High Burn-up Radioactive Spent Fuel

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Rad waste – US experience

- Obama withdraws funding from Yucca Mountain geological rad waste dump
- ‘After spending billions of dollars on the Yucca Mountain Project, there are still significant questions about whether nuclear waste can be safely stored there’ – Barack Obama, Feb 2009

UK rad waste experience

- Current legacy - 75 billion sterling
- CoRWM 1 – deep disposal concept subject to intensive research and development
- To date very limited R & D undertaken
- Rhetoric of deep disposal
- Until then - surface storage

Prof Andy Blowers OBE, Open University, member of NIREX, member of Committee on Radioactive Waste Management 1 (CoRWM)

‘There is, as yet, no proven technical solution for the long-term management of radioactive wastes’

Rad waste – French experience

- 2006 - after 15 years of inconclusive research on deep underground burial, the failure to find a solution led the French parliament to authorize continuation of research on disposal and on long-term storage of the wastes

Liberalisation of the energy market in Europe

- Pressured Electricité de France (EDF) to become more competitive
- Resulted in the testing of high burn-up fuel
- European Pressurised water Reactor (EPR) ‘re-engineered’

EdF ‘Optimization’ study

- Decrease in cost could be achieved if:

1. 15% increase in the reactor’s power
2. Fuel was enriched to up to 4.9% uranium235
3. Spent fuel discharged at a burn-up of 60,000 MegaWatt days per tonne of Uranium (MWd/tU)

High burn-up fuel

- More enriched uranium used as reactor fuel to increase burn-up rate
- Left in the reactor for longer
- High burn-up spent fuel is hotter and more radioactive than conventional spent fuel
- Much tighter ‘safety envelope’

Burn-up rate

- AGR burn-up MWd/tU
  - 5,000 - 30,000
- EPR burn-up MWd/tU
  - 45,000 - 70,000

Spent fuel pools

KW sq m at 5 yrs:

- AGR – 10.8
- EPR – 17.2

Risk Implications

- High burn up increases risk of radioactive releases as the fuel cladding gets thinner
- Increased risk persists throughout storage and disposal
- Hotter and more radioactive
- Take up much more space in any store

Conclusions

- Disposal of spent fuel in deep underground repositories is unproven
- No experience of high burn-up fuel stored over very long periods
- Degradation of high burn-up fuel elements over very long storage periods is certain
- Retrieval, encapsulation, emplacement cannot be assumed to be possible - let alone safe

Very little experience of spent fuel over 60,000MWd/tU

- Containment materials after cooling pond are still experimental
- Decades additional cooling time
- Spaced out in repositories - increasing ‘footprint’
- Uncertainties about high burn-up spent fuel - any fixed disposal cost exposes future taxpayer to huge liabilities

Driven by financial constraints

- Nuclear industry has raised the power output of proposed reactors
- Difficulties of managing and disposing radioactive waste are becoming insuperable
- Burdens of cost, effort, worker radiation dose transferred to future generations