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

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United Kingdom solid low level Waste Strategy: NDA (2010)

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 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** (unquantifed inputs, re-orphaning, poor rad' monitoring, weak traceablity 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:

- 1987: Irish Sea: **SSArdlough**: containerised deck cargo: Californium 252: lost off deck during storm (not recovered).

- 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)