

Experience on management of 'non-reprocessible' and damaged fuels (UK Perspective)

*Presentation to the NDEP-NOC/CEG workshop on SMP-2, 12 April 2007,
London, UK*

Presented by P N Standing

Introduction

- British Nuclear Group has extensive experience in transportation, handling, storage and reprocessing of spent nuclear fuel (from UK & overseas)
- Primarily manages 'as manufactured' fuel from commercial nuclear power plants.
- Can also accommodate
 - failed fuel
 - non-standard fuel
 - damaged fuel
 - post-irradiation examination (PIE) materials

Introduction (continued)

- The experience in managing non-standard, failed and damaged oxide fuels in support of reprocessing activities is covered:
 - *A H C Callaghan, P N Standring, J Prestwood & D G Makin, **The Management of Non-standard, Failed and Damaged Oxide Fuels at Sellafield, TD15035, December 2005.***
- The current presentation focuses on the experience gained in managing fuels covered by storage only contracts and fuels damaged during storage operations

Damaged Fuels

- Fuel Handling Operations (placement or retrieval activities)
 - Frequency is very low
 - Fault scenarios
 - Incorrect attachment of the fuel handling tool
 - Failure of the fuel handling tool during operation
 - Materials failure of the fuel assembly structure tube
- Where a generic materials failure mode is identified then action is taken to ensure that the remaining fuel can be safely handling (e.g. incorporation of supporting sheath, surrogate handling arrangement)



Damaged Fuels (continued)

- Fuel handling Operations

- Bespoke design solutions to put into a safe format for retrieval (also designed to be compatible for reprocessing)
- Guidance
 - ANSI Standard 14.33: "Characterizing Damaged Spent Nuclear Fuel for the Purpose of Storage and Transport"

- Chronic degradation of the fuel cladding

- Fault Scenario
 - Aggressive storage conditions which leads to gross corrosion of the cladding
 - Magnox storage pond (open) chloride ingress from the atmosphere
- £££££

Typical Fuels for Storage/Disposal

- Material that is not economically viable to reprocess for one or more reasons

- Product not of value for reuse, or required (yet?)
- Difficult to separate chemically
- Severe impact on plant through-put
- Difficult to put into a reprocessable format/cost
- Plant modifications
- Volume of material
- Can not make an economic safety case

Objectives of Spent Fuel Storage

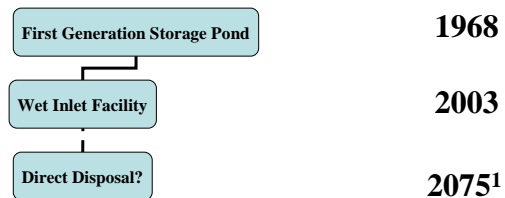
- The main objectives of spent fuel storage are :
 - Sub criticality of the spent fuel is to be maintained under normal and accident conditions
 - The primary containment barrier (i.e. the fuel cladding) should be maintained during handling and exposure to the storage environment
 - Ensure that radiation rates and doses do not exceed acceptable limits,
 - Maintain retrievability

Safety Case – Development, Renewal

- Consideration of materials performance and ageing processes under service conditions
- Guidance
 - International Atomic Energy Agency, Understanding and Managing Ageing of Material in Spent Fuel Storage Facilities, TRS no. 433, IAEA, Vienna (2006).
 - International Atomic Energy Agency, Spent Fuel Performance Assessment and Research, IAEA-TECDOC-1343, IAEA, Vienna (2003).
- *Major consideration now being given to spent fuel performance during transportation after extended storage (accident scenarios)*



Submarine Fuel Management



¹ Direct disposal is a potential option. Submarine fuel was included in the NIREX scope of wastes for a HA repository (NIREX report N/085). 2075 HA repository availability planning assumption

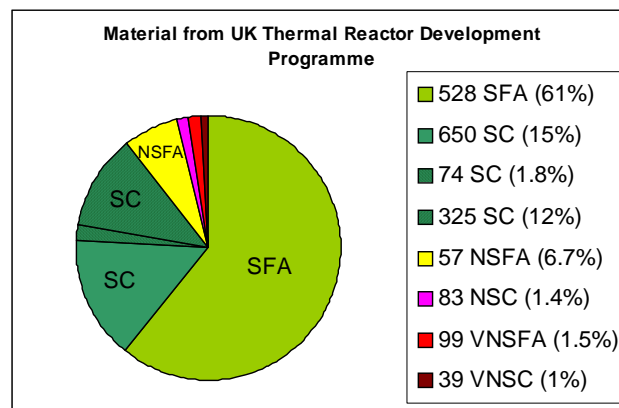
Submarine Fuel Storage

- Safety Case developed by the fuel manufacturer
- Materials performance supported by post irradiation examination
- Fuel has been stored since 1968
- Storage performance to date is good
- Requirement to provide a second generation storage facility
 - Capacity
 - *Asset condition/design*

Lifetime Costs - breakdown

- Annual Costs
 - Resource profile operations (phases of operation)
 - Receipts, Storage, Retrieval, decommissioning
 - Routine maintenance
 - Monitoring (inspections, analysis, Radiation Protection ...)
 - Materials (chemicals, ion exchange ...)
 - Laundry, Rates, Electricity.....
 - Supporting Services (Technical, Safety ...)
- Periodic Costs
 - Major refurbishment (e.g. building cladding, control systems, plant computers, regulations)
 - Long term Safety Review (rellicence) – 10 years
- Contingencies
 - New Storage Facility

2.5% may not be reprocessed



S – Standard, NS – Non Standard, VNS – Very Non Standard

Materials Assessment –Safety Case

- VNSFA (Fuel Assemblies)
 - Zirconium based – corrosion rate in wet storage conditions considered very low
- VNSC (Material in Stainless steel Cans)
 - Issues with condition of welds and epoxy resin (used for sealing pin punctures)
 - Repack or place in secondary containment
 - Preference to place into secondary containment as cans are held in sheaths (integrity for retrieval for transport etc. is placed on the sheath)

Lifetime Cost of Storing

- Relative small amount of material (0.07%) which can be accommodated along side existing business
- Storage at cost zero
- Incremental costs incurred
 - Storage format which is compatible with the existing business
 - Retrieval/transportation
 - Conditioning for disposal
 - Disposal
 - Conditioning of secondary wastes

Summary

- Examples of the experience gained in managing fuel storage and fuels damaged during storage operations has been provided
- Briefly looked at some the issues associated for managing fuel potentially for storage /disposal