ENSA (Grupo SEPI)

Spanish Spent Fuel Transport

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Outline

- Current Status of the SNF Storage Facilities
- Where and When SNF shall be Transported
- Classifying the SNF for Transportation
- Options for Damaged Fuel Transportation
- Disposal at the ATC

Current Status of the SNF Storage Facilities

- **SNF Inventory**
  - 4,600 tU SF in storage
    - Most of them in SF pools
    - 3 ISFSI under operation (Dry Storage)
      - Trillo NPP
      - José Cabrera NPP
      - Ascó NPP
    - 1 ISFSI under licensing & construction (Dry Storage)
  - Sta. Mª de Garoña NPP (in operation in 2016)
- **Estimated Total Amount of SF considering 40 years of NPP operation**
  - 20,000 Fuel Elements (6,700 tU)

Current Status of the SNF Storage Facilities

- **Trillo NPP**
  - Dry Storage system: ENSA-DPT metal
  - Licensed for both Storage and Transport
  - ISFSI: concrete building. Capacity for 80 metal casks

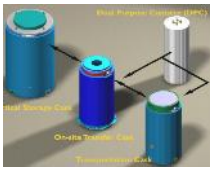


- **Sta. Mª de Garoña NPP**
  - Dry Storage system: ENSA-ENUN 52B
  - Licensed for Storage last Nov 2014. Transport License expected by Feb 2015
  - ISFSI: 2 concrete pads (open). Capacity 16 casks each.
  - First loading campaign expected by early 2016 (updated).




Current Status of the SNF Storage Facilities

- **José Cabrera NPP**
  - Dry Storage system: HI-STORM 100Z
  - ISFSI: concrete pad (open). Capacity 12 SF casks.
  - HI-STAR licensed in 2009 (Spain)



- **Ascó NPP**
  - Dry Storage system: HI-STORM 100
  - ISFSI: 2 concrete pads (open). Capacity 16 casks each.
  - HI-STAR licensed in 2012 (Spain)

Current Status of the SNF Storage Facilities

- **Almaraz I and II (PWR – W)**
  - Storage system: Wet (spent fuel pool)
  - Spent fuel pool full by 2018-2021

- **Vandellos II (PWR – W)**
  - Storage system: Wet (spent fuel pool)
  - Spent fuel pool full by 2021

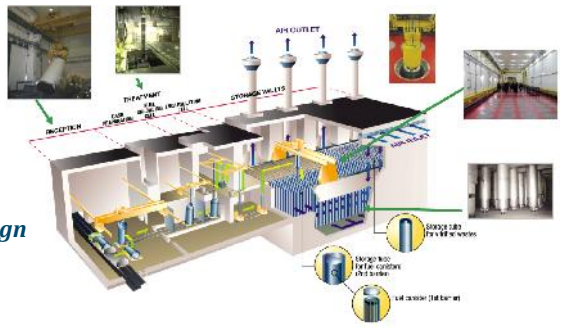
- **Cofrentes (BWR – GE)**
  - Storage system: Wet (spent fuel pool)
  - Spent fuel pool full by 2019

Where and When SNF shall be Transported

Where and When SNF shall be Transported

- First shipment is scheduled for 2018
- Maximum storage "estimated" time before first shipment:
  - 20 years for low burnup fuel
  - 10 years for high burnup fuel
- An ISFSI at the ATC facility shall be ready to receive the loaded casks

ATC Conceptual Design

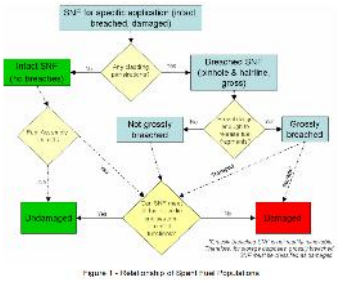


Classifying the SNF for Transportation

ISG-1:

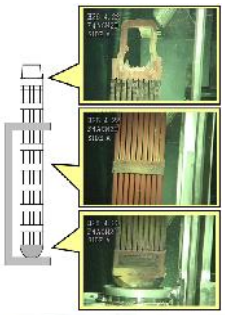
- This Interim Staff Guidance (ISG) provides guidance on classifying spent nuclear fuel as either (1) damaged, (2) undamaged, or (3) intact, before interim storage or transportation.
- In this guidance, SNF is defined in terms of the characteristics needed to perform the fuel-specific and system-related functions.

Damaged SNF	Any fuel rod or fuel assembly that cannot fulfill its fuel-specific or system-related functions
Undamaged SNF	SNF that can meet all fuel-specific and system related functions. As shown in Figure 1, undamaged fuel may be breached. Fuel assembly classified as undamaged SNF may have "assembly defects."
Intact SNF	Any fuel that can fulfill all fuel-specific and system-related functions, and that is not breached.



Classifying the SNF for Transportation

- It is established in the Spanish regulations that all of the spent fuel that are being loaded in a cask should be capable to be transported just after loading or after a storage period.
- Transport of intact and/or undamaged fuel is currently not a concern in Spain due to "short" period of storage (expected 10 years for high burnup fuel).
- Transport of damaged fuel is different. Following variables shall be considered:
    1. Leakage
    2. Cladding Corrosion
    3. Mechanical Damage/FA with defects
        i. Handling
        ii. Integrity
        iii. Stability (dimensional)



Classifying the SNF for Transportation

Leakage

A fuel assembly can be considered ***Unbreached*** (leak tightness) when evidence of no leakage in all of its fuel rods can be proved, based on the radiochemistry data, inspections (i.e. UT) or any other visual inspection performed.

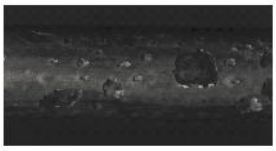
Based on the results, the following classification could be established:

- ***Breached or Unbreached***: if there is consistency between the results of the radiochemistry and the inspections
- ***Unclear***: inconsistency between both results. It is an standard procedure that in this case, all other fuels irradiated in the same cycle shall be considered as "unclear" fuels.

Classifying the SNF for Transportation

Cladding Corrosion

Classification of fuel assemblies with this pathology will be based, basically, on the oxide that has the possibility to become detached or spalled from the cladding fuel rods.



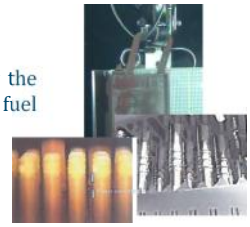
Using the data from different inspections, a relation between the thickness of the oxide layer and the rod average burnup has been obtained, defining the average burnup for potential spalling.

This criteria will be used to establish a design requirement to be implemented in the transportation cask, to assure proper behavior of the fuel under normal and hypothetical accident conditions. Note that based on this design criteria, fuels with cladding oxide may or may be not classified as damaged fuel, directly dependent on the system (fuel-specific or system-related).

Classifying the SNF for Transportation

Mechanical Damage or Fuel Assembly with Defects

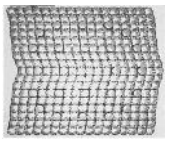
Refers to alterations of the fuel assembly that prevent it from fulfilling its fuel-specific or system-related functions.



- **Handling**

Maintaining the ability to handle individual spent fuel assemblies by the use of normal means. Mechanical defects in the Spanish spent fuel inventory are basically due to:

1. Top nozzle hold-down spring bolt failure due to PWSCC
2. Top nozzle-guide tubes thimble sleeves failure due to IGSCC



- **Integrity**

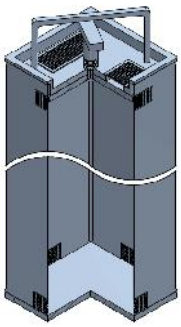
Basically refers to structural integrity of the grids, with problems such us, broken or missing grids or grid straps (spacers), missing or broken grid springs, weld spots failure, missing parts.

- **Stability**

Although this problem should not necessarily make a fuel a "damaged fuel", an excessive bow should have an impact on the fuel-specific or system-related functions.

Options for Damaged Fuel Transportation

According to the different pathologies the following assessment can be made to manage damaged fuel in the future transportation campaigns in Spain:



"All damaged fuels can be divided in two groups based on the fuel-specific or system-related functions"

- Damaged Fuel with leakage (breached) may be transported inside an special sealed damaged fuel can (if feasible). This sealed can will not only assure confinement of gross particles, debris and missing parts, it will also simplify the fuel-specific or system-related design assumptions (i.e. criticality)

- Other damaged fuel (corrosion and/or mechanical damage) shall be transported in a standard damaged fuel can (easier to operate).

Disposal at the ATC

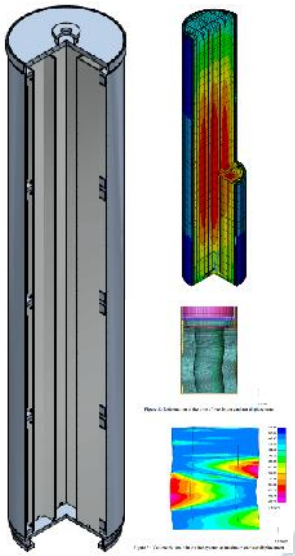
Fuel from transportation casks shall be transferred to welded canisters inside a dry hot cell.

Canisters shall be able to accommodate either intact, undamaged or damaged fuel (with its damaged fuel cans).

Canisters are designed for 100 years of storage, according to the Spanish IS-20 and IS-29, IAEA SSG-15 and 10CFR72, NUREG-1567 and 1536 regulations.

If canisters are to be used for transportation, design adjustments are required to meet transport regulations.

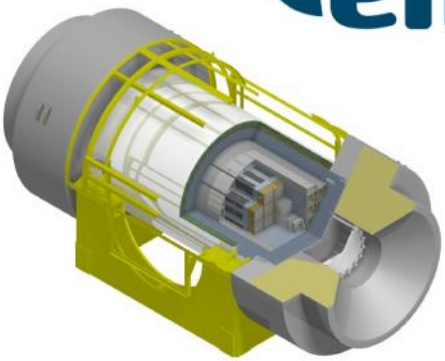
ATC canisters will accommodate a small number of fuels, as a consequence a huge number of shipments shall be required (possible social impact). Other transport combinations are under evaluation.

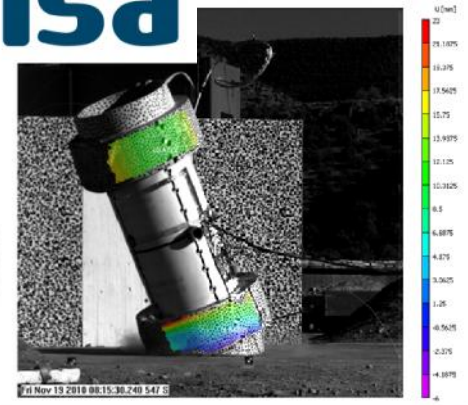


Conclusions

- Most of the SNF is actually stored in the spent fuel pools. 4 NPP have also an ISFSI for dry storage.
- The ATC will receive the first SNF by 2018, so transportation will become an important issue in the Spanish SNF management strategy.
- Transport of high burnup intact and/or undamaged fuel is not a concern in Spain (around 10 years of storage).
- Transport of damaged fuel needs to be carefully managed. All damaged fuel types can be grouped in two families: fuels with leakage and the rest. The first group can be transported in sealed damaged fuel can (if feasible). Second group can be transported in standard damaged fuel cans.
- Fuels from transportation casks shall be transferred into the ATC storage canisters, either undamaged or damaged.
- If canisters are to be used for transportation, redesign is required. Due to small number of fuels in the canisters (disposal), a huge number of shipments shall be required. Other alternatives under evaluation.

Thanks for your attention!





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