# VLLW : Characterization and recycling for sustainable development

IAEA Conférence

Tarragona, Février 2009

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# Regulation

- 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

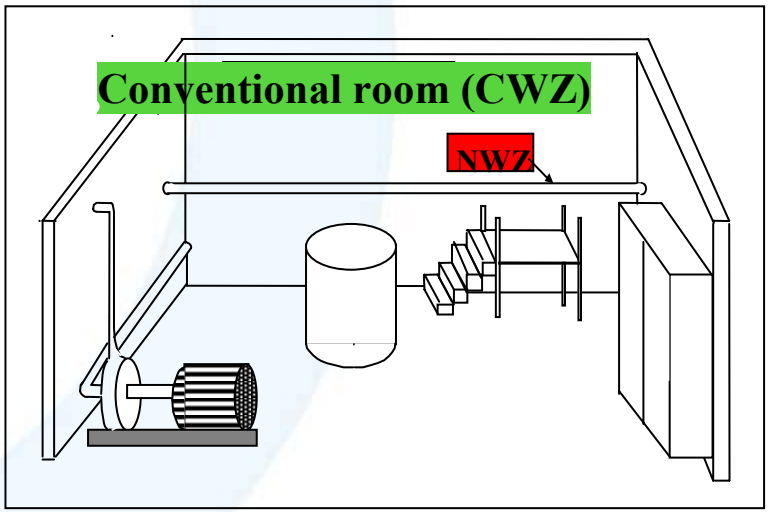
BUT

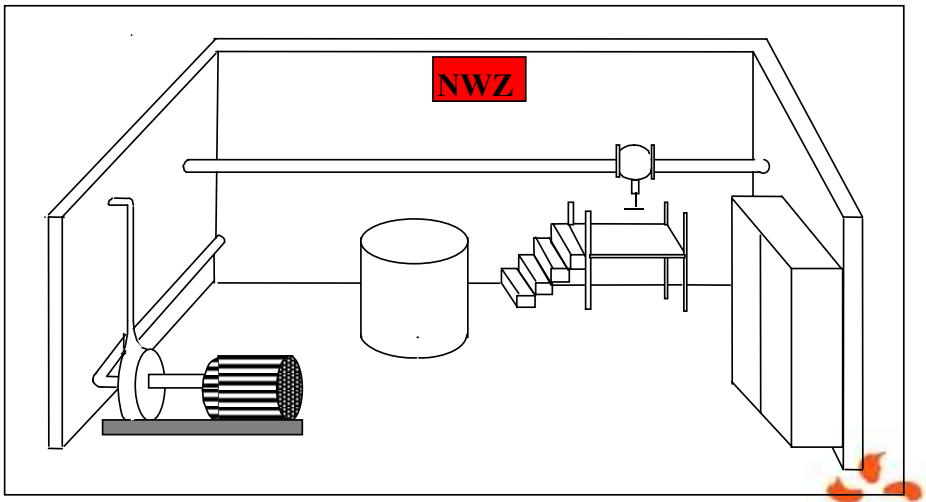
  - To ensure a maximal safety level AND to avoid absolutely that a radioactive waste goes to a conventional field, the two following barriers are set up :
    - An a priori waste zoning
    - Radiological controls on the wastes before their evacuation

# French Waste Zoning

## 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).**

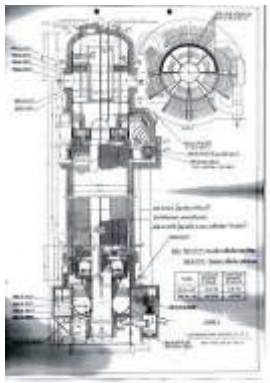


# From a Nuclear Waste Zone to Conventional Waste Zone

- 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 decomissioning of EDF's Power Plants (to VLLW and LLW Storages)

Travaux

Imprimé le 21/11/08

Flux en t de metal TFA/FAMA Pgm de deconstruction

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| | | | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Descriptif Cat | Descriptif Cla | Total | PREVISION Tonnes bruts | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| DIB Metalliqu | TFA | 38 451 | 2 07 | 3 72 | 4 36 | 3 47 | 734 | 286 | 1 15 | 1 08 | 1 25 | 1 17 | 461 | 372 | 618 | 1 11 | 1 47 | 1 09 | 1 05 | 2 13 | 1 53 | 687 | 215 | 447 | 2 23 | 1 22 | 310 | 273 | 144 | 128 | 1 19 | 2 05 | 126 | 180 | 52 | |
| DIB Metalliqu | FMA vc (A) | 23 624 | 600 | 434 | 1 20 | 322 | 574 | 282 | 303 | 420 | 1 09 | 1 39 | 402 | 476 | 739 | 576 | 786 | 3 11 | 1 65 | 431 | 821 | 1 29 | 1 43 | 288 | 1 60 | 977 | 120 | 1 26 | 620 | 255 | 68 | 78 | | | | |

- Goals:
  - Recycle maximum of scrap metals in the nuclear industry (based on environnemental, economical and technical study)



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# 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**
  - **Down stream to prevent « mis use »**

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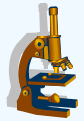
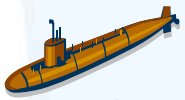
# Recycling in France : Closed loop

FUEL CYCLE

PWR x 58
GGNU x 9



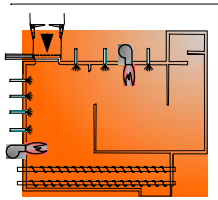
RESEARCH



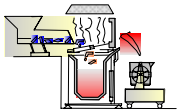
DEFENSE

MEDICAL WASTE

VARIOUS
INDUSTRIAL USES



INCINERATION



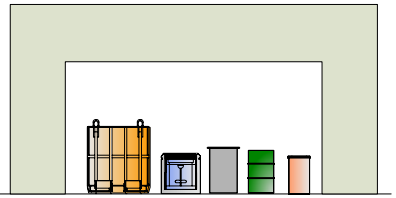
MELTING

RECOVERY-RECYCLING

VOLUME
REDUCTION

ELIMINATION
OF TOXICS

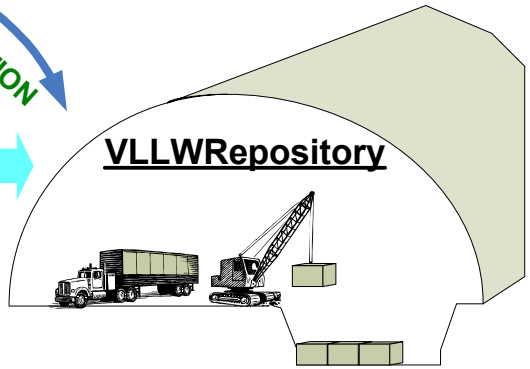
LLWRepository



CHARACTERISATION

RECLASSIFICATION

VLLWRepository



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# Operating experience in France

Steel recycling at Centraco

Subsidiary of EDF + AREVA

Single melt Integrated recycling

2 000 TPY LLW metal meting

LLW / VLLW


Lead recycling at Marcoule

Double melting (nuclear + conventional industrial)

VVLLW

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# Step nb 1 : Sorting the waste

There is scrap …

and scrap !

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# Step 3 : melting for an outlet

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

βγ (Bq/g ex H3)

**In-coming :**

Declared : 160

Measured : 24

**Out-Going bg (ex H3) :**

Measured : 20

α (Bq/g)

**In-coming :**

Declared :0.2

Back-Measured :1.01

**Out-Going :**

Ingots :1.00

Others :0.01

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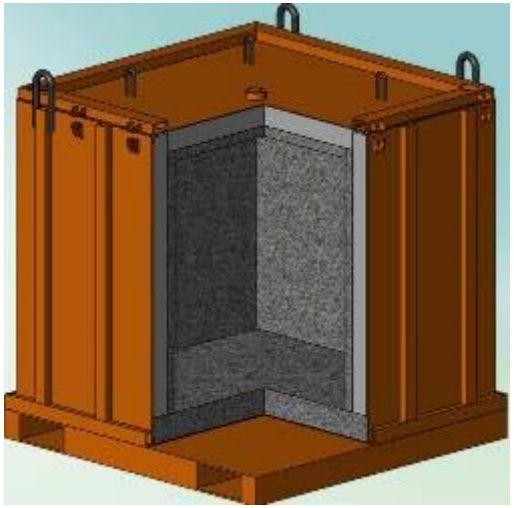
# Step nb 2 : Sell products

**Sophisticated …**

**… and simple**

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# Issues for standard waste < 2m & < 1t

ISO 20’ Container

Boxes :

8m3 4 m3 2m3 1m3

200 l drum

Segregation at source for better quality control

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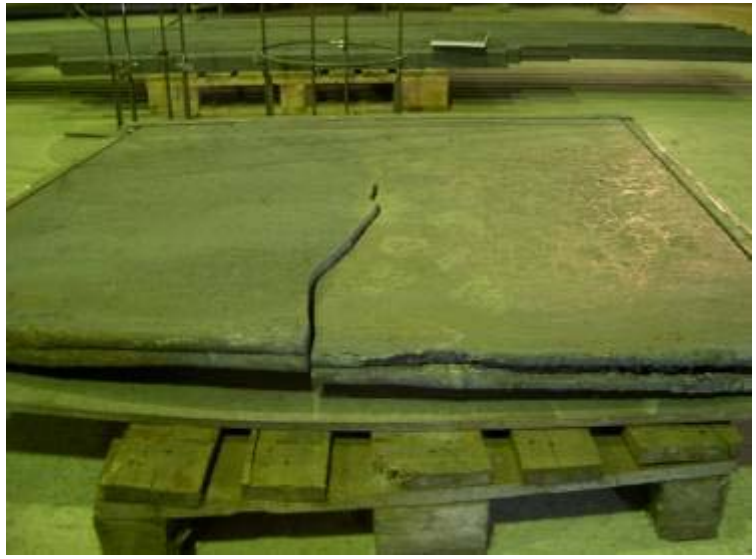
# « Crap » from non sorted waste

| | C eq | C | Mn | Cr | Mo | Cu | Ni | Si |
|---|---|---|---|---|---|---|---|---|
| Average (%) | 1,10 | 0,27 | 0,88 | 2,62 | 0,11 | 0,90 | 1,68 | 0,71 |
| Max (%) | 3,36 | 1,25 | 1,99 | 10,70 | 0,46 | 1,30 | 7,51 | 2,28 |
| Mini (%) | 0,05 | 0,02 | 0,13 | 0,02 | 0,00 | 0,50 | 0,03 | 0,06 |

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

| | |
|---|---|
| nb batchs < 0,5% | 21% |

Litte recycling possible



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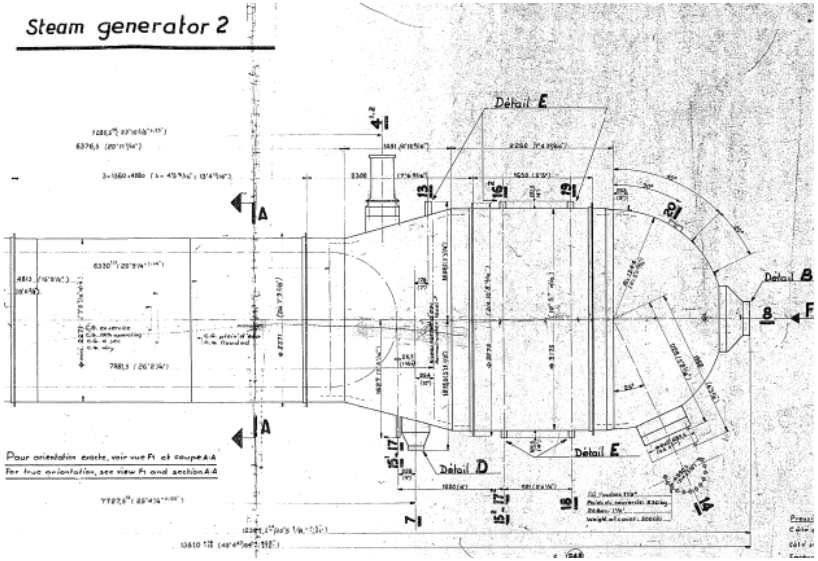
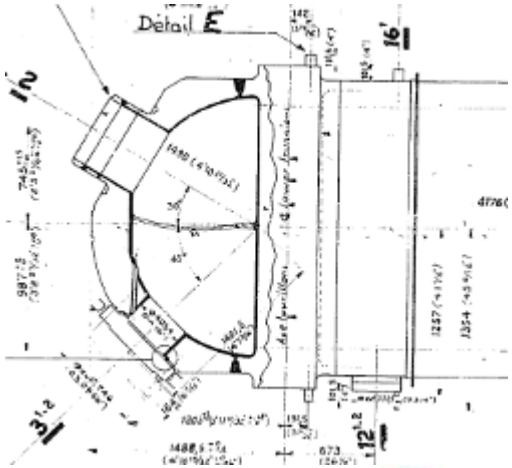
# Issues for Large components

- Good quality control of steel
- Thick pieces
- Nickel bearing components
- Transport can be a hurdle

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# Conclusions : Radwaste recycling in closed loop

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