FRENCH EXPERIENCE IN SPENT FUEL STORAGE
Gremikha case

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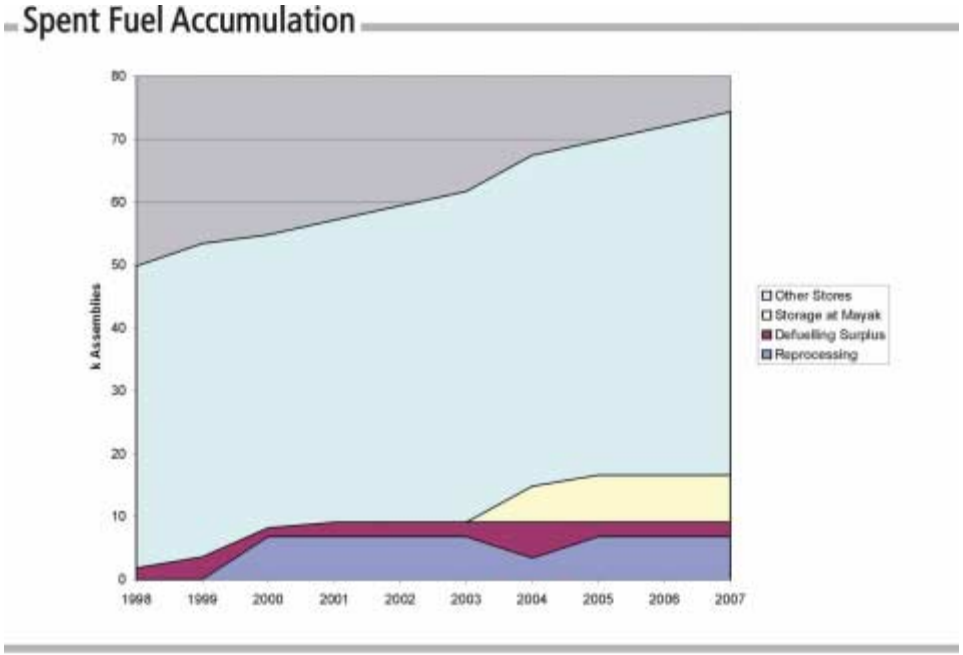
Problematic

- *After site visit, we have a better view of the actual situation.*
- *Nuclear Spent fuel (SNF) from Gremikha is part of a generic problem: Spent Fuel Management in NW Russia and more generally in Russia.*
- *Retrieval and transportation of SNF at Gremikha will be part of the analysis of the situation in NW Russia including Andreeva Bay.*



DBE TECHNOLOGY GmbH

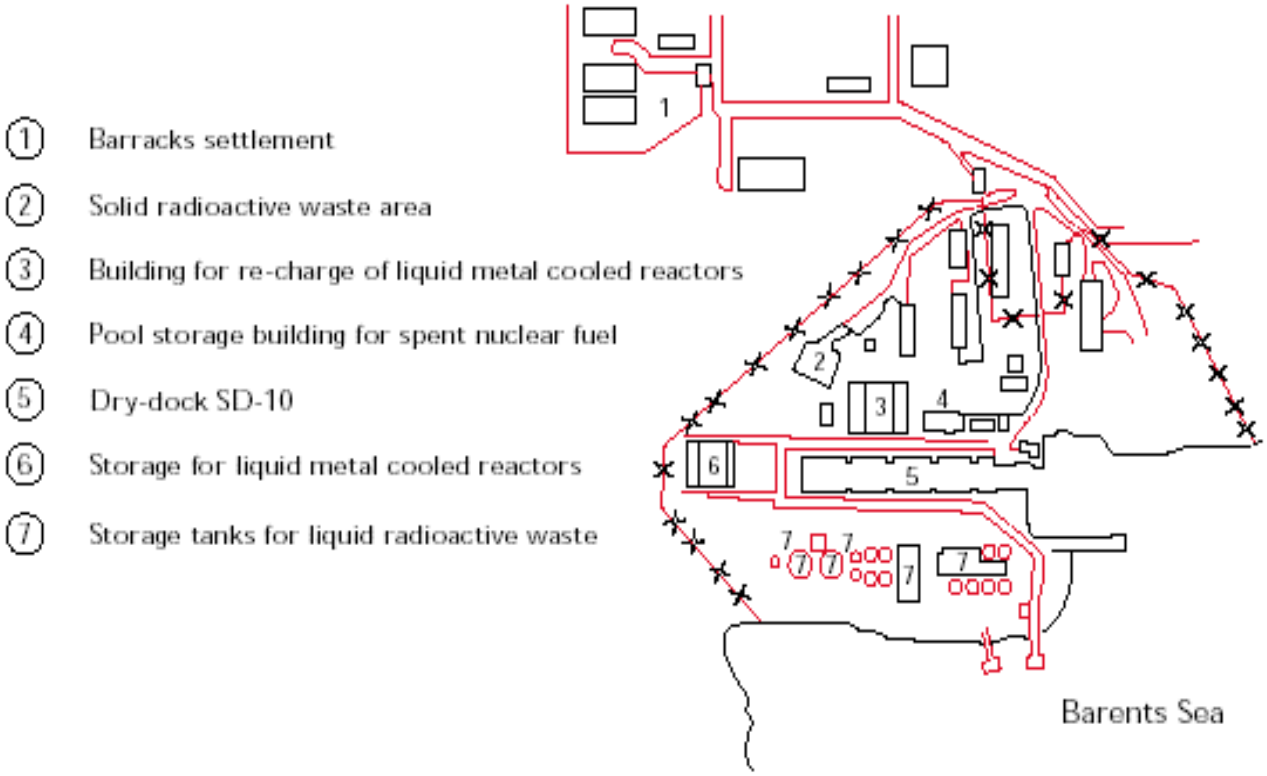
Problems to be solved

- *Today status of SNF and facilities status*
- *SNF conditioning*
- *Transportation*
- *Metal Core Treatment*
- *Buffer Storage*
- *Site working conditions (limitation of working period for infrastructure modifications)*
- *Safety rules to be applied:*
  - *Russian Standards (Military GAN but also Civilian GAN for transportation aspects)*
  - *Western rules internationally recognized*

The Site

- ***This site is isolated and well delimited.***
- ***Facilities in relation with SNF are:***
  - **Unloading and storage facilities for metal core (reference 3 and 6)**
  - **Storage facilities for VVER Spent Fuel (reference 4 et 2)**

Germikha costal technical base



VVER Spent Nuclear Fuel

- **VVER SNF stored outside:**
  - On a small hill, in different container's type (metal, concrete)
  - Circa 700 SNF stored
  - Circa 100 metal containers, with 7 elements in cartridge, weight 9 to 10 tons
  - 9 concrete containers with unknown number of damaged SNF elements, weight 25 tons
  - No handling devices in place and road access to be rebuilt
  - Dose rate between containers circa 20 m Sv/h.
- **SNF Status:**
  - What was the SNF status and fuel type when loading containers?
  - Actual status of container, are they transportable?
  - To be able to retrieve containers, is SNF fuel damaged during climatic cycles?

VVER Spent Nuclear Fuel

- ***SNF stored indoor:***
  - **Pool facility strongly damaged, pit watertight to be confirmed, handling devices obsolete, …**
  - **100 damaged SNF elements stored in 4 pits without real biological protection**
  - **No more SNF elements in the "dry pool"**

Metal Core SNF

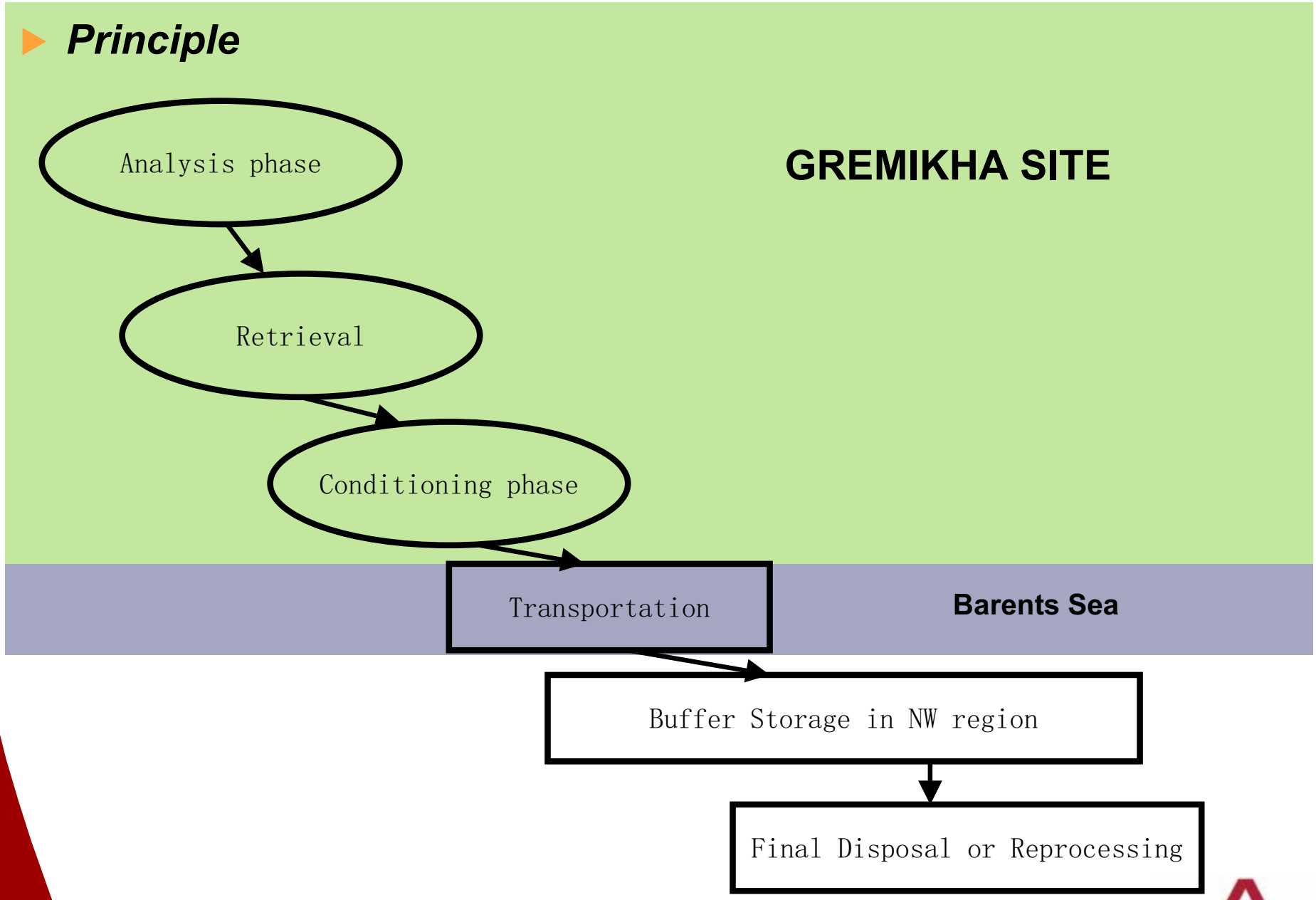
- **Already stored cores:**
  - **6 cores are stored onsite in a facility able to receive 8 cores (reference 6)**
  - **Cores are stored in special containers (including SNF, Internals, Absorbers)**
  - **Loaded container weight (circa 74 tons) is disposed in a pit and cooled with natural air circulation**
  - **No detectable dose rate on the facility roof**
- **SNF still on board:**
  - 3 cores to be unloaded
  - Existing facilities have to be renewed or replaced, procedures have to be updated
    - Steam production system out of order
    - Special tooling none used since 1992
    - Transportation until buffer storage
    - What to do with core n°9?

Actions to be done

- *Establish a detail inventory of the site, concerning:*
  - *Radiological aspects*
  - *SNF status*
  - *Facilities (are they usable or not), Is it possible or not to build none permanent installations on site*
  - *Existing equipment and tooling*
- *Define a real SNF retrieval strategy*
- *Define updated transportation system and strategy for SNF*
- *Define type and location of a buffer storage in NW region*

Actions to be done

Principle



How to do it

- SNF will have to be conditioned before shipment
  - Cleaning process
  - Drying process
  - Conditioning process (SNF damaged)
  - ⇨ Need of a site Conditioning facility
- Transportation
  - SNF (damaged) with containers adapted to buffer storage and final destination)
  - Metal core (transportation container to be defined)
- Buffer Storage in NW region
  - To have a continuous flow rate
  - To regulate transportation
- Optimal methodology to be define to process metal core (Technical, where,…)

AREVA Solutions

- ***AREVA Group skills and experience encompass all aspects of spent fuel management :***
  - ***Reprocessing*** *: over 30 000 tons heavy metal already delivered to La Hague*
  - ***Recycling*** *: 100 ton/y of MOX fuel assemblies manufactured at Melox*
  - ***Transport*** *: over 30 000 Tons heavy metal (equivalent to 70 000 fuel assemblies) transported worldwide*
  - ***Interim storage*** *:*
    - ***Wet interim storage (e.g. 8 000 ton SF in pool at COGEMA La Hague), and reracking in reactor pools***
  - ***Dry interim storage***
    - ***Over 5 000 ton capacity booked in dry storage systems***

The Dry Storage Solution

Our solution encompasses :

1. Design & Licensing, including consulting and expertise to support the decision maker in defining the best solution
2. Full project management, including construction of the selected system
3. Logistic management activities, including fuel interfaces with the plants (handling, unloading), fuel transfer and transportation to the processing or storage facilities, and resources operational planning
4. Dry storage units :
   - Vault system
   - Metal casks
   - Canister based concrete system

Design & Licensing

- *The AREVA Group is able to support its customers to select the solution that meets the specific requirements and constraints*
- *Thanks to its experience, the Group is in a position to perform any study and design work, including licensing support, public acceptance evaluation, safeguards analysis, site selection, etc …*

Logistic management activities

- ***Thanks to our experience, the AREVA Group is able to manage all the « logistic aspects » of the project :***
  - ***all interfaces with the plants (fuel handling and unloading at the reactors for instance)***
  - ***transport from the plants to the selected sites***
  - ***interfaces with the receiving facilities (fuel loading)***
  - ***transport casks maintenance and control***
  - ***resources***

Interim Dry Storage technical solutions

- Three approaches are made available
  - Cascad Vault systems (SGN)
  - NUHOMS® Canister based concrete shielded systems (COGEMA LOGISTICS*)
  - TN ™ 24 Family of metal casks (storage only and/or transport storage) (COGEMA LOGISTICS*)

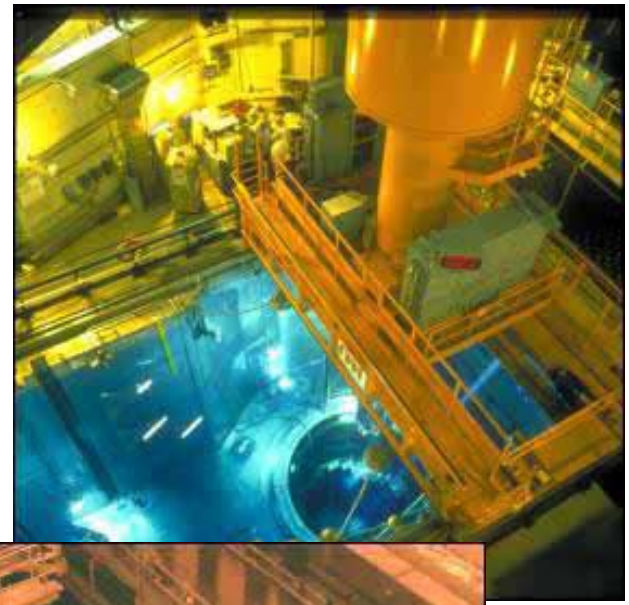
* : and affiliates TRANSNUCLEAR Inc. and TRANSNUCLEAR Ltd

Dry Fuel Storage Lifecycle Experience

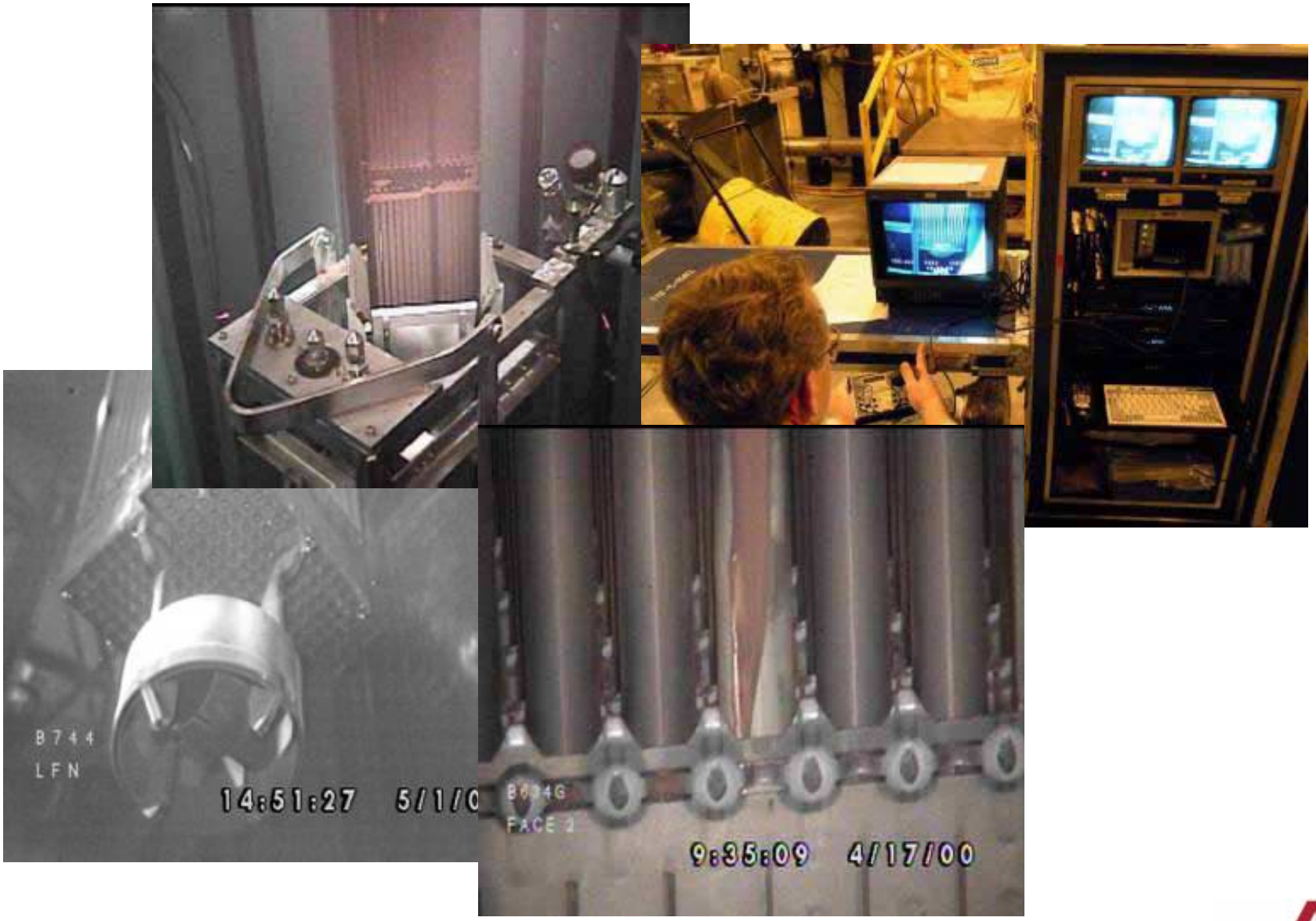
- **PWR / BWR /VVER / RBMK Experience**
  - Oconee
  - McGuire
  - Yankee Rowe
  - Zaporozhye
  - Maine Yankee
  - Connecticut Yankee
  - Vermont Yankee
  - Calvert Cliffs
  - Energy Northwest, Columbia Generating Station
  - Chernobyl

FANP Fuel Transfer Experience

- Fuel Characterization & Inspections
- Fuel Transfer Operations Oversight
  - Technical Oversight
  - Licensing Support,
  - Operations Support
- Fuel Transfer Operations
  - Fuel loading
  - Technical support
  - Cask movement
- Radiation Protection Support
- Radwaste Management
- Health & Safety Support

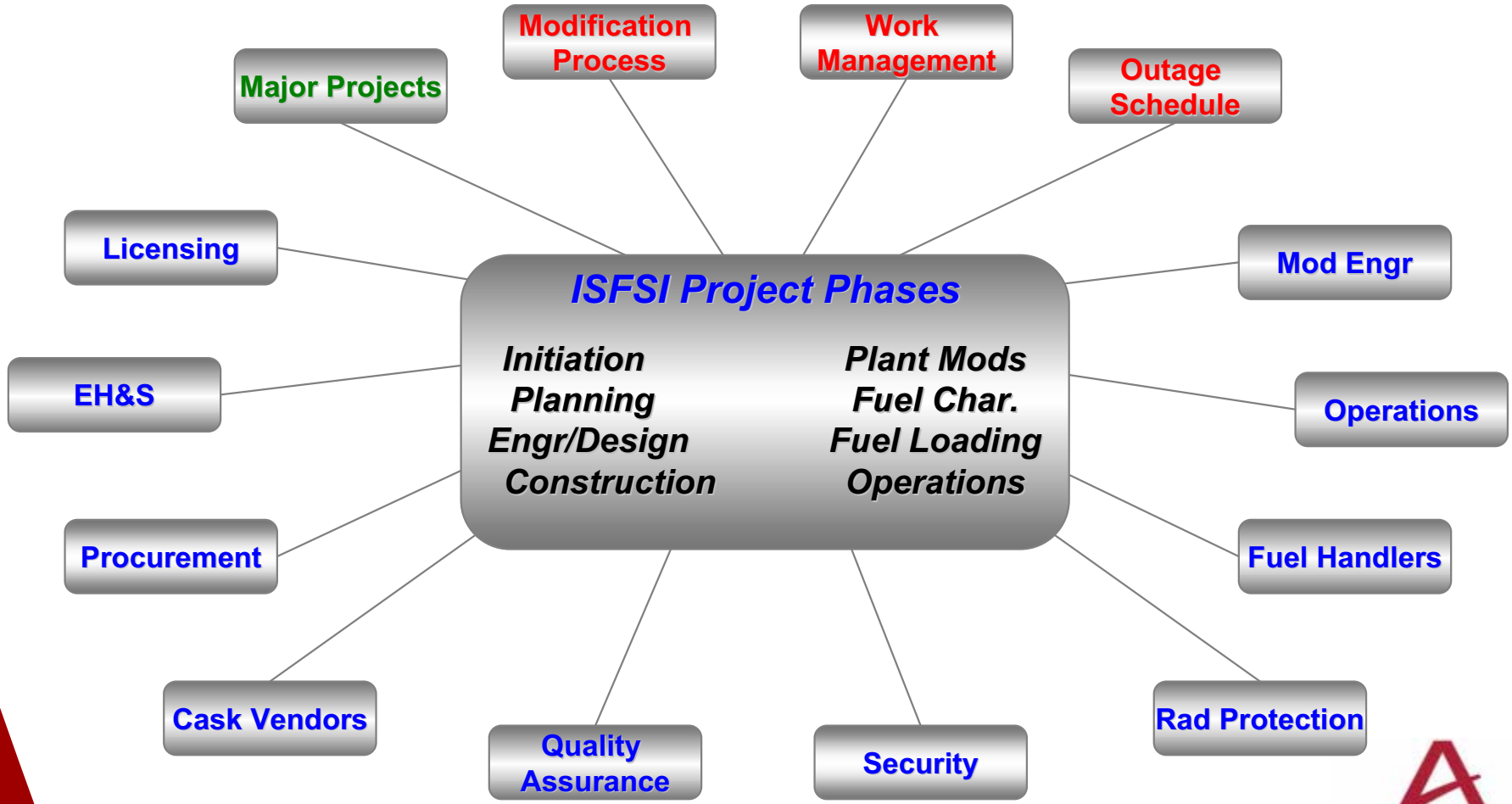


FANP Fuel Inspections Experience

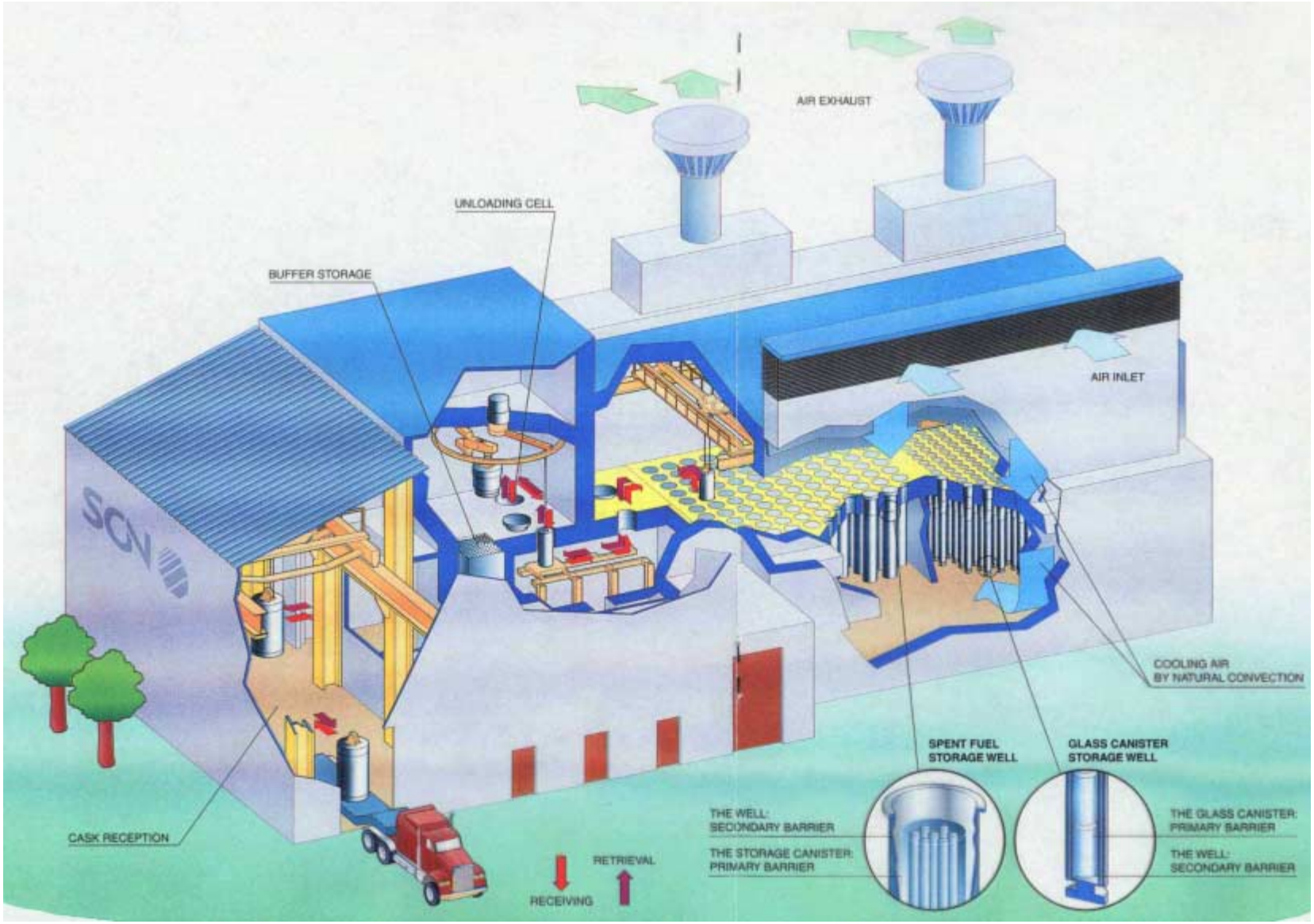


Storage Facility Project Complexity Model

- *Interfaces and stakeholder challenges*
- *Design and implementation challenges*
- *Cost and schedule challenges*



SGN 's vault system CASCAD



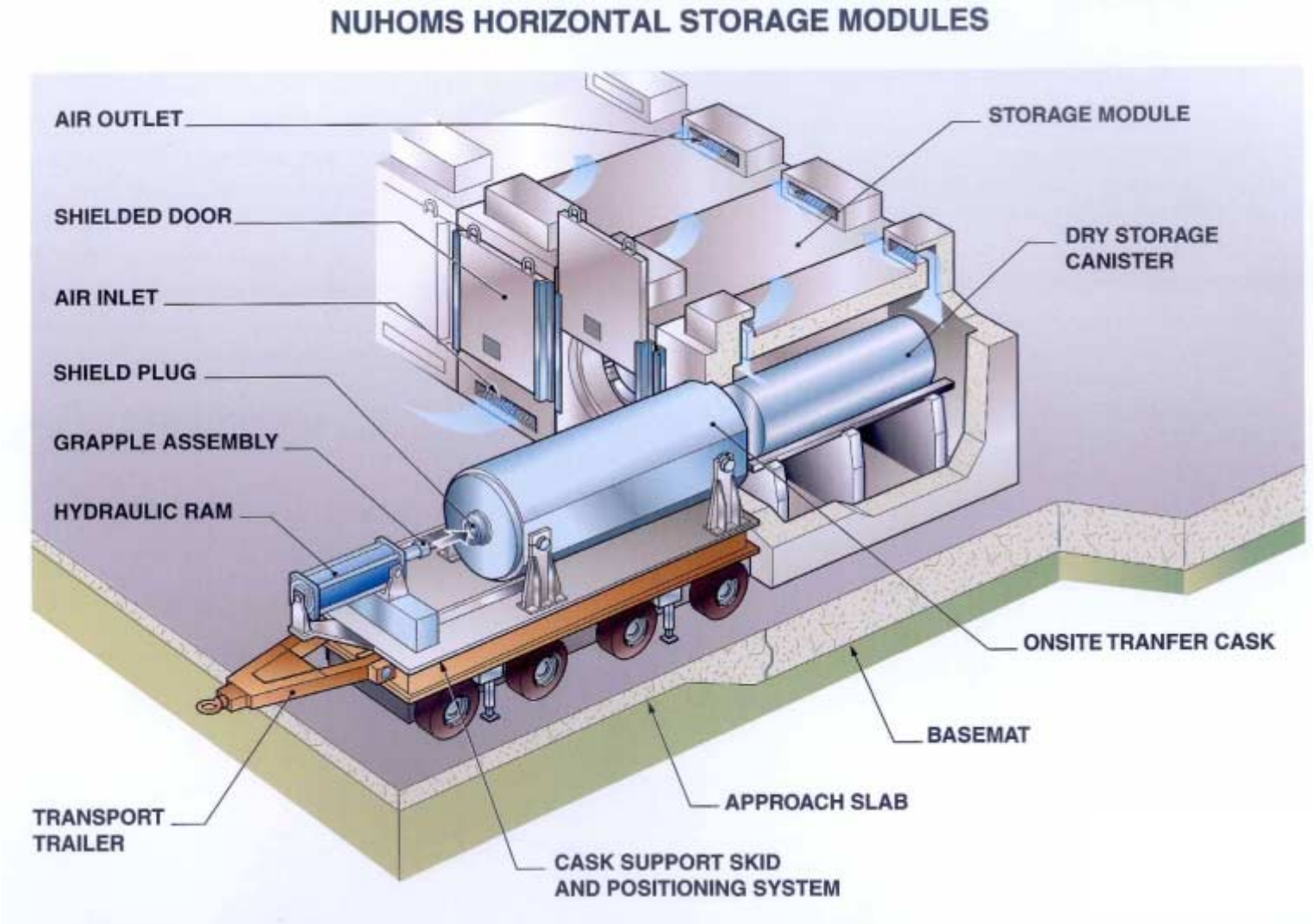
SGN 's vault system CASCAD

- A multiple containment barrier system : tight canister and storage pit
  - Passive cooling, while the Fuel Assemblies are stored in an inert atmosphere and under conditions of temperature preventing from the degradation of rod cladding
  - Sub-criticality controlled by adequate arrangements in any conditions
  - Safe facility meeting ICPR 60 Requirements as well as all applicable regulations (including severe weather conditions , earthquake, aircraft crash)
  - Safe handling operations
  - Retrievability of the spent fuel either during storage period or at the end of planned storage period (100 years)

HABOG, Netherlands

  - Future Decommissioning of the facility expedited through design optimisation
  - Construction and operating cost-effectiveness.

A canistered concrete shielded system the NUHOMS® System



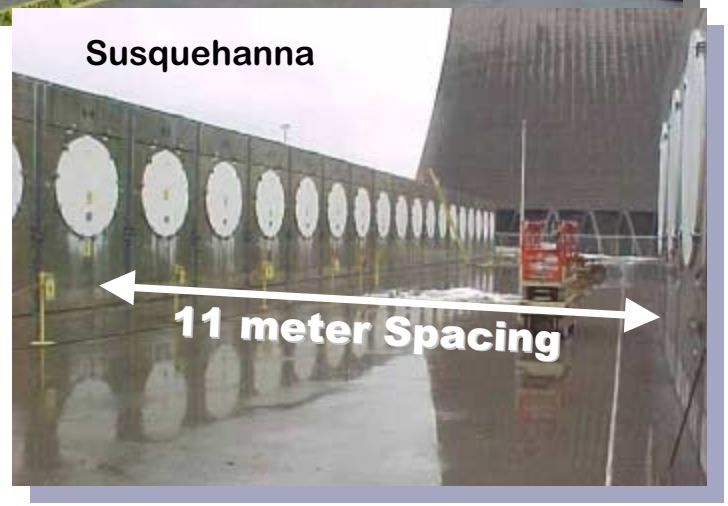
Dry Fuel Storage Transfer

- **NUHOMS® SYSTEM**
  - Compact and Integrated Trailer/skid/3-Stage Ram with all wheel steering
  - Fast and Reliable Operation
    - 3 Hours from the time it leaves the building to a loaded module
  - No critical lifts outdoors

  - No multi-million dollar outdoor cask handling facility: the HSM module sits on the pad and requires no operational handling. This allows optimum shielding unconstrained by handling considerations.
  - No building modifications = lower cost and risk.

The NUHOMS® Horizontal Storage Module (HSM)

- *System Components*
  - *NUHOMS DSC (dry storage canister)*
  - *Horizontal Storage Module (HSM)*
  - *On Site Transfer Cask*
  - *Integrated Transfer Trailer*
  - *Auxiliary Equipment*
  - *NUHOMS MP197 Transport Cask*
- *Advantages*
  - *No tipping and no critical lifts at the ISFSI*
  - *Simple proven horizontal transfer.*
  - *Close packing makes NUHOMS the best shielded system in the industry.*
  - *Concrete construction at the site can be avoided by prefabrication.*
  - *Over 250 built with 200 loaded to date*

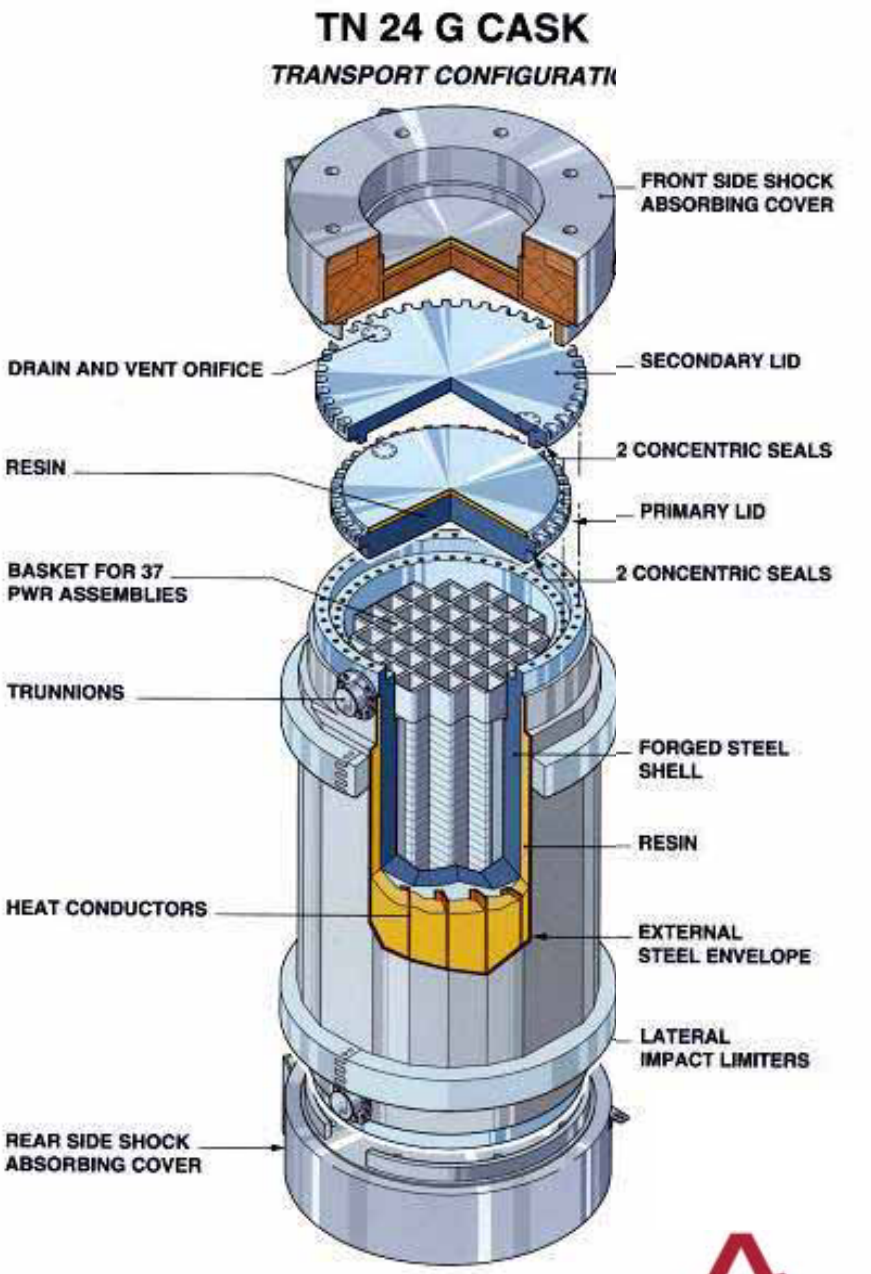


TN24, a transport/storage cask family

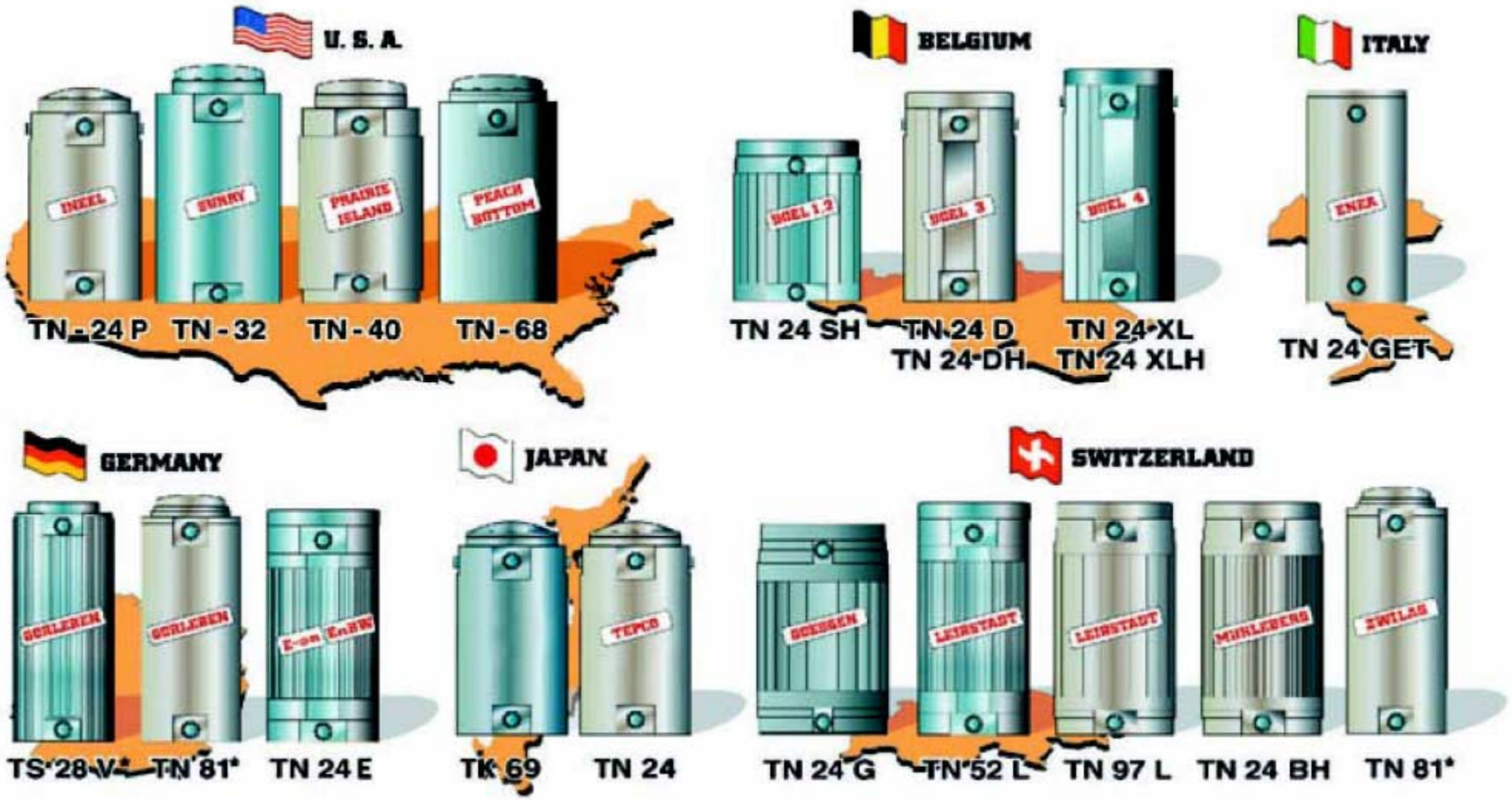
	Units ordered	Units delivered
USA	91	33
GERMANY	33	0
BELGIUM	41	29
SWITZERLAND	16	9
JAPAN	9	9
TOTAL	**190**	**80**

TN 24, flexible design

- **Advantages**
  - maximum modularity
  - Customization of concept and payloads
  - Robust self standing, requires minimal ancillary equipment
  - Readily transportable
  - Readily reversible
  - Monitored leaktightness

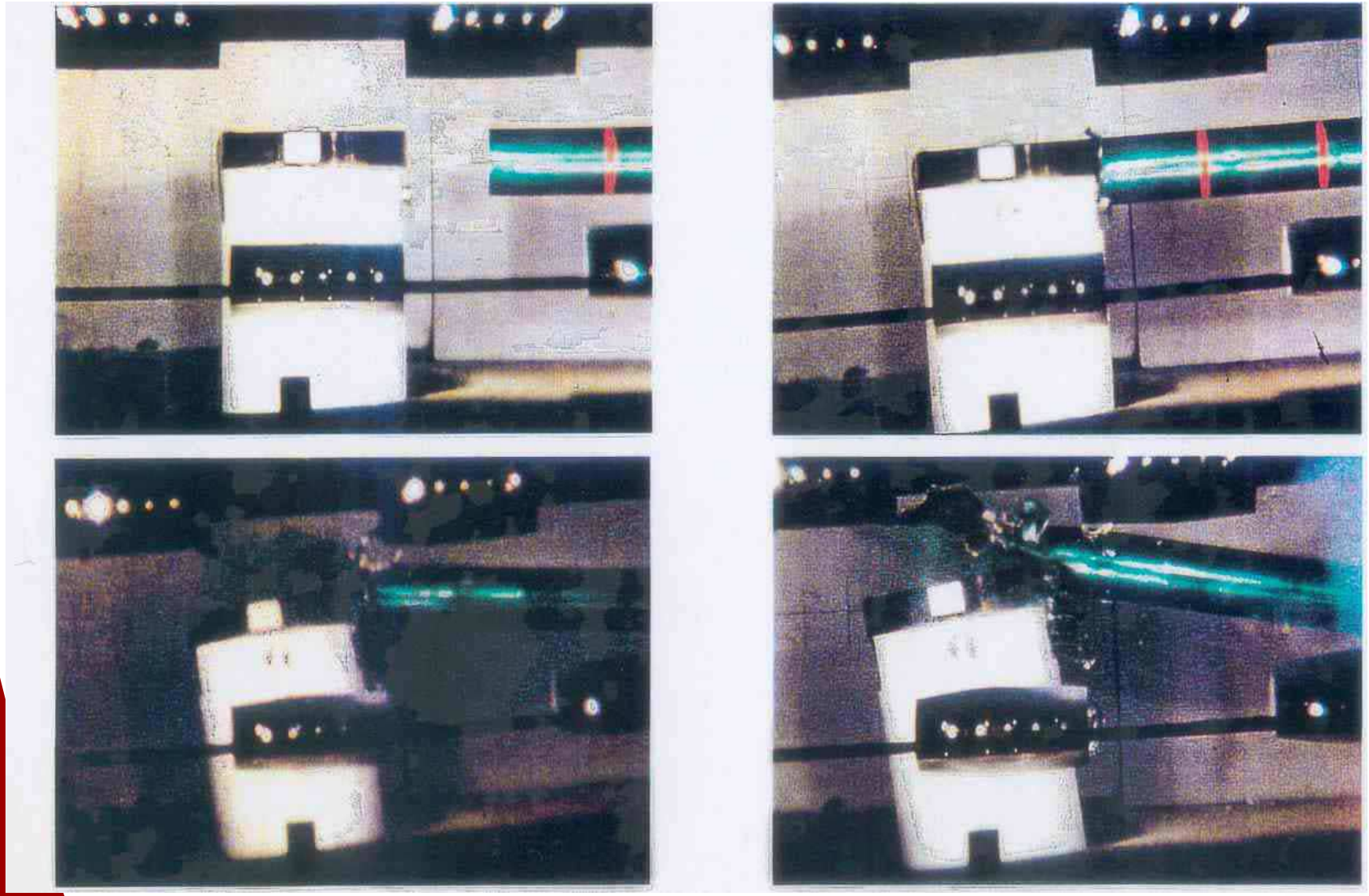


Flexible Design



*storage casks for vitrified residues

TESTING THE IMPACT OF A F16 FIGHTER ON THE TN 24 D



Robust, Transportable