

***French Operational Experience in  
Recycling Used Nuclear Fuel***  
***FCIX Conference***

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***June 25, 2009***

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***Back-End Division***

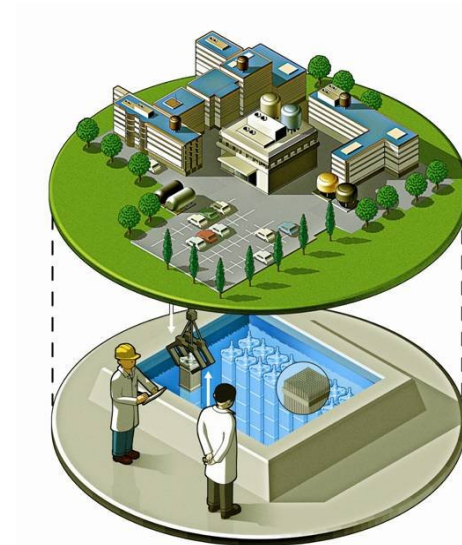
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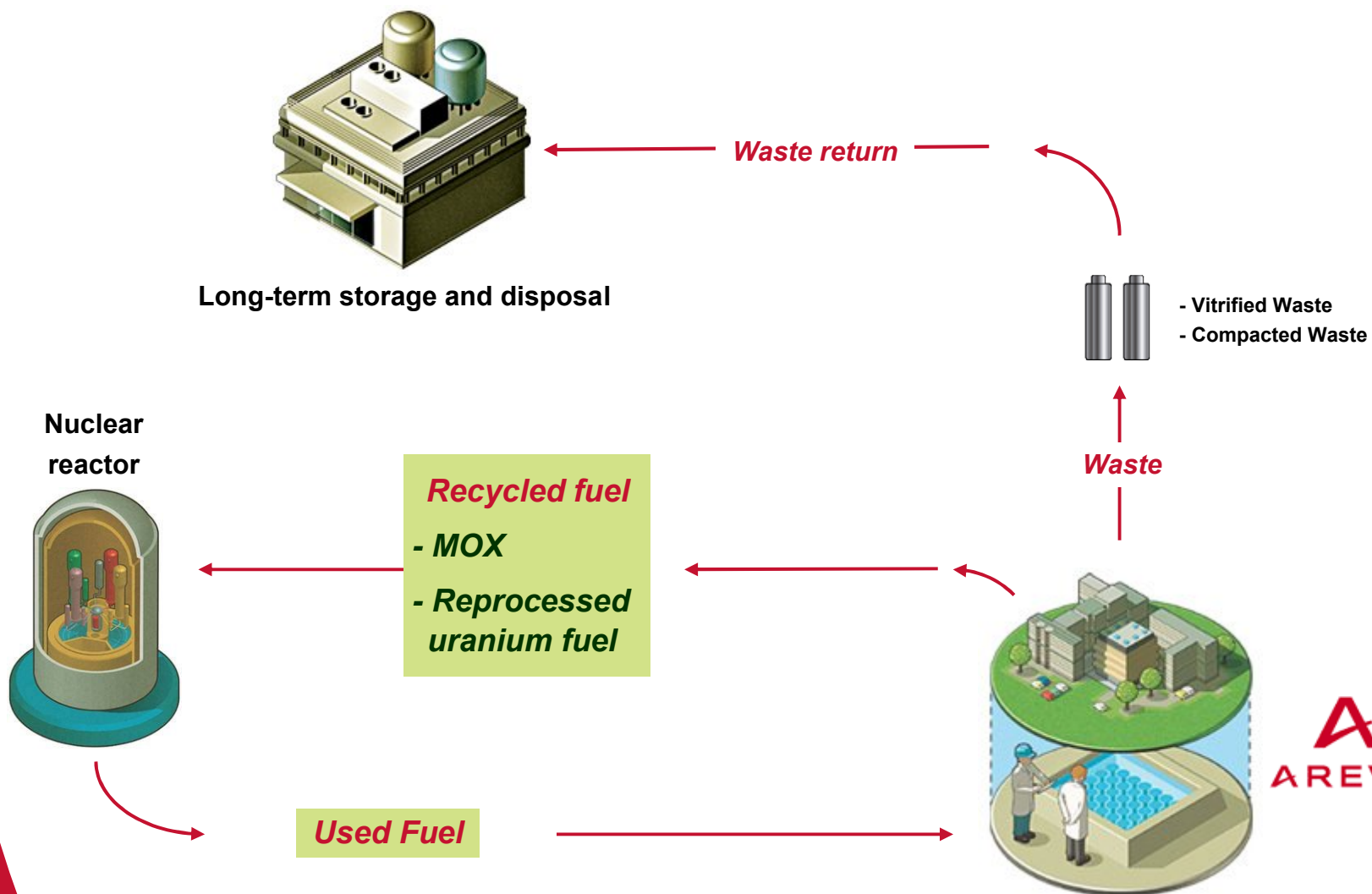
***La Hague and MELOX***



## Back-End Division

- ▶ **Solutions for used fuel recycling**
- ▶ **Solutions for used fuel storage and transportation**
- ▶ **Facility decommissioning at the end of service life**





# Recycling Industrial Sites in France



300 ha  
3 100 employees

**La Hague**

## ► Used fuel treatment

- ◆ Separation of valuable materials
- ◆ Ultimate waste conditioning

## ► RepU fuel fabrication



**FBFC Romans**



14 ha  
800 employees

**MELOX**

**Tricastin  
(conversion, enrichment)**

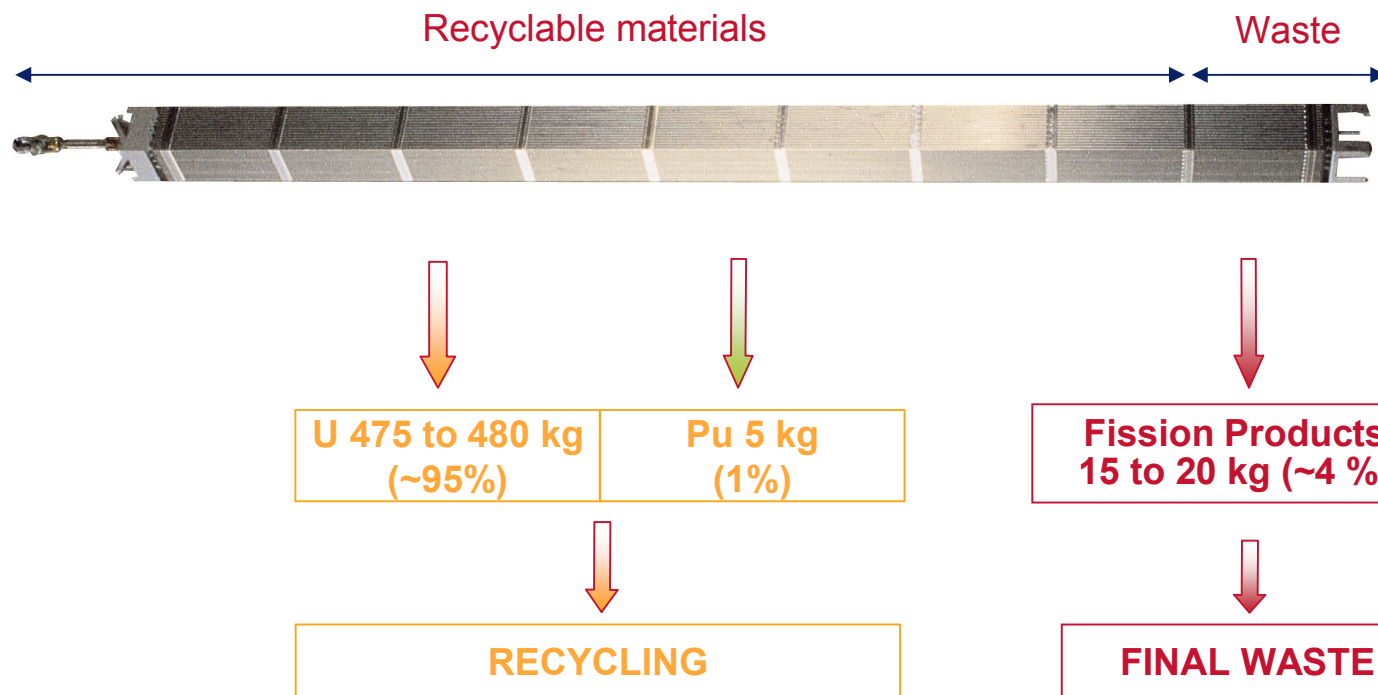
## ► MOX fuel fabrication

**Note :** ■ Reprocessed uranium activities (conversion, enrichment & fuel fabrication) are included in AREVA Front-End division

# 96% of a Used Fuel Assembly is Recyclable

## ► Typical composition of a Light Water Reactor Fuel

- ◆ Before irradiation: ~ 500 kg of Uranium (PWR)
- ◆ After irradiation:



\* Percentages may vary based on fuel burnup



## La Hague and Melox



# *La Hague Site*

## *The Largest Treatment Plant in the World*

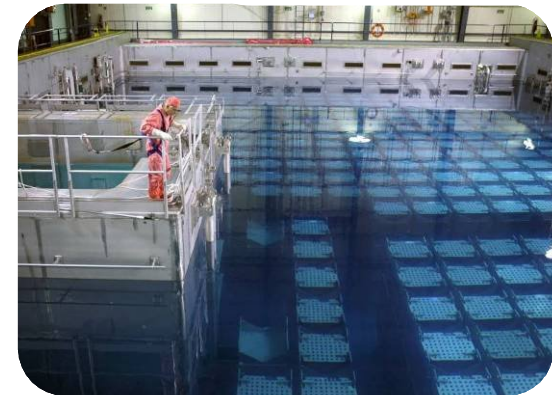
### *Key figures*



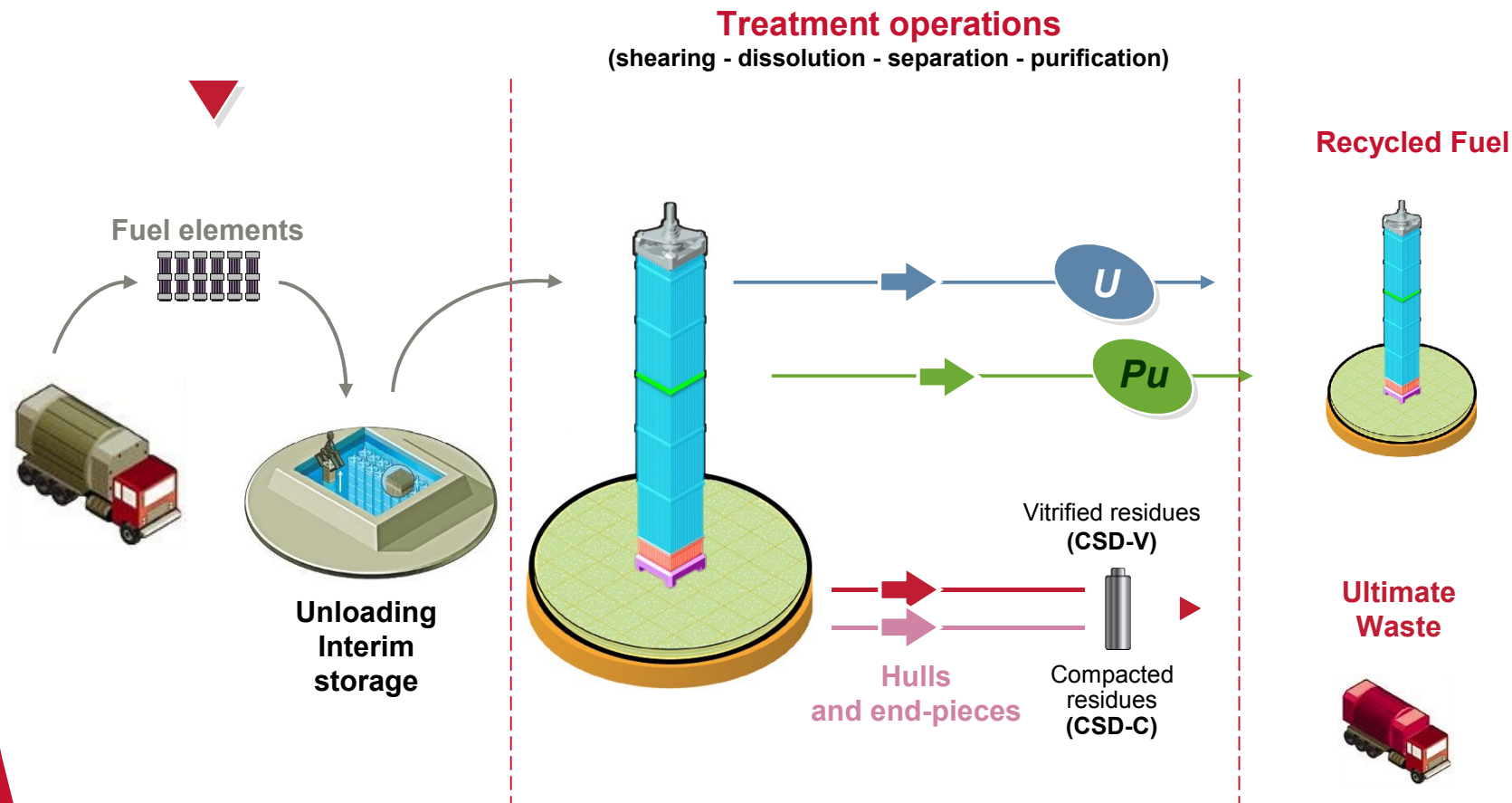
- ▶ **Surface area: 300 hectares**
- ▶ **Production capacity: 1,700 tons of used fuel**
- ▶ **Direct jobs: 3,100 direct jobs + subcontractors (5000 in all)**
- ▶ **Purchasing: €350 million injected into the local economy every year**
- ▶ **Taxes and duties: €175 million every year**
- ▶ **Environmental analyses: 70,000 analyses and 23,000 samples**

## A Constantly-Changing Site

- ▶ **2 production units with the same output**
  - ◆ UP3, commissioned in 1990
  - ◆ UP2 800, commissioned in 1994
  - ◆ a total annual capacity of 1700 tons of used fuel
  
- ▶ **Original UP2-400 production unit (1966-1994) under self-funded decommissioning**



# The Main Stages in Recycling



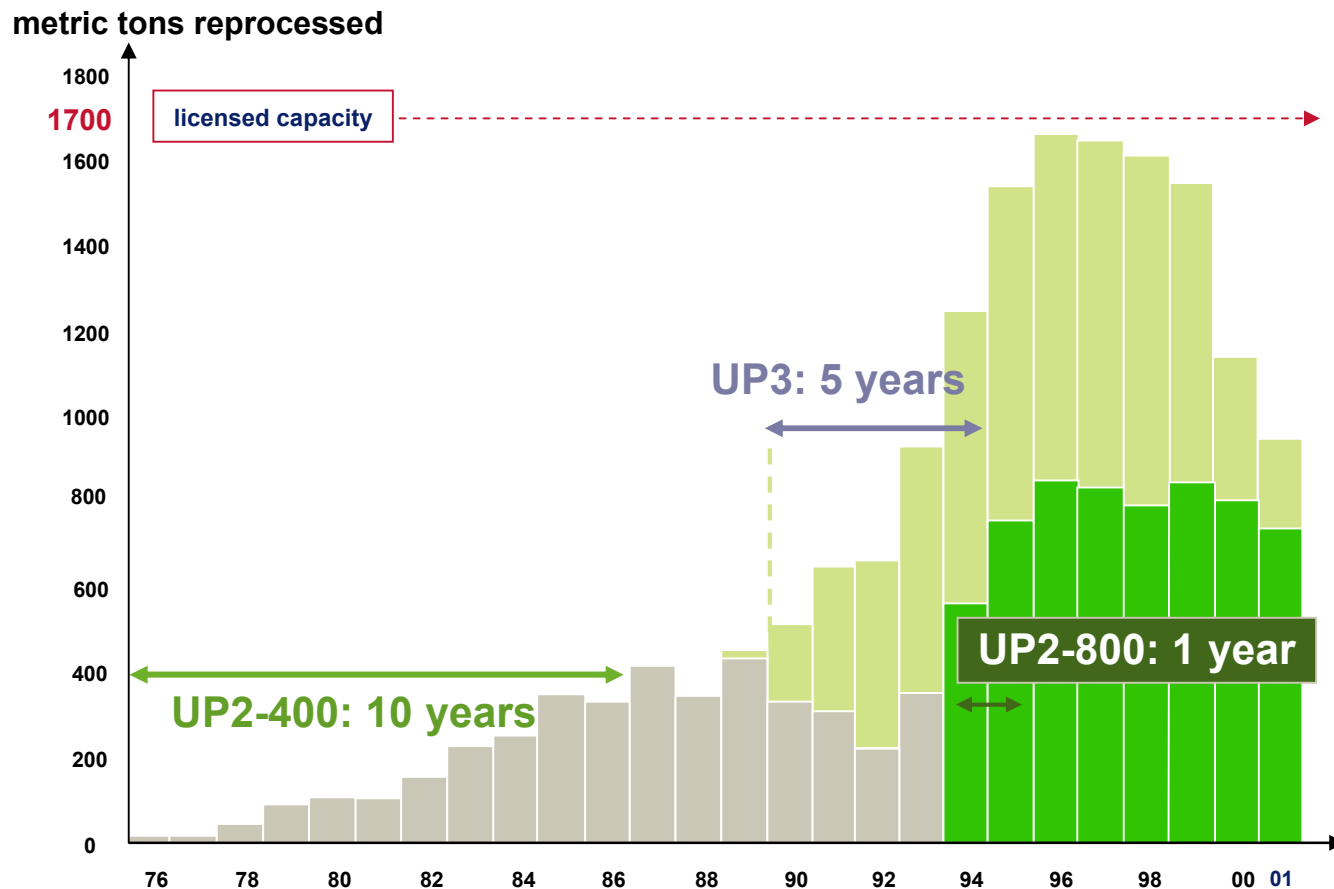
***At each stage, nuclear material accounting under EURATOM and IAEA safeguards***

# Over 23,600 Tons of Used Fuel Recycled

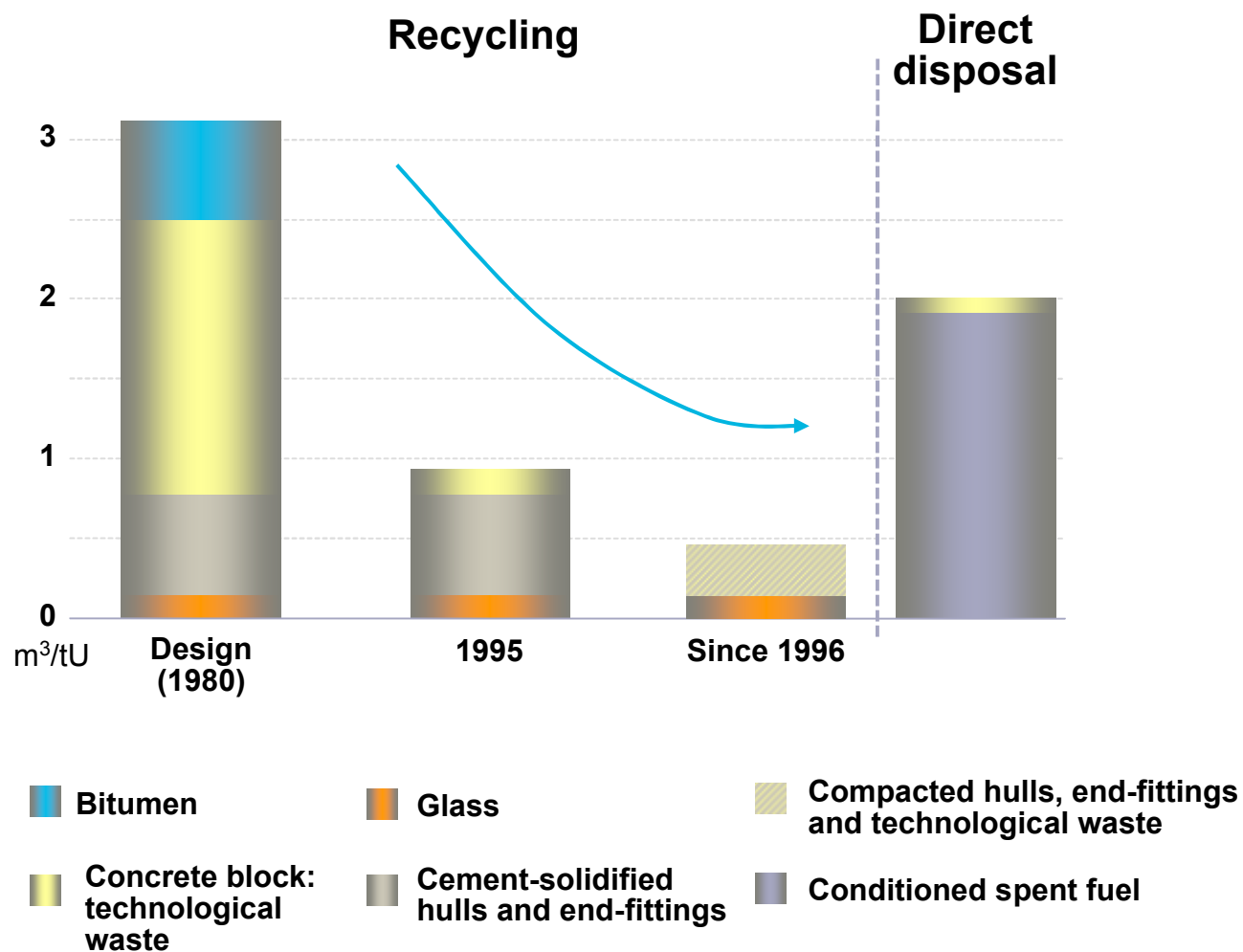
As of January 1, 2008

	Tons
<b>EDF <i>France</i></b>	<b>13,410</b>
<b><i>German</i> utilities</b>	<b>5,479</b>
<b><i>Japanese</i> utilities</b>	<b>2,944</b>
<b><i>Swiss</i> utilities</b>	<b>766</b>
<b>Synatom (<i>Belgium</i>)</b>	<b>672</b>
<b>EPZ (<i>Netherlands</i>)</b>	<b>326</b>

# La Hague Ramp-Up History

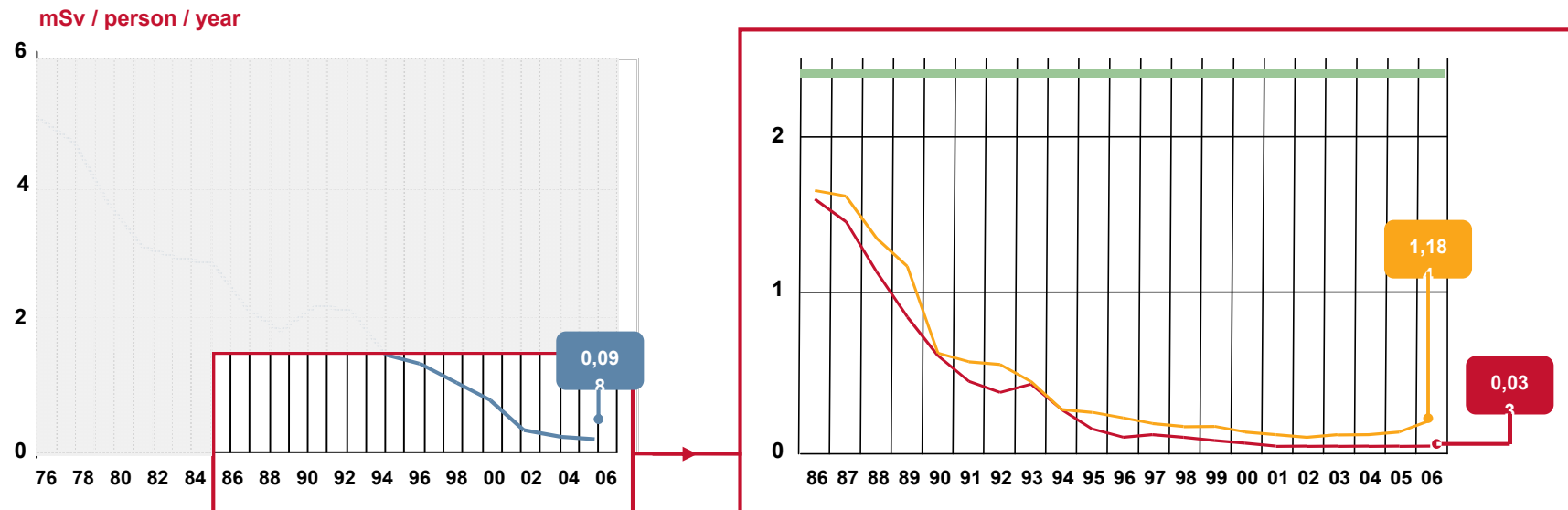


# Continuous Volume Reduction Over Time



# The Top Priority: Employees

## Average annual dose per person (AREVA NC and subcontractors)



### Site average

- AREVA NC-La Hague (2006: 0,098mSv/person/an)
- AREVA NC (2006: 0,033mSv/person/year)
- SUBCONTRACTORS (2006: 0,184mSv/person/year)
- NATURAL RADIOACTIVITY

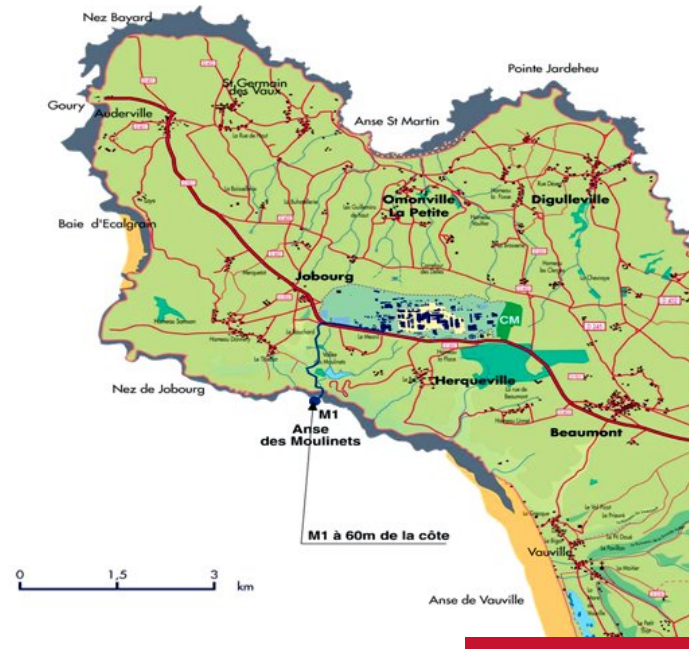
## ***Virtually No Impact on Health***

- ▶ **Example of la Hague: the maximum potential impact on the most highly exposed sectors of the public remains far below the natural radioactivity level**

**Natural Exposure**  
**2.4mSv / year**

**Fishermen**  
**< 0.02mSv / year**

**Farmers**  
**< 0.02mSv / year**



***Impact calculated since 2004 using the ACADIE model produced by the GRNC, making allowance for the results of the AREVA NC public enquiry (1998), for a reference group: population likely to be the most highly exposed due to its position and lifestyle.***





## Comparison of approximate annual doses

◆ Average <b>natural exposure</b> in France	2.4 mSv per person
◆ <b>Natural exposure</b> in Limousin	6 mSv per person
◆ A <b>medical X-ray</b> of the abdomen	1 mSv
◆ A <b>medical X-ray</b> of the lungs	0.1 mSv
◆ Consumption of one liter of <b>mineral water</b> per day during one year	0.03 mSv

**Annual impact of AREVA-La Hague releases :**

**< 0.02 mSv**

◆ A <b>Transatlantic flight</b> from Paris	0.02 mSv
◆ A <b>400-meter increase in altitude</b>	0.02 mSv
◆ <b>Consumption of 200 grams of mussels</b>	0.02 mSv

# ***MELOX site***

## ***A technological achievement for France***

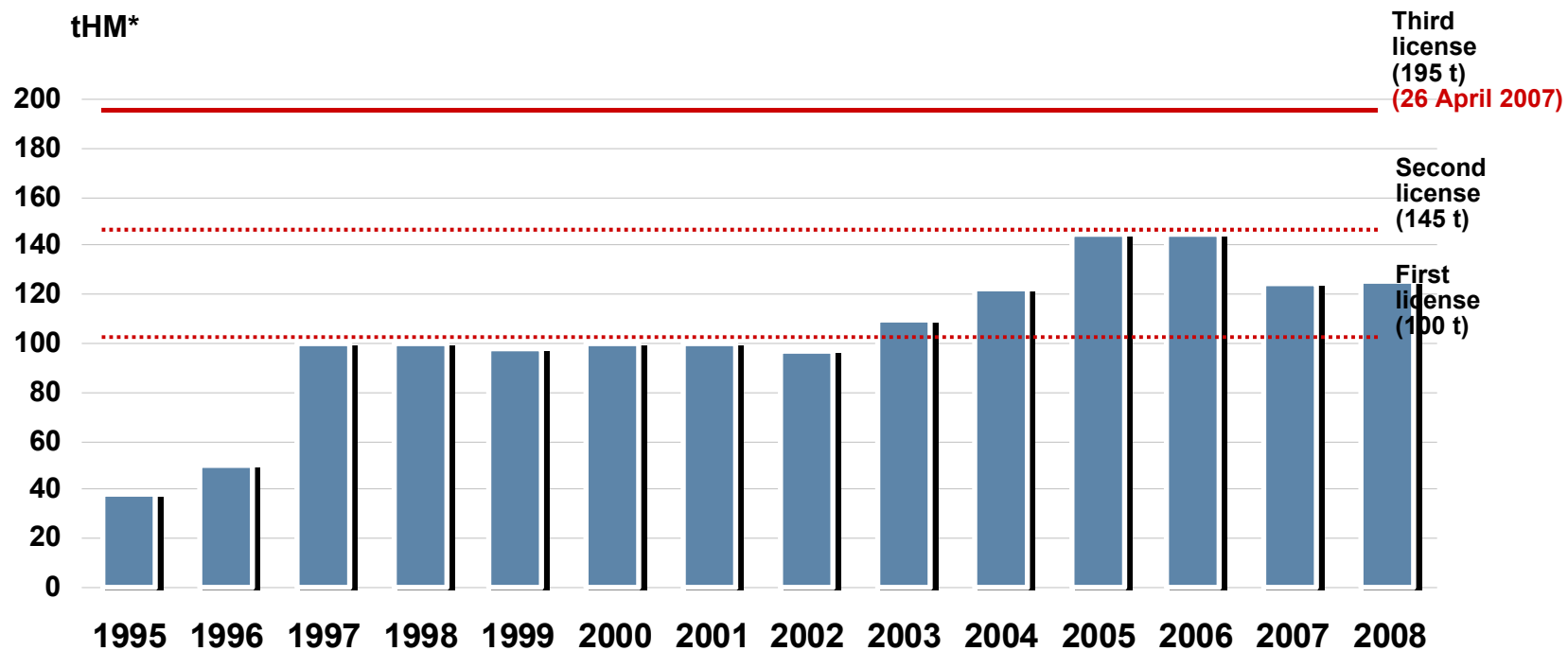
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### ***Key figures***

- ▶ **Surface area: 7 hectares**
- ▶ **Annual production capacity: 195 tons** (since april 2007)
- ▶ **Direct jobs :**  
**715 MELOX and AREVA NC employees**
- ▶ **Purchasing: over €100 million** in orders divided among 700 companies, most of them in the region (60% in the Gard and Vaucluse departments)
- ▶ **Taxes and duties: €10 million**



## Going from MOX to MELOX

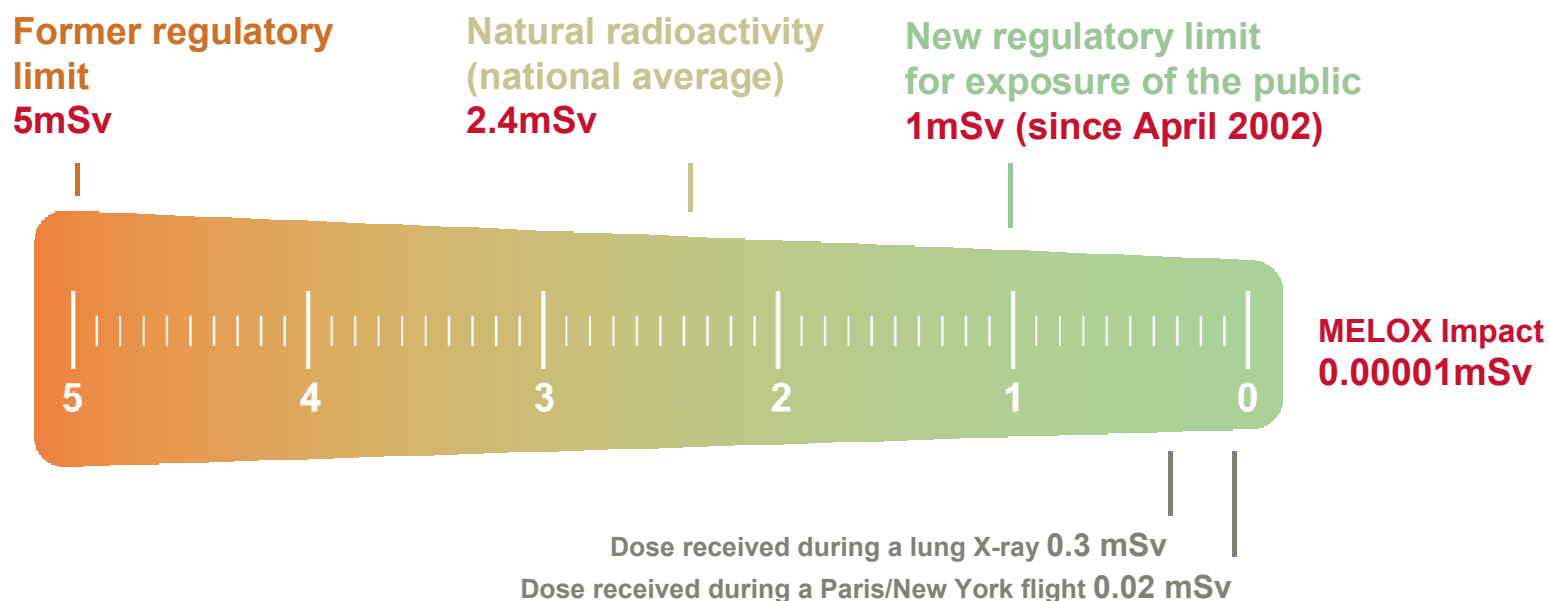


**1,425 tHM\* produced at end 2008**

(\*) tHM: tons of Heavy Metal

## ***Radiological impact of MELOX***

- ▶ **Annual impact of the radioactive liquid and gaseous effluents released from the MELOX plant was around 0.00001 mSv.**



***Maximum release impact authorized  
by decree: 0.0017 mSv per year***

- ▶ **Recycling can help foster and sustain the nuclear renaissance**
  - ◆ Sustainable management of the back-end of the fuel cycle
  - ◆ Front-end benefits for the utilities
  - ◆ Improving Public Acceptance for nuclear
    - France: **77%** of population “for or definitely for” recycling  
(Feb. 2007)
    - US: **83%** “prefer to develop technologies to recycle nuclear fuel”  
(2009 – Bisconti Research)

**Making Nuclear Energy a *Recyclable Energy***