Control and Management of Inadvertent Radioactive Material in Scrap Metal
Tarragona, 23-27 February 2009

The relevance for the nuclear industry decommissioning programmes

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Release of Materials and Buildings

Plan of Presentation

- **Background**
- **Overview of clearance levels**
- **Alternatives to clearance**
- **German case study**
- **Conclusions**

OECD Nuclear Energy Agency (NEA) Member Countries and Mission

Australia
Canada
Czech Republic
EU-15
Hungary
Iceland
Japan
Mexico
Norway
Republic of Korea
Slovak Republic
Switzerland
Turkey
United States

EC
IAEA

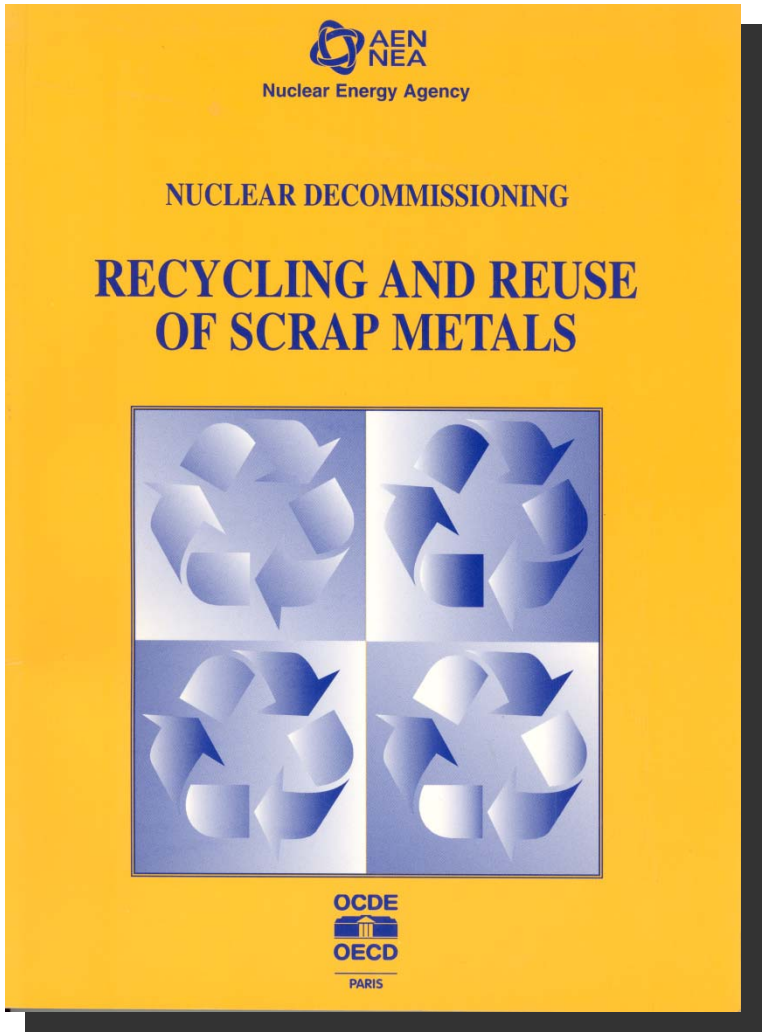
- *... developing the scientific, technological and legal bases for a safe, environmentally friendly and economical use of nuclear energy ...*
- *... provide authoritative assessments and to forge common understandings as input to government decisions and policy analyses…*

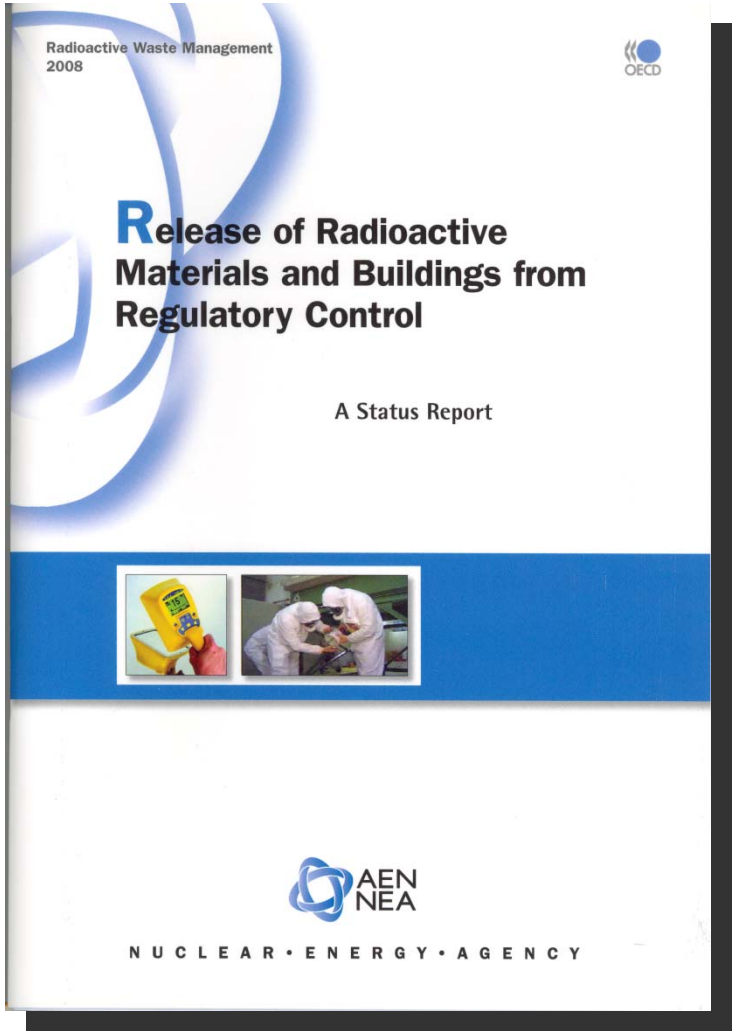
WPDD – Working Party on Decommissioning and Dismantling

CPD – Cooperation Programme on Decommissioning

Missions

- The WPDD Is a Working Party of the RWMC) with the mission
  - To facilitate multilateral an open dialogue among peers, in particular policy makers, the regulatory authorities, R&D institutions and the decommissioning industry
  - To undertake studies on the management and techniques for decommissioning
- The CPD is a joint undertaking amongst 22 decommissioning organisations for the exchange of experience in decommissioning


AEN NEA
Nuclear Energy Agency
NUCLEAR DECOMMISSIONING
RECYCLING AND REUSE OF SCRAP METALS
OCDE
OECD
PARIS


Radioactive Waste Management
2008
OECD
Release of Radioactive Materials and Buildings from Regulatory Control
A Status Report
AEN NEA
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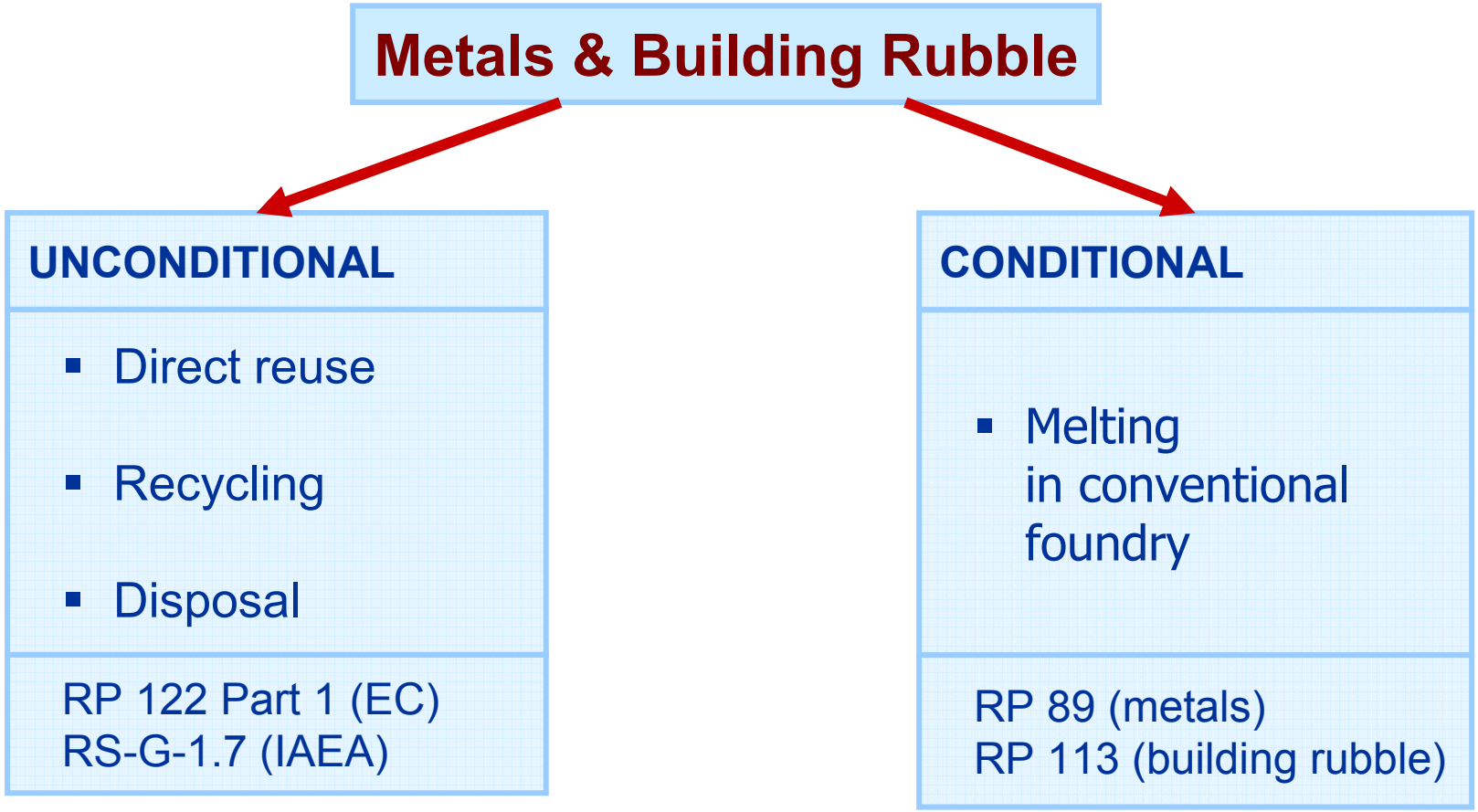
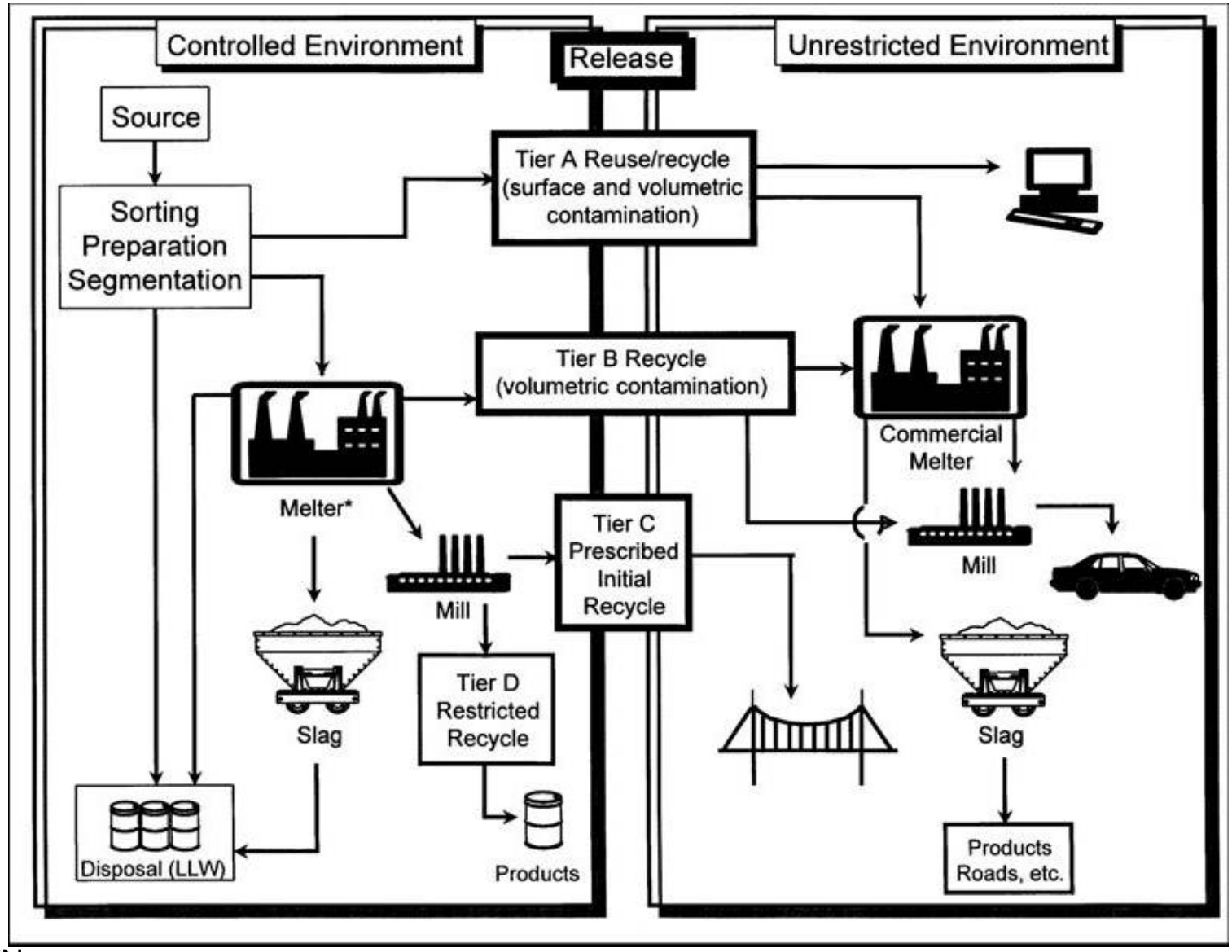
Relevance for nuclear industry decommissioning?

Decommissioning Materials (Forsmark-3 1 GWe BWR)

Radioactive Material (tonnes)		
Reactor pressure vessel	760 (metal)	
Other contaminated systems	5950 (metal)	
Concrete	1230	
Sand	1050	
Operational waste	400	
Inactive/decontaminated material (tonnes)		
Metal	7700	Includes c. 3000 tonnes from the steam turbines
Concrete	229 500	

RECOMMENDED RP CRITERIA




Controlled Environment
Release
Unrestricted Environment
Source
Sorting
Preparation
Segmentation
Tier A Reuse/recycle
(surface and volumetric
contamination)
Tier B Recycle
(volumetric contamination)
Commercial
Melter
Melter*
Mill
Tier C
Prescribed
Initial
Recycle
Mill
Slag
Tier D
Restricted
Recycle
Slag
Disposal (LLW)
Products
Products
Roads, etc.

RP CRITERIA: INTERNATIONAL RECOMMENDATIONS

Purpose	H 3	C 14	Ni 63	Co 60	Cs 137	Sr 90	U 235	Am 241	Pu 239	Unit
Unconditional clearance, RP 122/I	100	10	100	0.1	1	1	1	0.1	0.1	Bq/g
Unconditional clearance, RS-G-1.7	100	1	100	0.1	0.1	1	-	0.1	0.1	Bq/g
Metal scrap for recycling or reuse, RP 89	1,000	100	10,000	1	1	10	1	1	1	Bq/g

RP CRITERIA FOR CLEARANCE OF MATERIALS (Bq/g)

Country	H 3	C 14	Ni 63	Co 60	Cs 137	Sr 90	U 235	Am 241	Pu 239	Origin
Belgium	100			0.1	1	1	1	0.1	0.1	RP122/1
Finland	10	10	10	1	1	1	0.1	0.1	0.1	Reg.
Germany	1,000 1,000	80 80	300 10,000	0.1 0.6	0.5 0.6	1 9	0.5 0.8	0.05 0.3	0.1 0.2	Col.5 Col.10a
Japan	100	1	100	0.1	0.1	1	-	10	0.1	RSG1.7
Netherlands	10^6	10^4	10^5	1	10	100	10	1	1	EUBSS*
Spain	100 1,000	10 100	100 10,000	0.1 1	1 1	1 10	1 1	0.1 1	0.1 1	RP122/I RP89
Sweden	0.5 Bq/g for beta/gamma emitters						0,1 Bq/g for α-emitters			
*for ingots**:*	1,000	100	10,000	1	1	10	1	1	1	RP89
UK	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	Reg. (SoLA)
USA*	530	310	21,000	0.2	0.6	18	0.7	0.2	0.3	Reg.

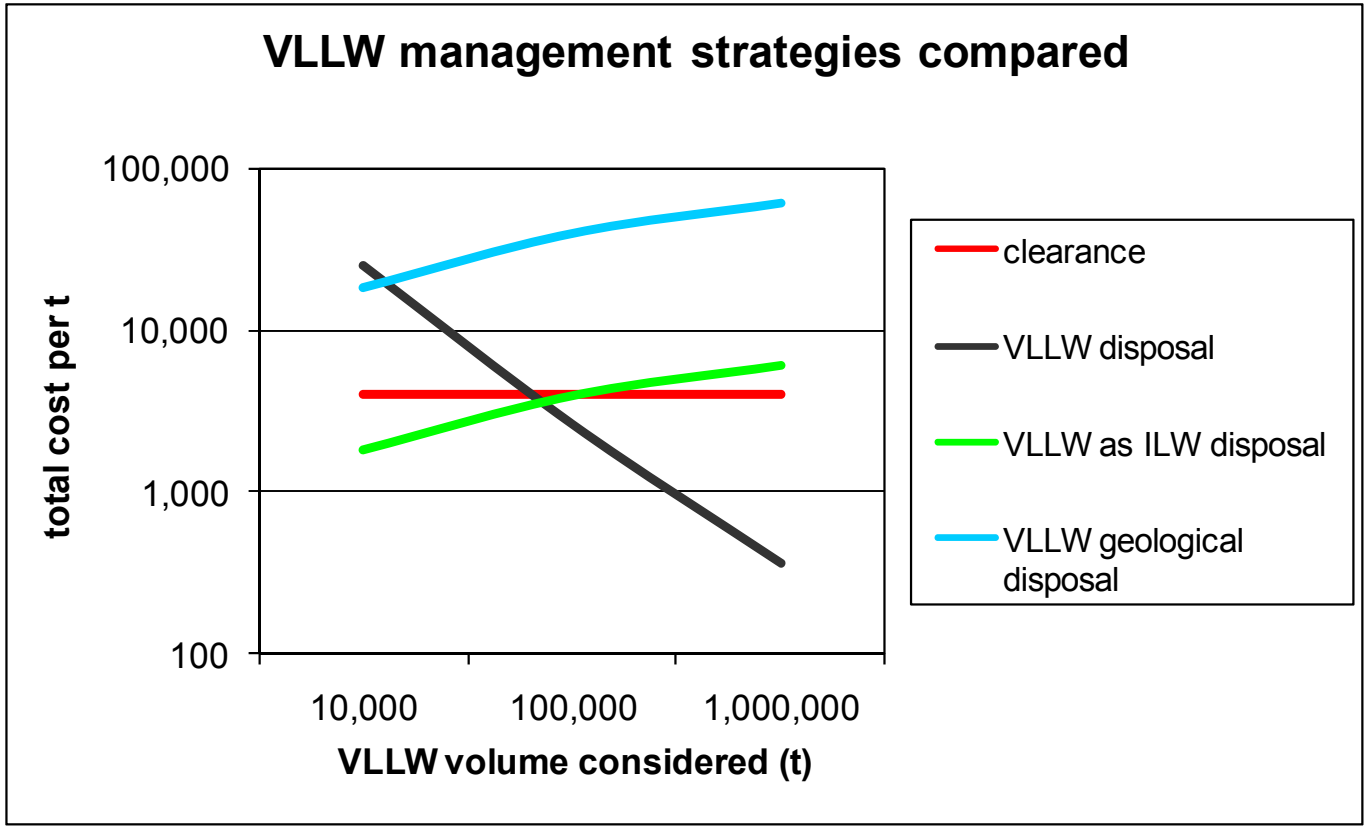
RP CRITERIA FOR CLEARANCE OF MATERIALS (Bq/g)

Country	Metals	Comment
Belgium	726 tonnes: (79% of total mass) 2390 tonnes (95% of total mass)	Eurochemic reprocessing plant BR3 RR
Finland	n.a.	no decommissioning project exists
Germany	several 1,000 tonnes per year	annual quantity for formal clearance procedure from various decommissioning projects
Japan	Clearance to be used for NPPs e.g. 30,000 tonnes for 1100 MWe BWR	
Netherlands	Clearance to be used for NPPs - several 1,000 tonnes in total	NPP Dodewaard only (clearance after 40-year safe enclosure)
Spain	7,500 tonnes ferrous scrap in total 86 tonnes non-ferrous scrap in total 370 tonnes other materials in total	Vandellòs I NPP (clearance after 25-year safe enclosure)
Sweden	metal scrap: 53 tonnes for recycling 119 tonnes for melting at Studsvik in total	for ACL and ACF facilities
UK	~10,000 m³ for disposal in total	Winfrith site only
US	Case-by-case approach	Decision by NRC based on 'very low amounts of radioactivity

ALTERNATIVES TO CLEARANCE (Recycling, Disposal as VLLW, Interim Storage)

- Logistical
  - Total amount of material arising from decommissioning
  - Availability of VLLW disposal sites
  - Need to characterise and segregate (and/or decontaminate) large amounts of non radioactive material
- Economic – cost of waste treatment and storage vs. segregation and clearance
- Regulatory – provisions within the regulatory framework (clearance options, clearance levels, restrictions to certain pathways etc.)
- Social – public opinion on clearance and view of other industrial sectors (like metal working) to the source of cleared material

Illustrative costs of several waste management strategies [Avérous, 2004]



Technical factors

- Demonstrating compliance with clearance levels
  - difficult for material with varying nuclide vectors (e.g. fuel cycle facilities)
- Decontamination techniques
  - Melting - removes long-lined nuclides (Cs-137)
  - Wet and dry blasting techniques
  - Electrochemical decontamination processes
  - Limitations due to geometry and access, e.g. piping valves

Health, environmental and socio-economic Impacts

- Comparison of disposal/replacement vs. recycling/reuse:
  - Physical risks from workplace accidents and transport accidents more important than radiological or chemical risks
  - Non-radiological health risks much higher for disposal/replacement (e.g. steel mill and blast furnace operations)
  - Environmental impacts also higher (e.g. disruption and environmental damage from mining operations and extra energy requirement for replacement)
  - Socio-economic impacts (public opposition) can affect both alternatives

German Case Study (1)

Type of installation	In the process of decommissioning	Fully removed or released from control
Reactors with electrical power generation (incl. prototype reactors)	17 reactors	2 reactors
Research reactors ≥ 1 MW thermal power (incl. nuclear ship Otto Hahn)	8 reactors	1 reactor
Research reactors < 1 MW thermal power	1 reactor	26 reactors
Fuel cycle facilities (primarily commercial production and reprocessing of fuel assemblies)	2 facilities	4 facilities

German Case Study (2)

- Metal recycling industry perspective
  - Any radioactivity should be prevented from entering scrap metal to prevent worker exposure and contamination of foundries
  - Any dose rate above background indicates radioactivity
  - Continuous melting of cleared material could ultimately increase the background activity level in the steel pool and lead to public opposition to the use of steel products
  - Reluctance to enter contracts with the nuclear industry

German Case Study (3)

- Decommissioning industry perspective
  - Decommissioning power plants are the main source of scrap metal /several 100,000 tonnes expected over the coming decades
  - Scrap is of high quality/ few residues
  - Regulatory framework for conventional waste prescribes recycling
  - No available disposal option
  - Large potential benefits from use of conditional clearance values (less decontamination, easier characterisation)

German Case Study (4)

- Outcome
  - Metal scrap accepted by certain scrap dealers and recycling companies
  - Material used only for defined end uses/ conditional clearance values
  - Control by competent authorities/ random checks of melting process

Overall Conclusions

- Large amounts of scrap metal from decommissioning presents a significant problem if reliance is placed on disposal
- Present-day technologies support decontamination of a large proportion of decommissioning steel to clearance levels
- Significant health, environmental and socio-economic benefits of recycling and reuse
- Conditional clearance options may satisfy the needs both of the metal recycling industry and of the decommissioning industry