



**COGEMA**

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**FUEL CYCLE RADIOACTIVE  
WASTE TREATMENT  
TECHNOLOGY DEVELOPMENTS**

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## OPTIMIZING THE FUEL CYCLE «RADIOACTIVE WASTE» MANAGEMENT

a «waste» is : «a residue resulting from a production or conversion process, or other substance, material, product which has been abandoned or is destined to be abandoned» (French law 15.07.1975 regarding the elimination of waste and the recovery of resources)

the French government favours a four-step policy regarding the management of all types of waste :

- 1) reduce waste production at its source («clean production») :  
develop technologies and products which minimise pollution
- 2) recycle all valuable materials
- 3) improve waste treatment techniques
- 4) condition ultimate residues with a view to their final disposal

COGEMA incorporates the above into its own waste management policy for each stage of the nuclear fuel cycle.

## ... IN THE URANIUM MINING INDUSTRY

### a new approach for the JEB mill

the Mc Clean Lake mill, or JEB mill, will process **high grade** uranium ores (up to 30% uranium) from the Cigar Lake, the Mc Clean Lake and Midwest projects

the initial capacity of the JEB mill (6 million lb U<sub>3</sub>O<sub>8</sub>) will be expanded to 24 million lb U<sub>3</sub>O<sub>8</sub> after approval of the Cigar Lake Project

the new approach for the JEB mill emphasizes : safe operation of the mill and a maintenance free solution after decommissioning. Both objectives are to be integrated into the early design stages.

## ... IN THE URANIUM MINING INDUSTRY (2)

### a new approach for the JEB mill

1) process optimization following high safety standards :

- automatization of the ore receiving facility
- the milling process is largely conventional, but a specific design used in the leaching circuit, the «elevated shielding slab concept», will protect operating personnel from gamma emitting sources (reduction of the risk of internal pollution)

2) an optimized waste management system for high grade ores :

- the waste neutralization circuit will combine the various waste streams, neutralize and treat them before any release to the environment
  - tails management : preparation of paste tailings in parallel with ore processing and deposit of these paste tailings sub-aqueously in the mined out JEB pit
- => long term containment of contaminants by channeling clean ground water around the consolidated tailings + quicker decommissioning

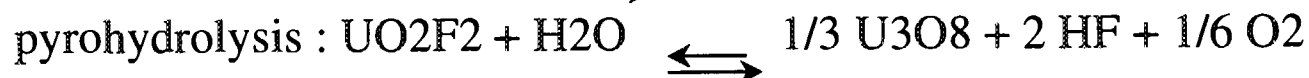
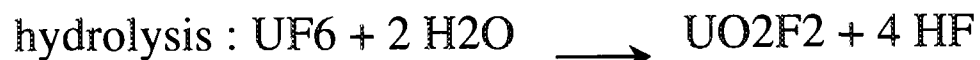
**... IN THE URANIUM ENRICHMENT INDUSTRY**  
**defluorination of depleted UF<sub>6</sub> at the W plant (Pierrelatte)**

2 defluorination lines in commercial operation since 1984

2 (new) defluorination lines in commercial operation since 1993

total plant capacity : 14.000 t U, resulting in 16.000 t U<sub>3</sub>O<sub>8</sub> and 10.000 t HF

plant production (1996) : 14.000 t U<sub>3</sub>O<sub>8</sub> and 10.000 t HF



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defluorination process : electrically heated rotating furnaces

banks of self-cleaning filters

compacting of the powder (cylinder type compacting machines)

HF processing : condensers working at temperatures comprised between +25 and +30° C

gaseous effluent neutralizing towers and ancillary equipment

motor-driven pumps circulating the liquid products resulting from the process

**... IN THE URANIUM ENRICHMENT INDUSTRY (2)**  
**defluorination of depleted UF<sub>6</sub> at the W plant (Pierrelatte)**

- 1) process optimization : recovery of high-quality aqueous HF
- 2) recycling of valuable materials : separation of the depleted UF<sub>6</sub> into HF and U<sub>3</sub>O<sub>8</sub>
  - hydrofluoric acid is a marketable material : the fluorine contained in UF<sub>6</sub> is recycled in several industrial sectors (glass industry, metallurgy, electronics...)
  - uranium oxide U<sub>3</sub>O<sub>8</sub> is a chemically stable, insoluble and inert product : it can be stored for a long-time period and recycled (MOX, AVLIS...)

## ... IN THE REPROCESSING-RECYCLING INDUSTRY

### 1) process optimization :

- optimization of the recovery rate of U and Pu through reprocessing in the La Hague plant : 99.88% separation efficiency in UP3 plant
- reduction of the releases to the sea despite increased production at UP2/UP3 plants :

|  | 1989  | 1996   |
|--|-------|--------|
| Annual quantities reprocessed at UP2/UP3 (tHM)       | 460.3 | 1680.9 |
| Releases to the sea $\beta, \gamma$ activities (TBq) | 588   | 29.4   |
| Releases to the sea $\alpha$ activity (TBq)          | 0.36  | 0.05   |

### 2) 3 main benefits from the reprocessing-**recycling** policy (in comparison with the DD option):

- reduces drastically final quantity of waste by recovering U and Pu
- lowers long term radiotoxicity to ALARA level
- saves natural uranium (30%) and SWU (15%), thus preserving natural resources

## ... IN THE REPROCESSING-RECYCLING INDUSTRY (2)

### 3) waste volume minimization

- **long lived final wastes** : 0.5 m<sup>3</sup> per MTU by 2000 compared with 2m<sup>3</sup> per MTU using the direct encapsulation process :

\* effective suppression of bituminized wastes in UP3 since the end of 1995

\* industrial compaction of hulls and end-pieces by 2000 in UP2 and UP3 (ACC):  
reduces waste volume by 4 compared with the previous cementation process

- **short lived technological wastes** : from 1.4 m<sup>3</sup> per MTU in 1995 to 0.8 m<sup>3</sup> per MTU in 2000 resulting from new management policies (NGD) to be implemented 1996-2000 :

\* precise measurement of the activity level inside the drums (2 counting lines)

\* uncontaminated waste is collected together. Low level wastes are controlled and sent for appropriate conditioning.

\* incineration of the non-metallic or liquid wastes, melting of the short lived metal wastes at the new CENTRACO plant (COGEMA-EDF).



## **... IN THE REPROCESSING-RECYCLING INDUSTRY (3)**

- 4) conditioning ultimate wastes with the objective of limiting the number of containers : by 2000, COGEMA will produce a standard canister, the Universal Canister, for all long lived wastes from the reprocessing plant (compacted hulls and end-pieces, vitrified wastes).