





The TN[®]117 A New Cask for the Transportation of Used Fuel From Piemonte Nuclear Sites

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With acknowledgements to T. Brion, H. Ripert, J. Baudouin and E. Bouyer

AREVA

TN International

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AREVA

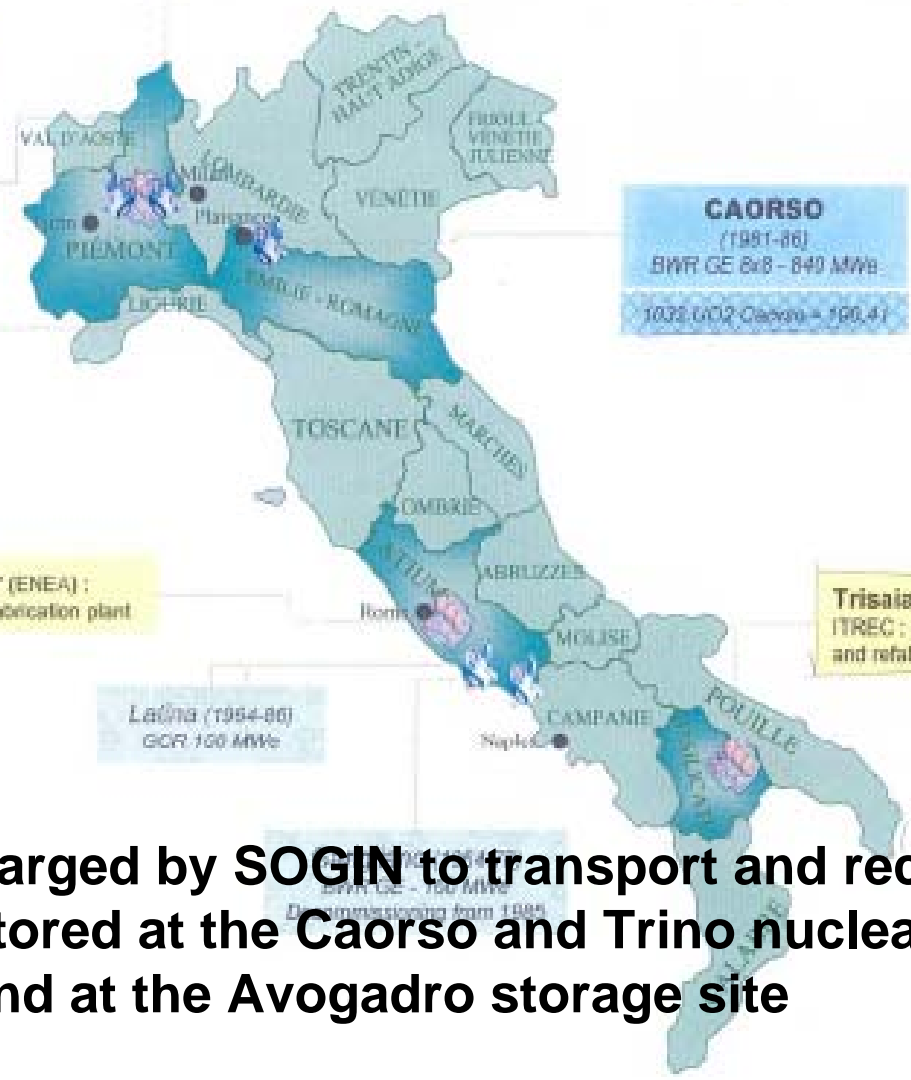
Transport of Used Fuel from Italy to La Hague for Recycling



TRINO
(1985-87)
PWR West: 15x15 - 270 MW_e
39 MOX Trino = 12.1 t
8 MOX Trino = 2.5 t

Saluggia center (ENEA):
EUREX pilot reprocessing plant
(MTR + CANDU spent fuel reprocessed)
incl. CORA vitrification facility

AVOGADRO
(shutdown 72)
Research reactor
+ AFR storage pool (1954-)
48 UO₂ Trino = 16.1 t
83 MOX Campiano = 12.4 t



CAORSO
(1981-86)
BWR GE 8x8 - 840 MW_e
1033 MOX Caorso = 190.4 t

Casaccia center (ENEA):
pilot plutonium fuel fabrication plant

Trisaia center (ENEA):
ITREC: pilot reprocessing
and refabrication plant

La Motta (1984-86)
GCR 100 MW_e

La Motta (1984-86)
BWR GE - 100 MW_e
Discommissioned from 1985

- ▶ AREVA was charged by SOGIN to transport and recycle the used fuel stored at the Caorso and Trino nuclear power plants and at the Avogadro storage site



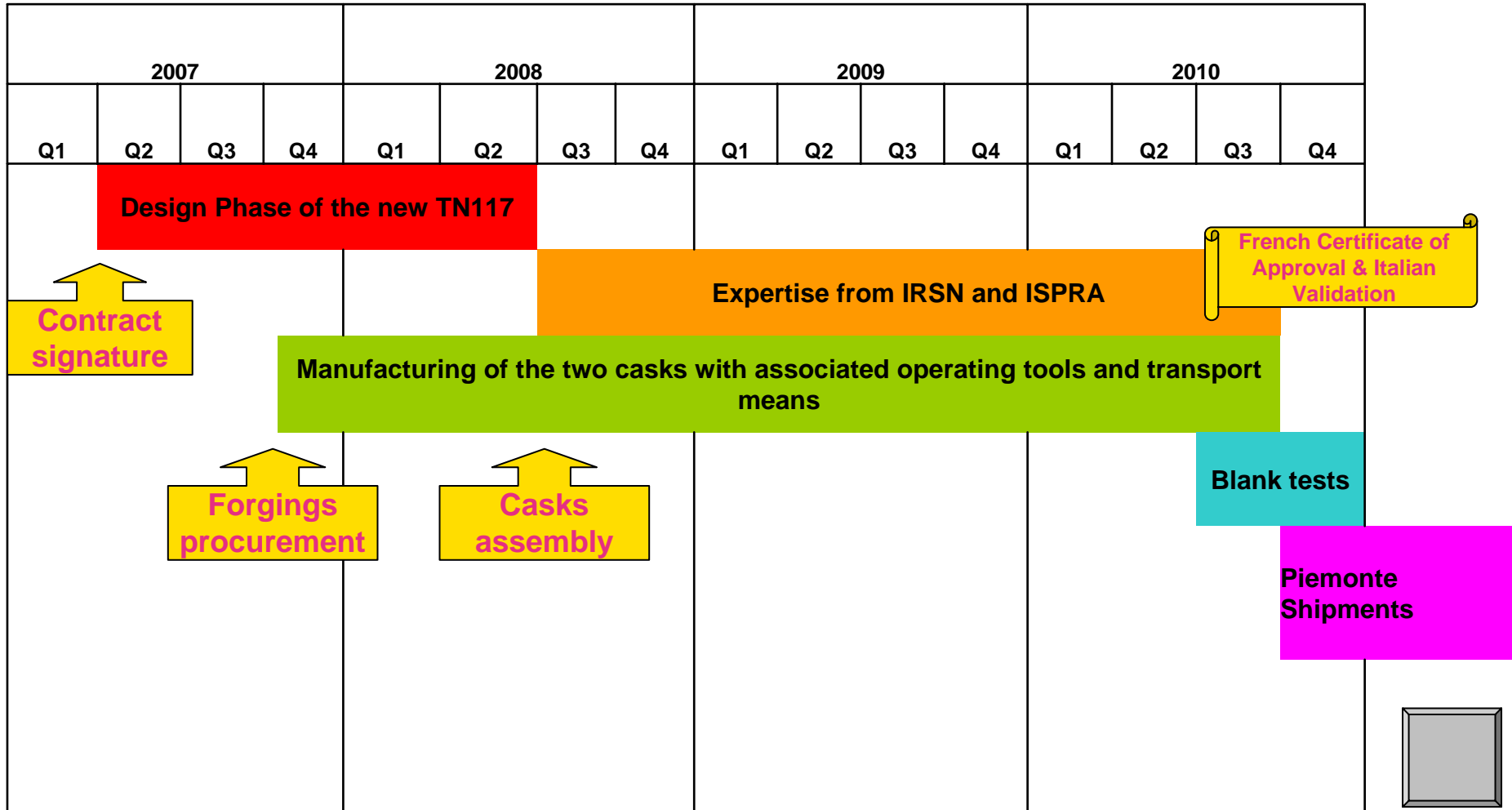
Why a New Cask?

- ▶ Piemonte sites (Trino and Avogadro) have specific interface constraints
 - ◆ Limited capacity of their cranes (60 t)
 - ◆ Limited capacity of Avogadro entrance height



LOGISTICS

Scope of Work and Time Schedule



LOGISTICS

Several Types of Used Fuel to Be Loaded with an Optimized Capacity

| Categories | PWR MOX fuel assemblies | PWR UOX fuel assemblies | | PWR UOX cruciform assemblies | BWR UOX / MOX fuel assemblies | | BWR UOX half-pins |
|---------------------------------------|-------------------------|-------------------------|------|------------------------------|-------------------------------|--------|-------------------|
| Array | 15 x 15 | 15 x 15 | | cruciform | 8 x 8 | | 9 x 9 |
| Nuclear power plant | TRINO | TRINO | | TRINO | GARIGLIANO | | GARIGLIANO |
| Sub-categories | | -1 | -2 | | MOX | UOX | |
| Maximum burn-up (GWd/tU) | 38.6 | 17.6 | 38.6 | 42.1 | 40.8 | 40.8 | 14.3 |
| Cooling time (years) | 22 | 20 | 30 | 33 | 29 | | 40 |
| Max initial enrichment (U235) | 0.72 % | 4.5% | | 4% | 0.72 % | 2.41 % | 2.5 % |
| Maximum initial Pu / (U + Pu) content | 6.8 % | | | | 6% | | |
| Leaking fuel assemblies | No | No | | No | Some of them | | No |

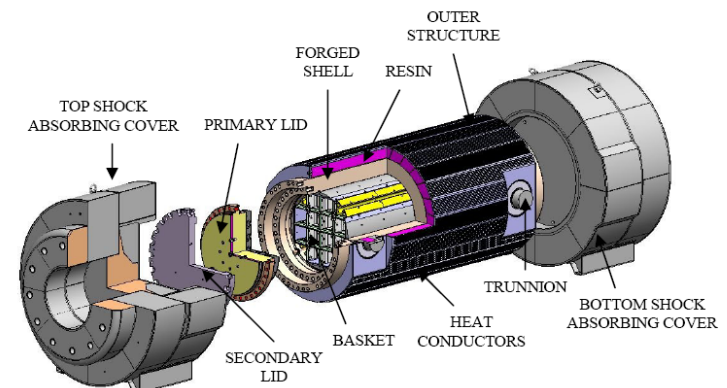
Several Types of Used Fuel to Be Loaded with an Optimized Capacity

| Categories | PWR MOX FAs | PWR UOX FAs | PWR UOX cruciforms | BWR UOX / MOX FAs | Fuel holder of BWR UOX half-pins | Total of FAs loaded |
|------------|-------------|-------------|--------------------|-------------------|----------------------------------|---------------------|
| Content | | | | | | |
| Content 1 | ≤ 2 | ≤ 10 | | | | ≤ 12 |
| Content 2 | | ≤ 12 | | | | ≤ 12 |
| Content 3 | | | ≤ 12 | | | ≤ 12 |
| Content 4 | | | | ≤ 12 | | ≤ 12 |
| Content 5 | | ≤ 2 | ≤ 4 | ≤ 4 | ≤ 1 | ≤ 11 |

- ▶ **Contents defined in the certificate of approval in order to optimize the number of transports**
- ▶ **Each safety analysis, dimension and characteristic of the cask was linked to the most conservative content, which was not always the same**

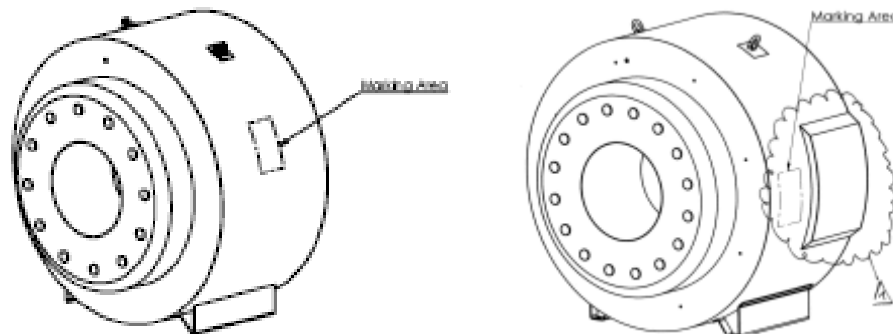
How to Get a Cask Licensed and Available in a Limited Period (1/3)

- ▶ **Design phase limited to one year, including the preparation of the safety analysis report**
 - ◆ **Mechanical behaviour of the TN[®]117 was based on the TN[®]24 GET drops tests**
 - TN[®]24 GET drop tests performed in January 2000 with a 1:3 scale model at Laudun platform
 - TN[®]117 designed with a similar geometry and similar shock absorbers
 - Both primary and secondary lids were demonstrated to be leaktight after numerical drop simulation
 - The model was benchmarked with the TN[®]24 GET drop test results, as the designs of the casks are similar



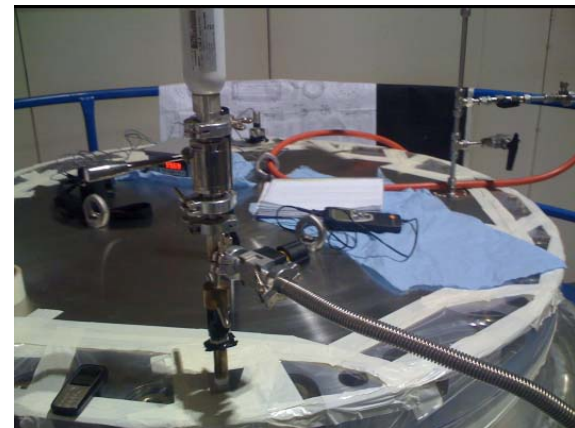
How to Get a Cask Licensed and Available in a Limited Period (2/3)

- ▶ **Manufacturing of the two casks in parallel with the design and licensing of the packaging**
 - ◆ **End of Structural analysis => Start of forgings procurement**
 - ◆ **Design validation & SAR submission => Start of cask assembly (welding, cladding, body assembly, basket assembly)**
 - ◆ **Management of design changes during manufacturing phase**
 - Addition of extra-thickness on the lateral parts of the shock absorbers
 - Reinforcement of the lid, modification of the bolts, adaptation of the basket length and addition of spacers



How to Get a Cask Licensed and Available in a Limited Period (3/3)

- ▶ **Cooperation with Italian Authorities at the beginning of the licensing phase in order to reduce the time necessary between the granting of the French certificate of approval and its validation in Italy**
- ▶ **Definition and manufacturing of the associated operating tools, handling and transport means necessary at both the Piemonte and La Hague sites parallel to the fabrication of the two casks**



Situation in October 2010

- ▶ The first TN[®]117 is in La Hague for blank tests
- ▶ The second cask is undergoing final tests in the manufacturing workshop
- ▶ Handling equipment and transport means have been manufactured and tested
- ▶ Operating tools have been manufactured and tested
- ▶ Blank tests at Avogadro under preparation
- ▶ Finalisation of the French Authorities expertise in progress



LOGISTICS

Conclusion



THANKS TO THE EXCELLENT RELATIONSHIPS BETWEEN ALL PARTIES INVOLVED, THE OPTIMISATION OF THE TIME SCHEDULE WAS MADE POSSIBLE, MAKING THIS PROJECT A MAJOR SUCCESS FOR ALL OF THE ACTORS