Location of the operations
Building 147 decladding workshops
Pit 7

- Pit 7 was designed to hold liquids during the operational period, and to enable the decanting and storage of graphite from EDF spent fuels and zeolites from cooling pool treatment.

- Height: 7.38 m
- Length: 6.55 m
- Width: 4.55 m
- Usable volume: 176 m³
- Covered by a 1m thick concrete ceiling slab
Worksite phases
Emptying and dismantling Pit 7 in the Decladding building

- Retrieval of the waste (sludge + graphite) present in the bottom of the pit
- Internal equipment rinsed
- A0 opening in the ceiling slab enlarged
- Dismantling and removal of the internal equipment
- Pumping system dismantled
- Final pit treatment (removal of polyester + concrete pit bottom and walls, and cleanup of black steel casing).
Equipment present

Diffuser pot and spreading blades 4 Gy/h

Opening A0

Pit center at mid-height 120 mGy/h

Effluent retrieval pot

Support frame

Wave control plates 240 to 400 mGy/h
Worksite setup

Plating attached over the Pit 7 slab

Telescopic sleeve

PYTHON remotely-controlled arm

Sleeve electrical motorisation

Elbow

Wrist

Gripper
Retrieval of waste from the bottom of the pit

- Use of a pumping SKID:

- The PYTHON arm enabled the suction nozzle to be positioned.
Rinsing the internal equipment

**RETRIEVAL POT**

**DIFFUSER POT AND ITS SPREADING BLADES**

**WAVE CONTROL PLATES**
Dismantling the internal equipment and the pumping system

- **Dismantled items cut up using:**
  - a Brokk 180 equipped with a grinder
  - A PYTHON arm equipped with a plasma torch

- **Dismantling the pumping system:**
  - Rinsing, then winnowing skid and pumping skid dismantled.
  - Removal of submerged pump and sludge retrieval pump.
Removal of cut pieces (1/2)

- The highly irradiating pieces were grouped in radiation-protected containers.

- These were lifted up through the pit ceiling and placed in a transfer cask, for containment in a special packaging or a suitable disposal site.
Removal of cut pieces (2/2)

- The other pieces were grouped in waste containers.
- An irradiation check was carried out by the PYTHON arm equipped with a measurement detector before their removal from the pit.
Final treatment of the pit

- Removal of the polyester lining and of the concrete tank walls until the black steel tank layer was reached (floor and walls).
- Surfaces chipped off by the Brokk inside the pit.
- Waste removed in suitable packaging.
- Complete radiological testing of the pit state.
- Brokk removed.
- Final cleanup carried out manually by operators.
The ALARA Approach
Operations carried out by STMI

- STMI carries out operations for AREVA (now ORANO), which is the prime contractor for the CEA (2010).
- STMI set out the ALARA approach associated with the operations (106 pages).
- Validated by the Order Giver after SPR validation.
- Operations planned to last 534 working days, i.e. 2 years.
- Forecast collective dose: 114.4 man mSv.
- Annual individual dose of 6.5 mSv.
Criteria taken into account in the ALARA approach

<table>
<thead>
<tr>
<th>INTERMEDIATE SLUDGE RETRIEVAL</th>
<th>Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>Criterion</td>
<td>1</td>
</tr>
<tr>
<td>Delivery time</td>
<td>5.8</td>
</tr>
<tr>
<td>Financial cost</td>
<td>5.5</td>
</tr>
<tr>
<td>Collective equivalent dose</td>
<td>4.0</td>
</tr>
<tr>
<td>Individual equivalent dose</td>
<td>4.0</td>
</tr>
<tr>
<td>Waste volume</td>
<td>6</td>
</tr>
<tr>
<td>Effluent volume</td>
<td>6</td>
</tr>
<tr>
<td>Technical difficulty</td>
<td>3.5</td>
</tr>
<tr>
<td>Security</td>
<td>6</td>
</tr>
<tr>
<td>Safety</td>
<td>6</td>
</tr>
<tr>
<td>TOTAL</td>
<td>46.8</td>
</tr>
<tr>
<td>AVERAGE</td>
<td>5.2</td>
</tr>
<tr>
<td>RANKING</td>
<td>2</td>
</tr>
</tbody>
</table>

Model

Criterion max value: 6

All criteria weighted at 1
Main variants studied (1/2)

SHOVELING

PUMPING

- PUMP OUTSIDE THE PIT
- PUMP INSIDE THE PIT

BROKK

- PYTHON Arm

Retrieval of waste in the pit

Rinsing internal equipment

- Directly via lead ball joint on existing openings
- Directly via existing openings in the ceiling slab
- Remotely handled

RETRIEVAL POT

DIFFUSER POT, WAVE CONTROL PLATES, SPREADER BLADES
Main variants studied (2/2)

- Lowering all the internals to the bottom of the pit for cutting up
- Cutting up internal items on the spot
- Lowering certain internals

Flowchart:
- Brokk
  - PYTHON Arm
  - Brokk + PYTHON Arm
  - No rinsing
- Rinsing the fragments
- Dismantling the internal equipment
## Dose forecasts in 2010

<table>
<thead>
<tr>
<th>Phase</th>
<th>Before optimization (man mSv)</th>
<th>After optimization (man mSv)</th>
<th>Dose gain (man mSv)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retrieval of waste in the pit</td>
<td>64.8</td>
<td>45.2</td>
<td>19.6</td>
</tr>
<tr>
<td>Rinsing internal equipment</td>
<td>182.6</td>
<td>9.4</td>
<td>173.2</td>
</tr>
<tr>
<td>Dismantling internal equipment</td>
<td>80.0</td>
<td>33.0</td>
<td>47.0</td>
</tr>
<tr>
<td>Structure treatment</td>
<td>26.9</td>
<td>26.9</td>
<td>0</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>354.3</strong></td>
<td><strong>114.4</strong></td>
<td><strong>239.8</strong></td>
</tr>
</tbody>
</table>
Evolution of the ALARA approach

- Since 2010, the ALARA approach has had 5 revisions (rev.7 → rev.12)
- 5 revisions of the forecast for the waste retrieval
- Discovery of highly irradiating waste (3 Gy/h) whose treatment has meant an increase in the forecast dose of 45 man mSv
- Premature wear on the aspiration pump leading to the need to change it 6 times, and meaning an increase in the forecast dose of 12.5 man mSv
# Operational doses at the end of 2018

<table>
<thead>
<tr>
<th>Phase</th>
<th>Forecast (man mSv) (Rev.7) 2010</th>
<th>Forecast (man mSv) (Rev.12) 2017</th>
<th>Actual (man mSv)</th>
<th>Dose gain (man mSv)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retrieval of waste in the pit</td>
<td>45.2</td>
<td>102.7</td>
<td>88.4 <em>Finished</em></td>
<td>14.3</td>
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<tr>
<td>Rinsing internal equipment</td>
<td>9.4</td>
<td>9.4</td>
<td>2.4 <em>Finished</em></td>
<td>7.0</td>
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<tr>
<td>Dismantling internal equipment</td>
<td>33.0</td>
<td>33.0</td>
<td>11.1 <em>Running</em></td>
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<tr>
<td>Structure treatment</td>
<td>26.8</td>
<td>26.8</td>
<td><em>Left to do</em></td>
<td></td>
</tr>
<tr>
<td><strong>Totaux</strong></td>
<td><strong>114.4</strong></td>
<td><strong>171.9</strong></td>
<td><strong>101.9</strong></td>
<td><strong>21.3</strong></td>
</tr>
</tbody>
</table>
Conclusion

For this worksite:
- 7 revisions of the ALARA approach before the worksite began
- 5 revisions since operations began (worksite started in 2010 and not yet finished)

On cleanup / dismantling worksites, the ALARA approach is applied continuously and dynamically.

There is a systematic updating of the ALARA approach at each significant change in the worksite, to establish the new dose forecast.

The objective is to guarantee the optimization of individual worker exposure.
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