Fuel cycle at NPP Paks

Frameworks for assurances of supply, operation and back end

Determining phases of the fuel cycle

- Fresh fuel supply (front end)
- Operation
- Spent fuel policy (back end)

Fresh fuel supply
I. Aspects to be considered

- Requested reload quantity pro year
- Suppliers
- Fresh fuel in stock

Fresh fuel supply

II. Requested reload quantity pro year

- 4 WWER-440 type units at NPP Paks
- 90-96 reload assemblies pro unit pro year
- Natural uranium (NU) and SWU request:
  - 939.35 kg and 526.5 SWU / follower assembly
  - 1 045,5 kg and 599,4 SWU / fixed assembly

Fresh fuel supply
III. Suppliers

- Primary Supplier: Russian Joint Stock Company TVEL
  - 100 % of the fuel delivery to Paks since 1983 until the present time
- Secondary (licensed only until 2008) Supplier: Westinghouse (BNFL)
  - 0 % of the real fuel delivery to Paks until now

Fresh fuel supply
III. Suppliers (cont')

- Primary Supplier's characteristics
  - Very low rate of fuel failure in case of delivered assemblies
  - Long term contract is in force between NPP Paks and TVEL until end of (extended) operation
  - Contract updating in every 3 years in order to fix the prices and other commercial conditions for the next 3 years sub-period
  - Attachments to the long term contract in order to fix the yearly amount of the delivered fuel assemblies

Fresh fuel supply
IV. Fresh fuel in stock

- According to the departmental order:
  - for ensuring the operational safety: 1 reload pro unit during the whole calendar year
  - for avoiding the effect of other disturbances coming from the transport, operation etc.: additional 1 reload during the time period between first of January and the start of the maintenance period

Operation

- 349 assemblies in a core
- 312 fixed (working) assemblies
  - Three enrichment levels by the rods
  - Average enrichment: 3.82 % (U^{235})
- 37 follower assemblies
  - One enrichment level of 3.6 % by the rods

Operation

- Characteristics of the present (4 years) fuel cycle strategy
  - Reload quantity: 90-96 assemblies / unit
  - Cycle length: 320-325 eff. day
  - Maximum allowable assembly burnup: 49 MWd/kgU
  - Average assembly burnup: 37 MWd/kgU
  - Maximum allowable rod burnup: 55 MWd/kgU
  - Average rod burnup: 43 MWd/kgU

Operation

- Plan for the future:
  - Partially 5 years fuel cycle
  - Reload quantity: 84 assemblies/unit
  - Gd rods within the assemblies are necessary

Remark: according to the experiences in the past a good cooperation is supposed between Hungarian and Russian scientific institutes during the licensing period of the new type of fuel

Spent fuel policy

- First step: at reactor storage during 3-5 years (spent fuel pool)
- Second step in the past (until 1998) : spent fuel transportation back to the former Soviet Union without sending back the waste after reprocessing
- Second step at the present: Interim Spent Fuel Storage Facility (storage duration: appr. 50 years)

Spent fuel policy

- Governing principle behind the present practice: “wait and see” before making the final decision on the long term solution
- Possible long term solutions:
  - spent fuel reprocessing
  - fuel leasing or take-back offer (Russia?)
  - final (geological) repository for the spent fuel

Background of the fresh and spent fuel policy

- Additional protocols (1994 and 2004) to the Hungarian-Soviet inter-governmental agreement (1966) on establishment of NPP Paks
- According to the protocols
  - 100 % of the fresh fuel supply is ensured by the Soviet/Russian Party, and NPP Paks should receive the fresh fuel such an extent for the whole (extended) lifetime of Paks's reactors
  - In the framework of a contract between dedicated companies the Russian Party is ready to take back the generated spent fuel for the whole lifetime of Paks's reactors (the updated contract is not given yet)

Summary I

Strategies at the Paks NPP for hedging against the uncertainties in fuel supply

- Hungarian-Soviet/Russian inter-governmental agreement (with additional protocols) ensuring the long term fresh fuel supply and an offer for taking back the spent fuel
- Long term contract between NPP Paks and TVEL until end of (extended) operation
- Very low rate of fuel failure in case of delivered assemblies
- Large amount of fresh fuel in stock

Summary II

Strategies at the Paks NPP for hedging against the uncertainties in fuel supply

- good cooperation between Hungarian and Russian scientific institutes during the licensing period of a new type (or modification) of fuel
- From point of view of Paks NPP Russian Joint Stock Company TVEL operates like a ‘fuel bank’. *Direct* connection with TVEL means *indirect* connections with many other companies:
  - scientific institutes
  - mines for feed
  - facilities for EUP production
  - fuel assembly fabricators
- diversification in licensed fuel types