST START-UP IN NOVEMBER 1989

1.1 Main objectives

The essential objectives of the first working campaign were the following ones :

- test the functioning of each facility (partitions and purifications) ;
- check the specifications of PuO2 produced in T4 ;
- check the quality of solvent recyclings ;
- test the liquid waste transfer on line to the liquid waste treatment facility STE3.

The programme was progressive : the main principle was to start each facility independently with small quantities of solutions, to identify clearly both process and technological questions and solve them. When enough PuO2 has been produced, quality operations of the whole UP3 chemical units and T4 conversion were demonstrated.

1.2 Progress

The governmental authorization for the active start-up has been given to COGEMA on November 16, 1989. On the following day, UP2 began its shearing and extraction operations on Japanese fuel. The effective UP3 active start-up took really place on November 23, as the first U + Pu solutions were received in T2 accountability vessel, through the UP2-UP3 connecting pipe.
A few days later and as soon as the amount of solution was sufficient, the solvent extractions units were started in the T2 and T4 facilities.

This campaign began with a 8 tons batch, corresponding to the hold-up of T2 accountability unit ; then, after checking the good running of T4, the head-end operations restarted in UP2 during the first week of December, then without any break until the end of the month after a total treatment of 30 tons of fuel.

From a global view point, each facility worked satisfactorily and reached rapidly its nominal performances. Extraction operations on T2 ended before the end of 1989 and the transfer of the last PuO2 container to BSI, which is the very last step of UP3 operations, took place on January 16, 1990 : exactly 2 months after the active start-up authorization.

1.3 Results

The chemical process gave excellent results ; high efficiency of the pulsed columns in T2 and T4, satisfactory use of the Organic Waste Treatment unit (OWT) and the associated solvent recycling to the extraction cycles : the recycled products (TBP and diluent) were fully useable.

One of the UP3 specific features is the automatic sampling system and pneumatic transfer to the analytical laboratories.

This new and sophisticated system (700 samples/day) required a 4 weeks running-in period. The results were satisfactory ; out of 21,000 planned analyses, 90 % have been really achieved.

The progressive start-up procedure made possible to proceed after this first campaign to the few technological adjustments needed, in easy radiological conditions :

- Air-lift at the beginning of the second Pu purification cycle, which was due to a parasit gas formation in its up-stream leg (T4).
- Stirrer turbin throwed out of gear on partition battery (T2).

1.4 Conclusion

The gradual start-up of the plant allowed to test each unit from a safety point of view and to identify several minor questions easily solved.

The different facilities worked very well and reached rapidly their nominal capacity so that the scheduled dates for this first campaign have been respected day by day.

2. SECOND CAMPAIGN - MARCH/APRIL 1990

2.1 Objectives and performances

This campaign concerned 70 tons of fuel and aimed at strengthening the first conclusions and complete them on the following points :

- Check the efficiency of the modifications performed during the intercampaign.
- Investigate the flexibility scale of the different chemical functions.
- Test the units start-up and shut-down procedures.
- Characterize the liquid effluents transferred to STE3.

The whole operations took less than 2 months and were achieved in satisfactory conditions, as no particular difficulty was encountered. The good performances of chemical units observed during the start-up of the plant were maintained and it appeared that they had an important flexibility (T2 worked up to 5.2 tons/day). Moreover, thanks to an optimization of OWT operating conditions, the average rate of organic residues was significantly reduced.

2.2 Conclusions

The progressive start-up period in two campaigns followed by small modifications phases allowed to benefit of important operation technology feed-back. These two campaigns have also authorized a global test of the whole system, including both operations and maintenance, in conditions close to the nominal ones.
It has also shown the volume, nature and activity of the various effluents. In this respect, results are encouraging, as every recycling device proved to be efficient.

After U and Pu treatment, corresponding to 100 tons of fuel, it appeared that the plant operation, except fission products, was globally demonstrated from T2 to BSI, from a quality point of view (meeting the required specifications) as well as from throughputs.

3. COMPLETE PLANT START-UP PREPARATION (T1 START-UP)

The T1 facility includes 2 independant lines.
At the end of 1989, only line B was tested with Uranium.
Line A, totally inactive, was kept as a priority line for adaptations.
Dismounting works of Zirconium equipment began in November and assembling works of new equipments occurred in Spring 1990 on line A, then on line B.

Five main objectives were assigned in 1990 for the T1 facility :

- Active start-up of Line B feeding cell in April, to test the burn-up measurements on real fuel elements.
- End of equipment assembly on Line A in May.
- Realization of an inactive Ultimate Reference Period on Line A during June.
- Finishing of Line B before the end of June.
- Control procedures qualification for the hulls and end-pieces drums.

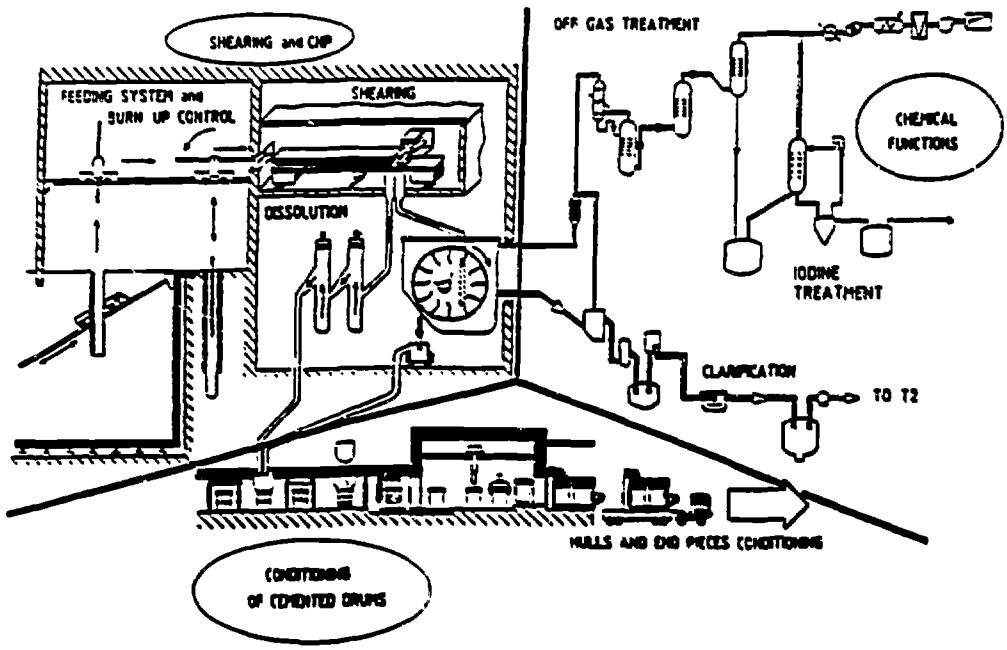
All these objectives were reached as planned and T1 facility was ready to work in active mode at the beginning of August 1990.

4. FACILITY START-UP IN AUGUST 1990

4.1 Objectives and programme

It should be reminded that the 3 major functions of T1 facility are clearly separated (see Figure 2) :

Figure 2 : The three main functions of T1 facility



. Shearing, dissolution of fuel elements and the associated CNP (Nuclear Process Control).
. Hulls and end-pieces conditioning in drums filled with cement and evacuation to the EDS workshop (solid wastes storage).
. Chemical functions such as clarificatioon of dissolution solutions, fines treatment, iodine treatment...

The T1 facility start-up programs followed the same principle tested successfully in November 1989 : i.e. a progressive starting mode of the units, in two successive phases :

A 6 weeks period covering :

. Integrity checking of the first confinement barrier of the T1 facility.

. Progressive qualification of operations relative to the three T1 above-mentioned functions, successively on each line of the facility.
The capacity estimation concerned only shearing operations on short periods such as one or two days.

. Progressive transfer of fission products in the extraction equipments in order to examine gradually their influence, both from a radiological and chemical process point of view.

A 4 months production phase allowing to :

. Qualify the functions capacities other than shearing, on campaigns batches increased gradually from 10 to 25 tons.

. Quantify phenomena like accumulation in the first cycle extraction and determine when the equipments had to be cleaned or rinsed.

. Qualify procedures and specific equipments for the most frequent interventions.

. Optimize the time needed to shift from one line to the other one.

. Reprocess 160 tons of fuel before the end of January 1991.

4.2 First step start-up

The start-up governmental authorization was received on August 17, 1990.

A short transfer period from vessel to vessel of U, Pu diluted solutions allowed first to check the radiological integrity of the first barrier.
The first irradiated fuel element was sheared on August 23 on Line A of T1 facility.

The first fuel elements to be treated were chosen with low burn-up (16,000 MWd/t) and long cooling time (10 years).

This first operating phase alternated shearings and investigations periods to check the good status of the different equipments.

The amount of sheared fuel for each period was gradually increased from 1/3 to 17 fuel elements without interruption.

After 10 tons had been sheared on Line A, operations were transferred on Line B. Eight days have been necessary to change from Line A to Line B. After a short inactive reference period, Line B began on its turn its active operation on September 25.

The first active solutions produced by T1 were treated in T2 at the beginning of September after dilution with uranyl nitrate to obtain 1/10 of nominal concentration.
A second campaign was achieved with a dilution of 1/4. Then the solutions were treated in T2 facility as produced by T1.

At the end of September, 15 tons of fuel were sheared, which ended the first part of the programme.

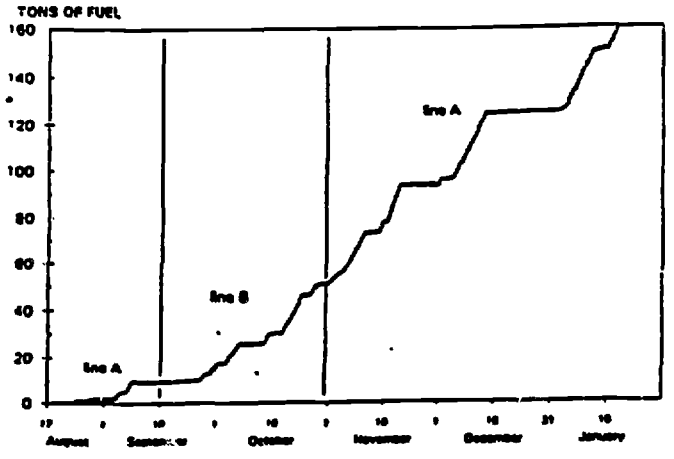
The results were satisfactory as the capacity of 3 tons per day was overpassed several times during that period.

4.3 Second start-up step

. The main objectives of this second step was to increase progressively the shearing rate and periods. However it was planned from the beginning, systematic stops every 12 tons at first, then every 25 tons, to check the dissolver feeding chute and to perform hulls and end-pieces drumming operations.
A new change of line was programmed at the end of October.
Taking into account the knowledge from UP2 operation, it was planned to rinse the extraction columns after about 60 non-diluted tons programme period.

. On January 18, 1991, 160 tons of fuel were reprocessed (see Figure 3), most of it with a burn-up close to nominal value.

Figure 3 : Cumulative mass of sheared fuel assemblies.



The only significant adjustments shown necessary by the campaign were related to :

. Evacuation of the hulls from the rinser to the drumming station.
. Cleaning of the lower part of the dissolver feeding chute.

During that campaign, the average shearing rate, increased progressively from 1,6 tons per day to 3,2 tons per day ; the nominal throughput of 4 tons per day was repeatedly achieved.

. The flowrate increase of hulls and end-pieces drums was significant during this period although not enough to allow the same operation pace as the shearing rate.
The Process Nuclear Control (CNP), which checks and qualifies the hulls and end-pieces drums, gave satisfaction.
Quantities of fissile materials measured in the drums are significantly lower than the guaranted values. This shows that the rinsing process before conditioning is particularly efficient.

. The major chemical functions have operated correctly, in particular :

- The quality of iodine trapping and treatment before release, was clearly proved.
- The clarification of dissolution solutions gave the expected results.
- The fines calibrating system after centrifugation operated correctly.

. The extraction facilities operations ran well ; no problem due to interphase residue accumulation was encountered in the pulsed columns. The beta decontamination factors are high, thanks to the good quality of the solvent. For instance, the uranium decontamination factor in the first cycle attained 800,000, while the objective was 2,500.

For plutonium, the 1st cycle decontamination factor attained 700,000 for an objective of 1,250. However it should be remembered that these decontamination performances have been attained on 7 or 8 years long cooled fuels.
The solvent, even in the 1st cycle has a much higher radiological quality than that observed on UP2.
The rinsing effluents of the columns showed only a low activity.

CONCLUSIONS

Five months after the T1 and the complete UP3 start-up, it is clear that all the units run properly in each facility.

No major problem was met and the first operation data feed-back proves that the new process equipments and the technological devices are fully satisfactory.

160 tons of fuel have been reprocessed in UP3. Some improvements are still necessary to reach a nominal operation : ensure a high level of the hulls and end-pieces conditioning capacity, up to the level reached by the other units of T1, improve some programmable computers softwares, and of tools for curative interventions specific to mechanical high activity areas.

A first intercampaign will allow, during the first quarter of 1991, to realize the adjustments generated by the operation technology feed-back of that first shearing campaign.

Finally, in terms of health physics, the first months of operation of UP3 have proved extremely encouraging, as a very low level of collective radioactive dose to the personnel has been recorded, below 10 Man-Rems, a tremendous progress on usual values observed in the reprocessing plants up to now.