Spent Fuel Management Activities

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What we did not know 20 Years ago?

Geological repository implementation take much longer than expected - none into operations for commercial spent fuel and High level wastes

9/11 Tragic event - Threat assessment

March 2011 Magnitude 9 earthquake and subsequent Tsunami in Japan: Fukushima-Daiichi: another tragic event, impact of spent fuel management conditions under wet conditions

June 2008 DOE filed a license application to the Nuclear Regulatory Commission: 10 years after submittal still huge uncertainties on feasibility of US geological repository at Yucca Mountain
Responsive Back-End projects are key for nuclear sustainability

**Market demand**

1. Used Nuclear Fuel inventories
   - LWR

2. End of life management
   - Fuel cycle facilities
   - NPP and Research Reactors

**Challenges**

- Pool Saturation
- Extended interim storage period beyond design
- Geological Disposal Facilities Delays
- D&D project reliability (costs, planning)

**External pressure**

- Regulatory pressure
- Public preoccupation
- Environment impact
- Financial accountability

"Back End requires reliable and flexible solutions to adapt to a changing environment"
Orano: Innovative, Flexible & Sustainable Nuclear Back End Management

**Recycling**
- La Hague and Melox operations at a large industrial scale

**Waste solutions**
- Ultimate Waste (UC-V/C) from UNF recycling
- Solutions for all type of waste incl. legacy and orphan waste

**Interim Storage & Transport**
- Logistics solutions for radioactive materials and waste: transports (multi modal), interim dry storage,

**D&D solutions**
- Engineering, project management and operations on nuclear plants and fuel cycle facilities

Orano’s solutions focus on immediate benefits:
Reducing risks & costs, enhancing nuclear responsibility
Interim Storage and Transport Solutions – more than 50 years

- Interim storage at NPP site
- Centralized interim storage
- Road/rail/maritime transport
- Final Disposal
- Services: Loading, aging management, public acceptance, transport oversight, trainings,…
- Vertically integrated

TNs’ level of Dry Storage experience is second to none.

NUHOMS® Concrete Overpacks

TN dual purpose casks
Dry Shielded Canister – NUHOMS® & TN Nova®

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Orano TN Dry Storage Solutions
2 Technologies, 3 Families...

Dual purpose Casks

Metallic Dual Purpose
TN®24 family...

Canister Systems

Metallic Canister System TN
NOVA™

Concrete Canister System
NUHOMS®

Dual purpose casks
Canister Systems
Concrete overpack

3 Families
Why this Diversity for Interim Dry Storage: Dual Purpose Casks / Canister Systems

Dual Purpose casks
Once loaded, the fuel can be stored and transported
In Germany, Belgium, Switzerland, Spain, USA, Japan,…

Canister systems
The fuel is loaded in a welded metallic canister, stored in an over-pack
For transportation, the canister is inserted in a transport cask
In the USA, Spain, Republic of Armenia, UK,…

• Regulators requirements are not the same worldwide
• Customers needs are not the same worldwide
  ➔ Need to adapt, while remaining cost effective
Used Fuel Transports is a Must
Cask Evolution

Cask of the future

1960’s

1970’s

1980’s

2000’s

2015-18

2030’s

TN®1

TN®12/1

TN®12/2 - TN®13/2 - TN®17/2

TN®G3 & MP197: New generation cask

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Where are going to be in 20 years
Back End Perspective?

Larger spent fuel inventories in wet and dry storage

Spent fuel in dry storage casks will have exceeded 45 years

More shutdown reactors

More secluded decommissioned sites with only spent fuel pad/facility

More knowledgeable in aging phenomena of interim storage solutions and fuel behavior

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UNF Management Routes in 20 years

- A few geological repository into operations: Finland, Sweden, France, others.???
- Recycling: France, China, Russia, Japan, (re-evaluating: USA, others?)
- Interim Storage at reactor
- More Consolidated Interim Storage (1 or 2 in the US, Japan, Spain, others….)
Orano TN: UNF Management from Pool to Repository

Nuclear Power plants

On-site loading services

Pad and dry storage systems supply

After loading services: aging mgt, turnkey ISFSI mgt, maintenance, loading

Consolidated Storage

Outdoor and indoor consolidated storage

Transportation Services

Geological repository

Transportation Services

Recycling
Where are going to be in 20 years
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Continuous Innovation Efforts to Improve our technologies

Long Term Interim Storage becomes a reality:
- Need to ensure continued safety and security of “old” systems
- Need to improve performance in time of “new” systems

Industry Economics:
- Customers looking at cost reduction/optimization

Innovative Materials, Products and Services (performance and costs):

**Materials:**
- Shielding materials
- Impact limiters
- Better resistance to corrosion

**Products:**
- EOS (higher capacity/burn-up)
- MATRIX (reduce footprint)
- Other dual purpose casks

**Services**
- Improve materials performance for long term
- Develop inspection, monitoring and repair solutions
Integrated Interim Storage
Remove Burden from Customers

- Indoor and outdoor solutions based on customer needs
- Loading Services
- Site design and licensing
- Inspection, monitoring, repair
- Site management (ISFSI decommissioned sites)
- Public acceptance
- Trainings
- Transportation
An Active Player into Consolidated Interim Storage Facilities (US and Others)
Wrap-Up

Preparing for extended interim dry storage by optimizing of the safety-technology-economics-availability equilibrium

Innovations provide tangible improvement to proven solutions

Provide responsible and sustainable solutions
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Giving nuclear energy its full value
Giving Nuclear Energy Its Full Value