NFLA: ROTHERHAM
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Recycling Radioactive metals from Nuclear Power Station Heat Exchangers

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Stipulates that Re-cycling is the preferred option for treatment of metallic LLW.

*Identifies the need for “fit for purpose” waste management routes.

- States that plans for the management of LLW should be informed by the “proximity principle” : *(in state: no international trade, avoid unnecessary transports)*

- Stipulates the need to “move away from disposal”

- Stipulates the need to “minimise the overall impact of LLW management on peoples and the environment”
Description of Magnox HE

* 8 HEs per reactor
* Converts reactor coolant heat to steam energy (turbines)
* 310 tonnes: 21 metres long
  5 metres diameter
* Outer shell: 28.6mm mild steel
* 100 kms internal steel tubing
How many more Heat Exchangers?

• UK=26 Magnox reactors x8 HEs =208
• UK=14 AGR reactors x4HEs=56

• PWRS=4 HEs per reactor
• Sizewell B: 1reactor/ 4 HEs
• Hinkley C 2 reactors/8 HEs
• 7 other new build sites:14 to 21 reactors= between 56 & 84 HEs

• TOTAL HE’s for recycling = between 332 & 360
Radiological status of Magnox HEs

• Tritium held within HE steel grain structure, surface Co60 and Fe55
• Internal pipework: steel tubing exposed to reactor coolant
• Outer surface of pipe work radioactive "carbonaceous deposit", "scaling" and red rust:
  
• Rad content final shutdown: 36 nuclides inc’ Pu (3), Cm (2), Am 241
• Rad’ inventory: 35 GBqs (35 thousand, million Bq: \[x15=525 \text{ Gbq}\]
• Inlet/outlet ducts have been blanked & sealed
• Regulators define HEs as “SCO” (doubtful)
Re-cycling/disposal of Magnox Heat Exchangers (HEs)

• Authorisation issued to Magnox Ltd for export of 15 HEs from Berkeley NPS (Severn estuary)
• Authorisation runs from Jan 2011 to Jan’ 2015
• Transports to occur in 3 shipments of 5 HEs

Ist and 2nd Transports:
• 5 units by road from Berkeley NPS to Sharpness Docks (Severn Estuary)
• Then by barge from Sharpness to Avonmouth Docks (Bristol Channel)
• Transhipped to deep sea heavy load carrier (sole cargo) bound for Studsvik Nuclear AB, Nykoping, Sweden.
Pollution management by Export

- **HEs to Nykoping (Sweden)** southerly route through Irish Sea, English Channel, North Sea, Kattegat and Baltic

- **At Studsvik** (20 years + work at rad’ decom’) HEs will be decomm’ by:
  - Size reduction, chemical decontamination and sand blast
  - Major % of rads’ removed by above
  - Tritium removal requires additional heating 500 degrees C for 3 to 4 hours

- Claimed 90 to 95% of all metals from HE will be “free released” as conventional scrap immediately after deconn’
- But some may require “decay storage”
Outcome of MAGNOX HE recycling

- 5 to 10% of total HE metal will be returned to country of origin as “low/intermediate level waste
- “decay store” material (low/intermediate) to be returned to country of origin pending later sale
- residual products”: ingot slag, cutting/blasting residues, dust, decontamination liquids (?)

- Return transport to UK….containerised, RoRo ferry/short haul container ship, road/rail to DRIGG

- Magnox Ltd avoid costs of disposing 4665 tonnes & 525GBq (525,000,000,000Bq) of bulky rad’ waste metal to DRIGG LLW
- LLW Authority and Magnox say the process is “economically and environmentally beneficial”
- Breaches “Proximity” principle?
Regulation. Good or bad?

- Studsvik operations within current national regulatory framework for such sites

- **Global metal recycling appears poorly regulated** (unquantified inputs, re-orphaning, poor rad’ monitoring, weak traceability chain)

- **1998 Taiwan identifies 1,573 residential apartments with excess radioactivity** (RSJs, metal fittings etc)

- **1998: Algeciras. Cs 137 source enters smelting process;** atmospheric plume triggers alarms France, Italy, Switzerland, Germany, Austria. (1000 times background)

- **2000: Sheffield. Pu 238 (pacemaker) contaminates 16 tonnes metal & slag** *(smelting plume?)*

- Detailed data on the issue in NFLA BRIEFING “Radioactive Scrap Metals” July 2000
Regulation. Good or bad??

- **2010**: Rotterdam metal recycling company reports finds of 200 “nuclear items” in 2010 including weapons grade uranium and Pu (pacemakers)
- **2010 IAEA statement of intent to develop Metal Recycling Code** in consultation with metals recycling industry and others
- **March 2013**: IAEA publish Draft “Metals Recycling Code of Conduct” (non-binding)
- **2013 (Nov)** Chinese seize 953 tonnes of radioactive scrap metal imported from Japan (+ 1,800 tonnes earlier same year: double permitted radioactivity)
- **Since 2000**: cutlery, tissue dispensers, metal studded belts, hammers, screwdrivers, elevator buttons, building structural items: North America, South America, Africa, Asia, Europe.
Transport accident risks

- **Cargos classified as IMDG 7** in appropriate packaging
- May be transported on Ro Ro ferries, container, general cargo etc ships

- mid 1980s: Franco Belge coast, **Mont Louis**: ran aground and sank: 60 drums U hex:


- 1999 Irish Sea: **City of Manchester**: on fire & adrift: 10 tonnes UraniumO2 (Liverpool/Spain)

- May 2013: Hamburg City: containership **MV Atlantic Cartier**: fire on board while carrying containerised Uranium Hex
Conclusion

• Entry of NPS decon’ radioactive metals into global scrap metal stream is increasing more reactors means more HEs
• “Return” transports of radiologically concentrated “recycling residuals” and “decay store” ingots to increase
• HE recycling may breach Proximity Principle
• Long distance/international transports of NPS decon’ metals to increase
• Existing IAEA “Guidance” is weak, general and non-binding
• Global scrap metal regulation remains poor
• Many examples of breaches (post IAEA Guidance)