What is the regulation in France concerning for the separation of nuclear and non nuclear metals?

- No clearance level authorized in France to determinate
  - Which waste is conventional
  - Which waste is nuclear

BUT

- To ensure a maximal safety level AND to avoid absolutely that a radioactive waste goes to a conventional field, the two following barriers are set up:
  - An a priori waste zoning
  - Radiological controls on the wastes before their evacuation
Principles of waste zoning

- Justification a priori, based on the design, operating rules and operating history (zones are confirmed through measurements)
- Physical barrier between the NWZ’s and CWZ’s,
- Application of waste zoning to outdoor areas (to the entire site),
- Information to the Regulator in case of change in the waste zone (or approval NWZ => CWZ).
From a Nuclear Waste Zone to Conventional Waste Zone

The regulation

- ASN allows us to present a “downgrade of waste” paper (SD3D07). To have the approval of ASN the document has to be conservative and has to respond to zoning principles.

Example of Secondary System of Creys Malville

- Contamination: 20 Bq/g of Tritium
- 1800 tonnes of metals (stainless steel...)
  - Downgrade this waste?
  - 1800 tonnes of metals will go to
    Radioactive disposal

Example of Creys Malville’s dome

- No radioactivity
- Demand to ASN to downgrade this waste
- Acceptance from ASN
- Conventionnal Wastes
Scrap metals

- Quantity of scrap metals due to the decommissioning of EDF’s Power Plants (to VLLW and LLW Storages)

Flux en t de metal TFA/FAMA Pgm de deconstruction

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DB Metalloqu.</td>
<td>TFA</td>
<td>30,451</td>
<td>2,071</td>
<td>3,772</td>
<td>4,308</td>
<td>3,478</td>
<td>7,397</td>
<td>285,019</td>
<td>115</td>
<td>1,088</td>
<td>1,251</td>
<td>1,170</td>
<td>461</td>
<td>372</td>
<td>618</td>
<td>1,101</td>
<td>1,475</td>
<td>1,088</td>
<td>1,060</td>
<td>2,130</td>
<td>1,500</td>
<td>807</td>
<td>216</td>
<td>447</td>
<td>2,230</td>
<td>1,220</td>
<td>313</td>
<td>273</td>
<td>144</td>
<td>120</td>
<td>1,113</td>
<td>2,039</td>
<td>126</td>
<td>180</td>
<td>53</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DB Metalloqu.</td>
<td>FMA vz (A)</td>
<td>23,624</td>
<td>600</td>
<td>43,41</td>
<td>1,202</td>
<td>3,222</td>
<td>574</td>
<td>283</td>
<td>303</td>
<td>420</td>
<td>1,098</td>
<td>1,308</td>
<td>4,022</td>
<td>4,468</td>
<td>7,397</td>
<td>576</td>
<td>7,683</td>
<td>3,116</td>
<td>1,656</td>
<td>431</td>
<td>821</td>
<td>1,298</td>
<td>1,483</td>
<td>2,630</td>
<td>1,923</td>
<td>977</td>
<td>720</td>
<td>123</td>
<td>126</td>
<td>620</td>
<td>256</td>
<td>68</td>
<td>78</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Goals:
  - Recycle maximum of scrap metals in the nuclear industry (based on environmental, economical and technical study)
Recycling is tough for radwaste

- Public acceptance
  - Syndromes: NIMBY, NIMEY, BANANA
  - Extra Nuclear - anxiety (pedagogy and media)

- Release variations: European diversity
  - Free? On Threshold? Conditional?

- Final repositories: a scarce resource
  - What is the net present value of future capacities?

- Characterisation
  - Precise characterisation difficult, but melting helps

- Traceability:
  - Upstream for better characterisation
  - Downstream to prevent «mis use»
Recycling in France: Closed loop

- Fuel Cycle
- PWR x 58
- GGNU x 9
- Research
- Defense
- Medical Waste
- Various Industrial Uses

Before:
- VLLW Repository
- Volume Reduction
- Elimination of Toxics
- Characterisation
- Reclassification
- Recovery-Recycling

After:
- Incineration
- Melting
- LLW Repository

Recycling in France: Closed loop
Operating experience in France

Steel recycling at Centraco
Subsidiary of EDF + AREVA
Single melt Integrated recycling
2 000 TPY LLW metal melting
LLW / VLLW

Lead recycling at Marcoule
Double melting (nuclear + conventional industrial)
VVLLW
Step nb 1 : Sorting the waste

There is scrap …

and scrap!
Step 3: melting for an outlet

- Decontamination factor: > 9 (alphas)
- Perfect characterisation
- Perfect homogeneisation
- No need for demonstration for « unaccessible parts »

\[ \beta_y (\text{Bq/g ex H3}) \]

**In-coming:**
- Declared: 160
- Measured: 24

**Out-Going \( \text{bg (ex H3)} \):**
- Measured: 20

\[ \alpha (\text{Bq/g}) \]

**In-coming:**
- Declared: 0.2
- Back-Measured: 1.01

**Out-Going:**
- Ingots: 1.00
- Others: 0.01
Step nb 2: Sell products

Sophisticated ...

... and simple
Issues for standard waste < 2m & < 1t

Segregation at source for better quality control

ISO 20’ Container

Boxes:
8m³  4 m³  2m³  1m³

200 l drum
### « Crap » from non sorted waste

<table>
<thead>
<tr>
<th></th>
<th>C eq</th>
<th>C</th>
<th>Mn</th>
<th>Cr</th>
<th>Mo</th>
<th>Cu</th>
<th>Ni</th>
<th>Si</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average (%)</td>
<td>1,10</td>
<td>0,27</td>
<td>0,88</td>
<td>2,62</td>
<td>0,11</td>
<td>0,90</td>
<td>1,68</td>
<td>0,71</td>
</tr>
<tr>
<td>Max (%)</td>
<td>3,36</td>
<td>1,25</td>
<td>1,99</td>
<td>10,70</td>
<td>0,46</td>
<td>1,30</td>
<td>7,51</td>
<td>2,28</td>
</tr>
<tr>
<td>Mini (%)</td>
<td>0,05</td>
<td>0,02</td>
<td>0,13</td>
<td>0,02</td>
<td>0,00</td>
<td>0,50</td>
<td>0,03</td>
<td>0,06</td>
</tr>
</tbody>
</table>

Ceq contribution | 1,13 | 0,27 | 0,15 | 0,52 | 0,02 | 0,06 | 0,11 |
Ceq contribution/100 | 100% | 24% | 13% | 46% | 2% | 5% | 10% |

nb batches < 0,5% | 21% |

Little recycling possible
Issues for Large components

- Good quality control of steel
- Thick pieces
- Nickel bearing components
- Transport can be a hurdle
Conclusions: Radwaste recycling in closed loop

- PRECAUTION PRINCIPLE chosen in early days
- SIMPLE and EASY to implement
- Implies « VERY LOW COST » of « VERY LOW LEVEL DISPOSAL »