

German Research Reactor Back-end Provisions

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Fuel Cycle History of Half a Century

- US 'Atoms for Peace Program', President Eisenhower 1953
- HEU for peaceful research and development (R&D)
- First RR built in Germany in the late 1950s
- US supplied fuel on a lease basis until 1974
- Until 1987 fuel sale with option to return spent HEU + LEU fuel
- 1987-Dec-31: DOE's policy for receipt of FRR SNF expires without prior notice

German RR Back-end History

- 1960s: US Reprocessing, no return of waste
- 1960/70s: UK Reprocessing, no return of waste
- 1970s: Belgium + France Reprocessing, no return of waste
- 1980s: US Reprocessing, no return of waste
- 1990s: UK Reprocessing, mandatory waste return

Current German Back-end Solution

- 1996 - 2006: Return SNF to US under 'FRR SNF Return Policy' (US-origin)
- Non-Proliferation: Return of all HEU to the US

- Promote RR conversion to LEU
- 10 yrs to provide for national Back-end solutions
- Establish int. Back-end solutions (e.g. IAEA promotion)

German Spent RR Fuel Output

- Current Reactors (operation time): 'BER-II' (2015), 'FRG-1' (> 2010), 'FRJ-2' (2005?), 'TRIGA-MZ' (>2010), 8 'SUR'
- Future Reactors: 'FRM-II' (2003-2033), 'NN' (possibly needed > 2010)
- Fuels: U-Al, U-Si, U-ZrH, U-PE, U-Mo in future
- US- and RUS-origin
- RUS-origin: 'FRM-II' + 'RFR' (shut down) with 1,000 FE leftover

Interim Storage ('IS') for SNF

- Germany have started an 'IS' concept for RR in 1990
- German Atomic Law (AtG) requests Back-end solutions for 6 yrs in advance
- 'IS' in BZA (spent fuel element interim storage facility in Ahaus)
- German designed 'CASTOR MTR-2' transport + storage cask
- Designed for interim storage up to 40 yrs
- Covers all different types of German spent RR fuel (except SUR)

'Castor MTR-2' Transport + Storage Cask

- Basically licensed
- 18 'CASTOR MTR-2' loaded with 1,000 'RFR' fuel elements -->
- Heading for BZA (Ahaus)
- Storage license for BZA pending
- BZA already stores the full core of THTR-300 in 'CASTOR' Casks
- RR storage capacity reserved in BZA
- 60 'CASTOR MTR-2' casks until 2025 (estimated)

Final Repository

- Final disposal route in slow progress
- Current policy: one repository for LAW/MAW/HAW
- Research on long-term behavior of RR SNF (disintegration?)
- Little expertise on long-term integrity of RR SNF available
- Promising results received in FZJ
- Final repository does not yet exist
- Gorleben - PKA Pilot Conditioning Facility, operational since 2001

Back-end Alternative

- COGEMA: Reprocessing of U-Al + U-Si fuels (ratio of 10:1), no time limits
- La Hague Plant for power reactors (all U-origins)
- U is down-blended to < 1 % U-235
- Waste return to country of origin mandatory
- Germany promotes and funds R&D of direct disposal of LAW + MAW in RUS

Summary and Conclusion

- Germany learned its lesson after DOE stopped acceptance of spent fuel in 1987
- Germany has taken responsibility for SNF disposition
- Back-end route for RR has been developed for > 2006
- 40 yrs of interim storage in special designed transport + storage casks
- Final disposal after conditioning (PKA)
- Back-up solution is reprocessing in France or future solutions