



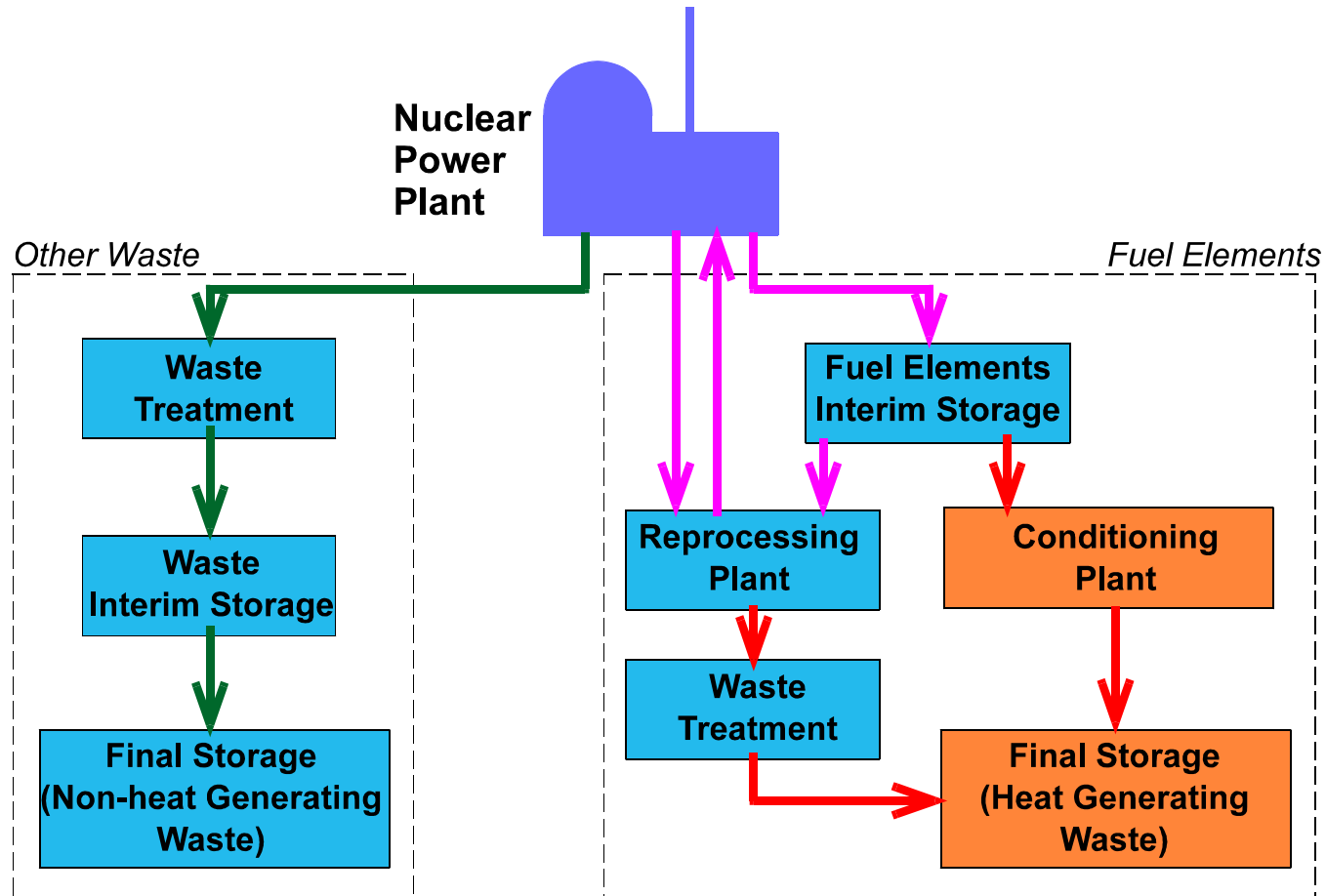
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Kernkraftwerk Gundremmingen GmbH



Material Management



Reference: Brenk Report FKZ 02 S 7452-0

FH0164e



Expected Volume of Radioactive Waste

... is in general determined by

- type and quality of construction materials
- quality of the used nuclear fuel
- age of the plant
- operational history
- availability of clearance levels for materials

Volumes of LLW and ILW from Reactor Operations and Decommissioning in m³



Country	Canada	Germany		Sweden		United States	
Size and type of reactor	4 x 515 MWe PHWR	1.200 MWe PWR	800 MWe BWR	900 MWe PWR	1.000MWe BWR	1.000 MWe PWR	1.000 MWe BWR
waste from 25-year operations*	6.900 - 27 500	6.100 - 11.000	6.000 – 20.000	6.300	7.500	21.700	40.000
Decommissioning wastes	10.000	6.900	12.400	6.700	15.000	15.200	16.300
Total wastes* (operations and decommissioning)	16.900 - 37 500	13.000 – 17.900	18.400 – 32.400	13.000	22.500	36.900	56.300
Decommissioning wastes as a fraction of total waste	0.3 -0.6	0.4 -0.5	0.4 - 0.7	0.5	0.7	0.4	0.3

* Ranges in some estimates indicate the conceivable effect of possible incineration and compaction treatments.

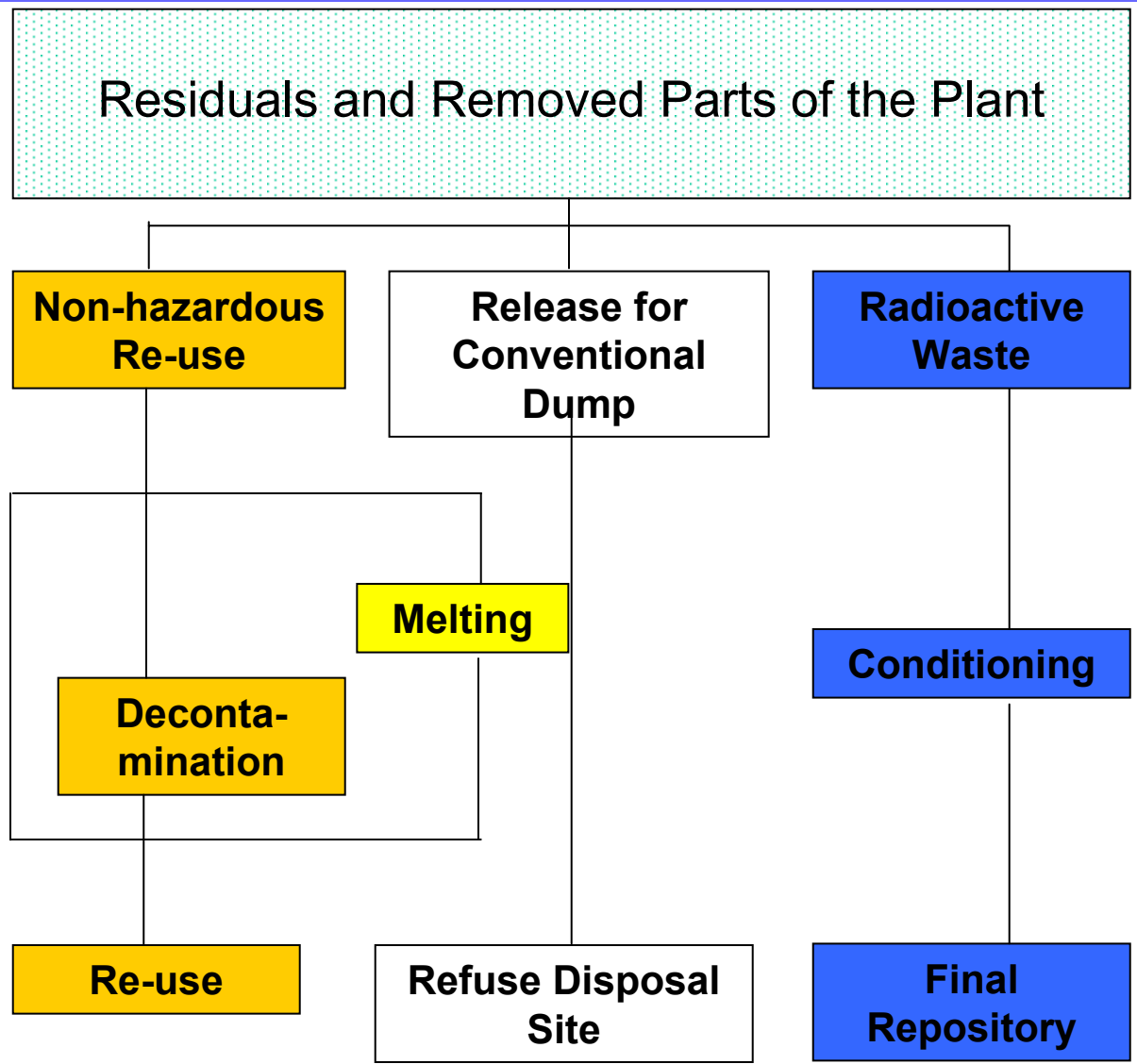


Major Primary Waste Stream

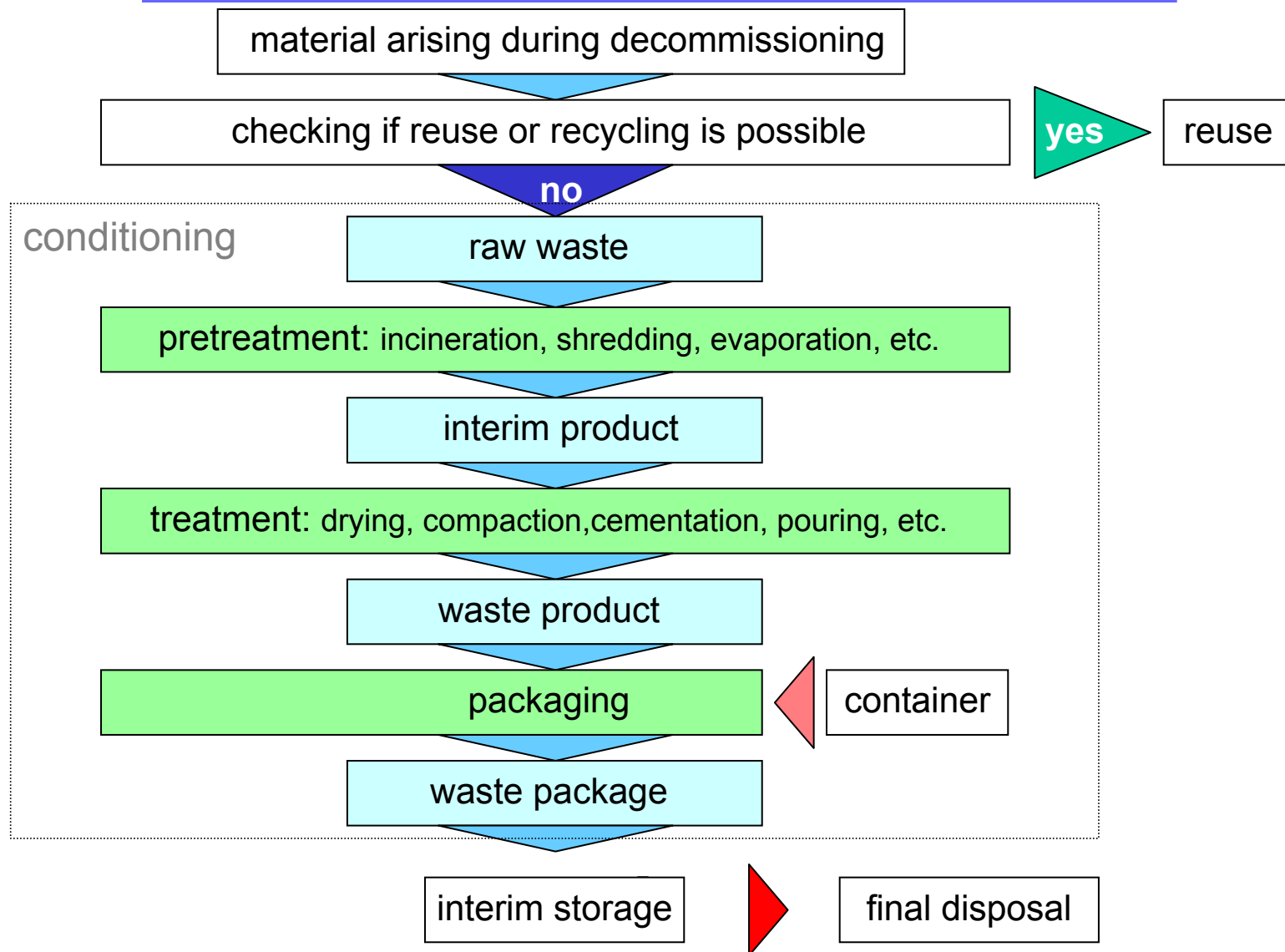
- Burnable wastes (protective clothing, wood from ventilated hoods, laboratory furniture...)
- Low to High level massive metallic wastes (reactor internals, reactor pressure vessel, primary pumps, reservoirs, valves, structural materials...)
- Low to High level super-compactable metallic wastes (same sources as above plus e.g. electric cables, light supports, instrumentation...)
- Massive concrete wastes from slightly activated or contaminated slabs, floors, shielding walls, room walls...
- Concrete and bricks super-compactable rubble from demolition activities of activated or contaminated materials.
- Sludges from deposits in reservoirs and liquid sumps.
- Light non metallic super-compactable materials (isolation, asbestos...)
- Special waste such as contaminated lead bricks and shielding.



Ways of disposal

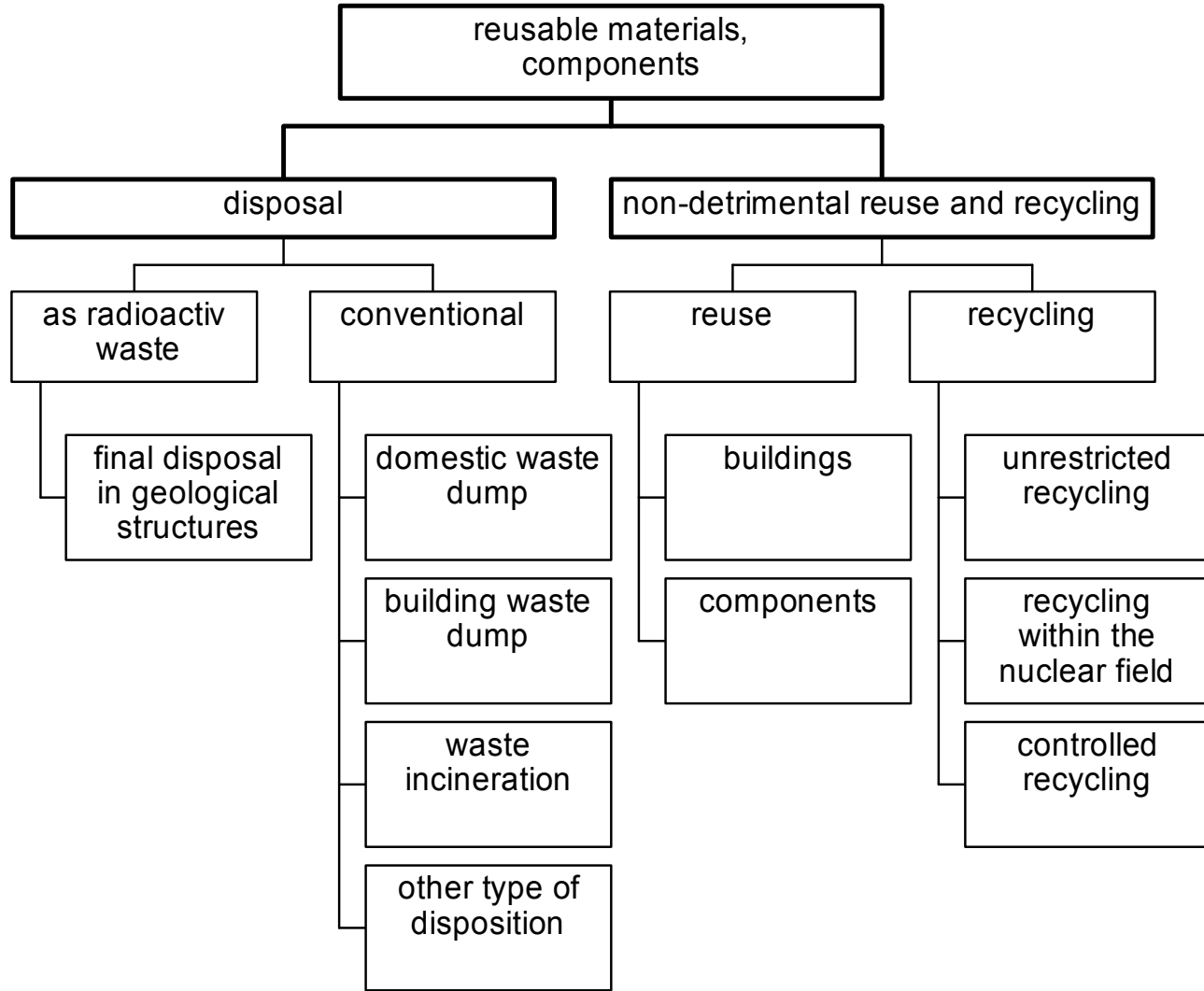


Definitions and working steps during treatment of material

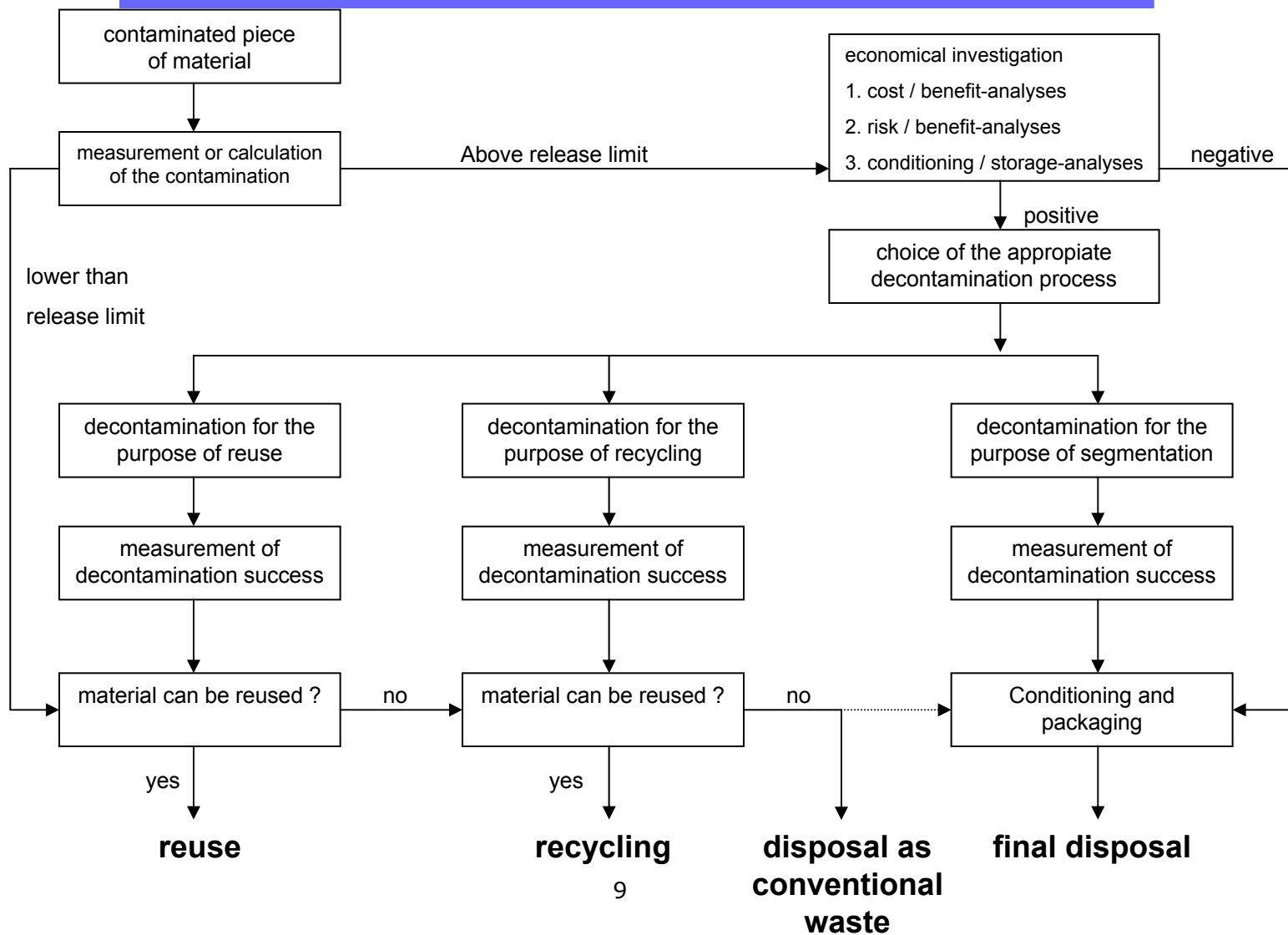




Structure for the treatment of material



Decontamination measures for possible waste streams



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Example: KRB A

1st Commercial Nuclear Power Plant of the FRG



Dual Cycle BWR of General Electric Type

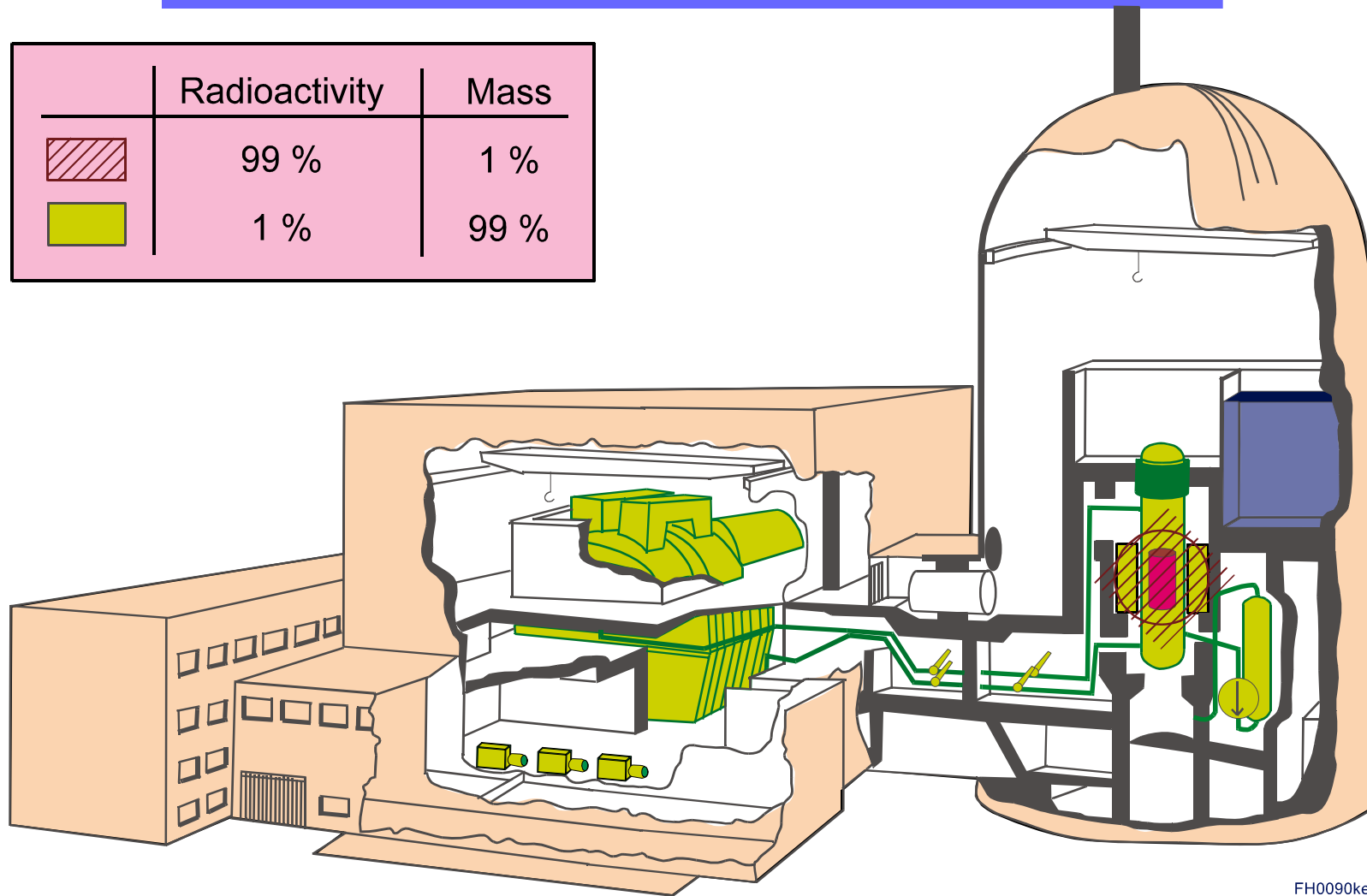
250 MW_{el}

Operating Period 1966 - 1977

1983 Beginning of the Decommissioning Work

Initial Status

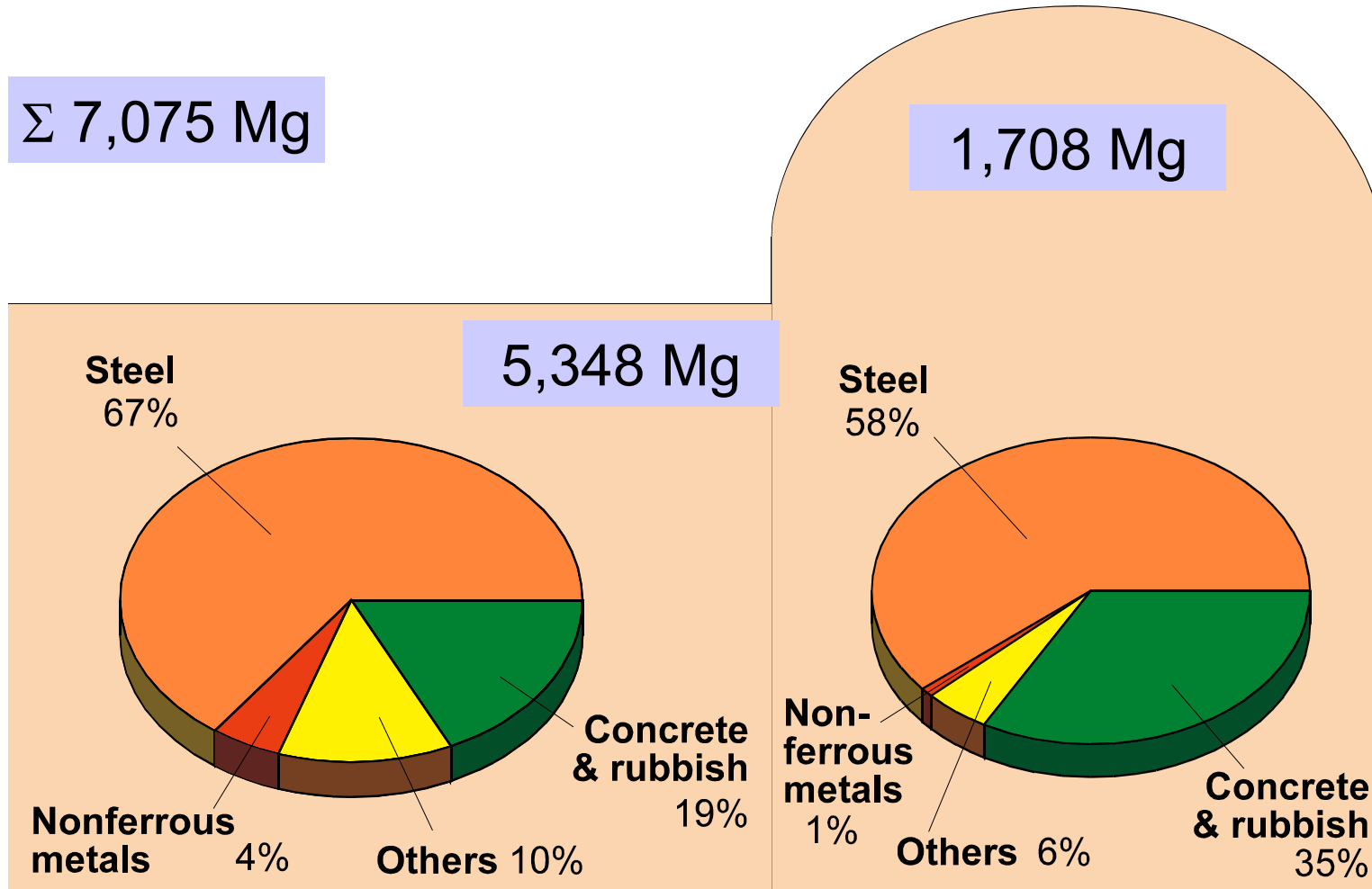
	Radioactivity	Mass
	99 %	1 %
	1 %	99 %





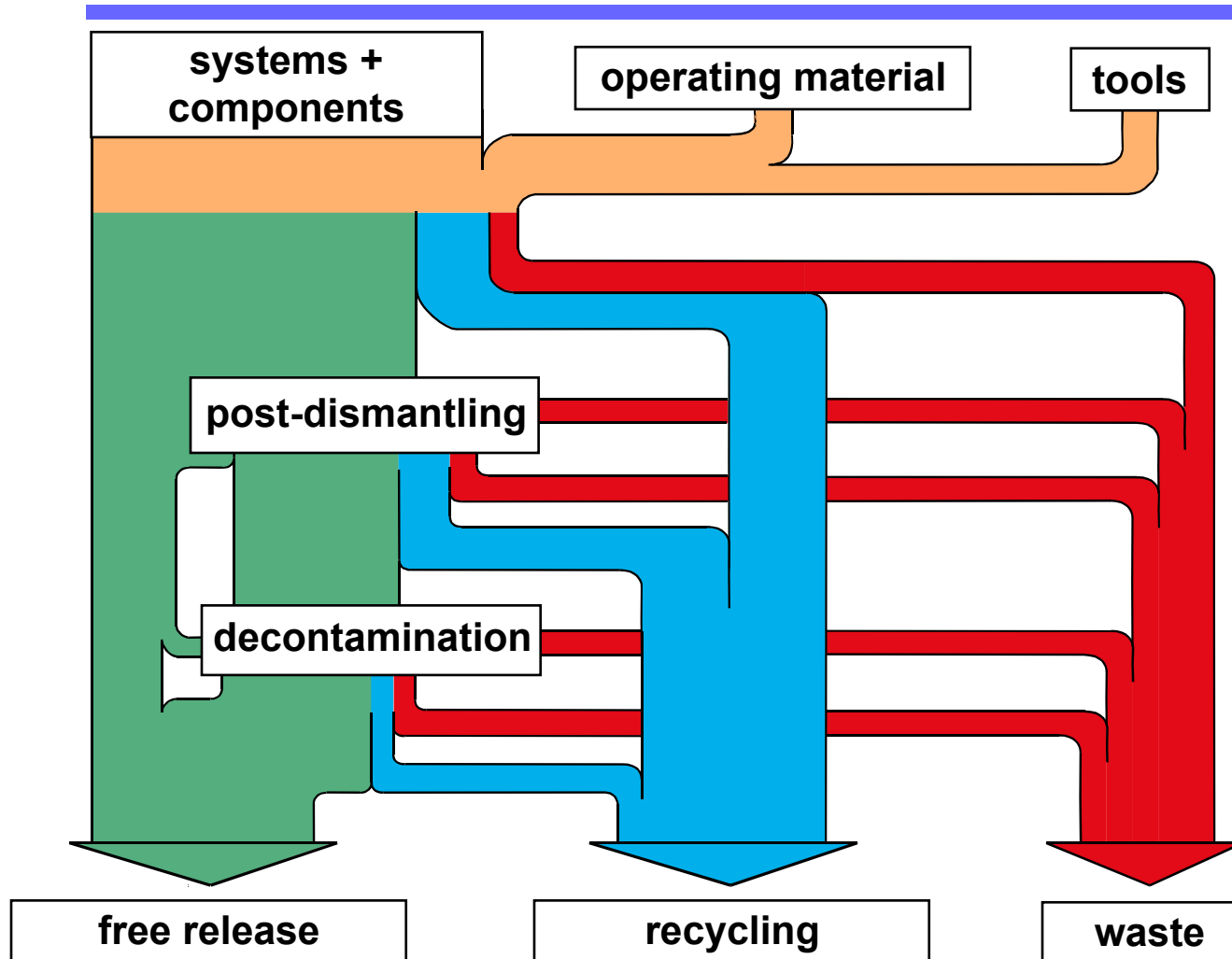
Material Balance at KRB A

Σ 7,075 Mg





Material Flow during Decommissioning



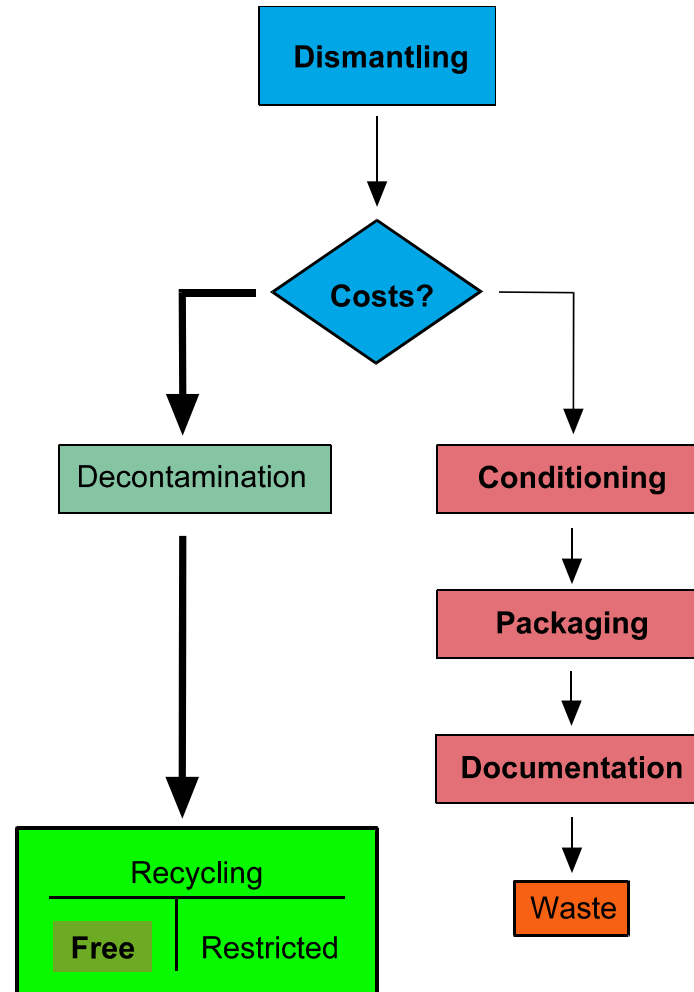
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Turbine Hall at KRB A





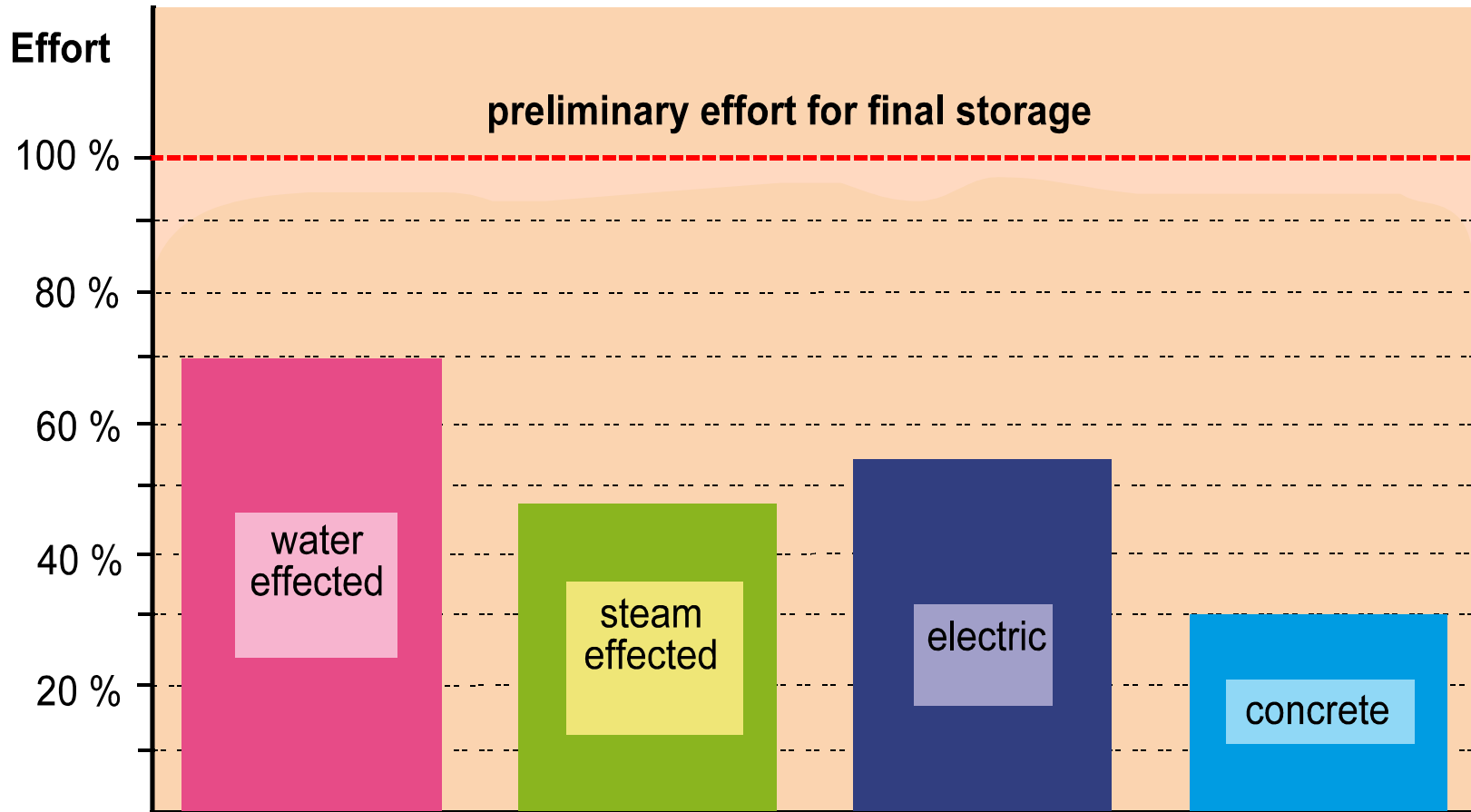
Factors for Material Management



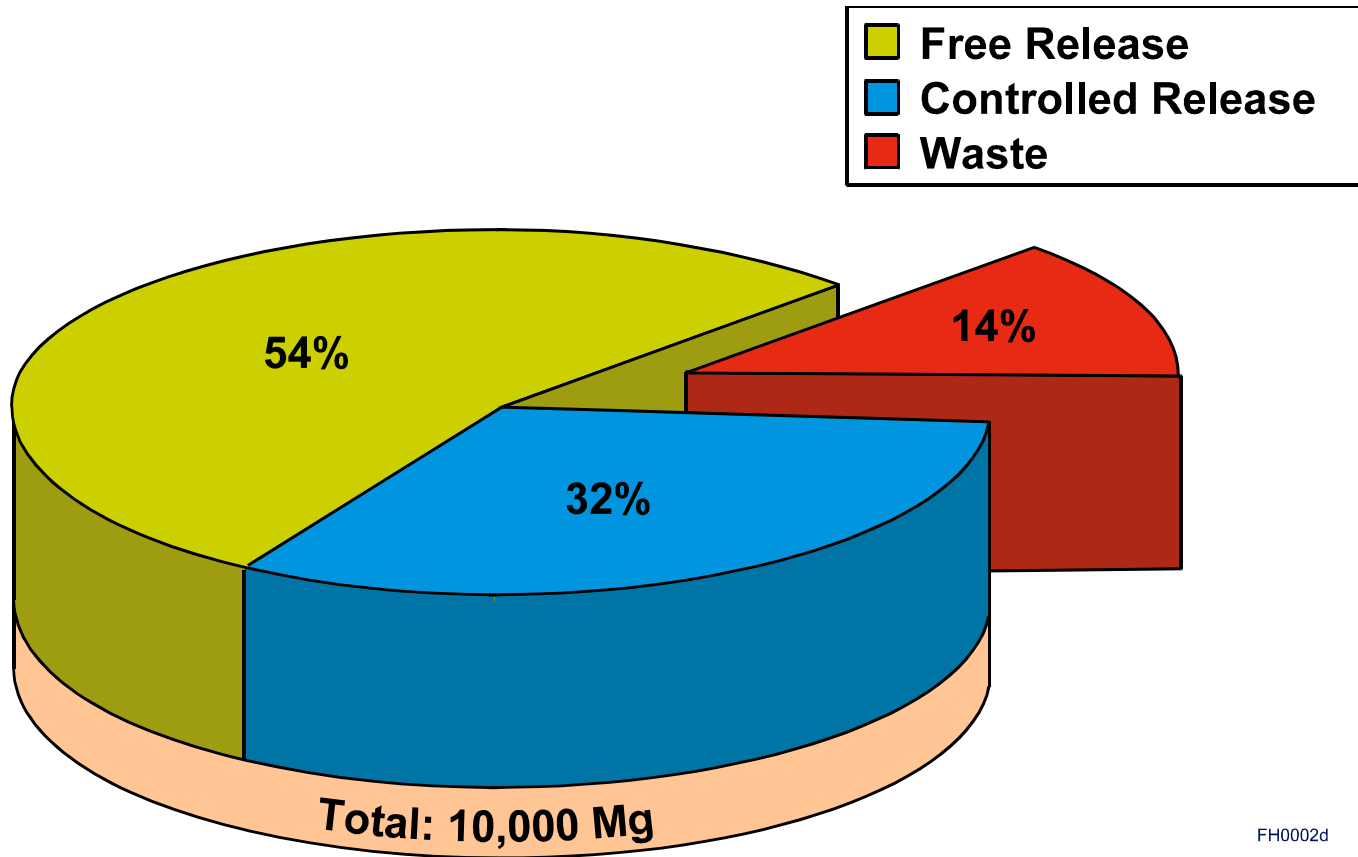
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Disposal or Recycling ?

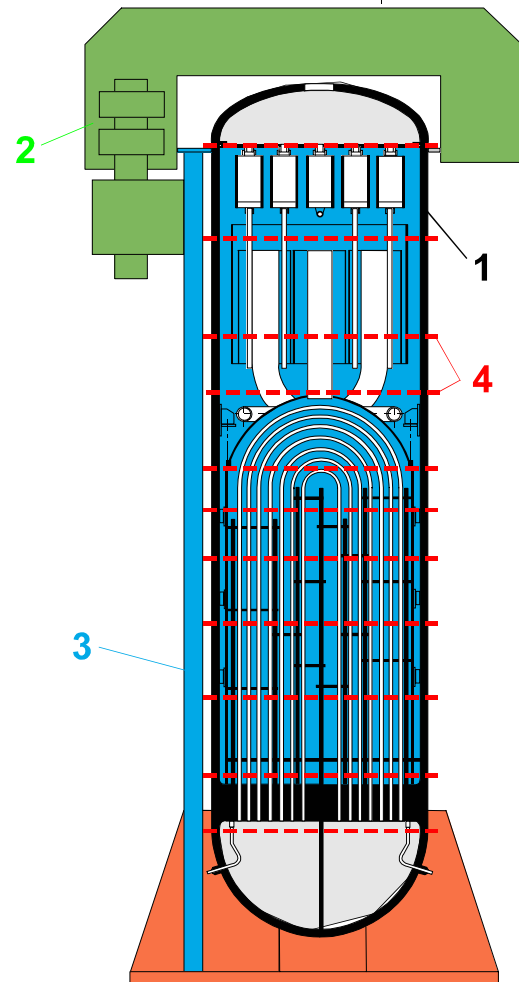


Mass Flow of contaminated Material at KRB A



FH0002d

Example for contaminated material: Ice-Sawing of a Steam Generator



1 Secondary steam generator

2 Band Saw

3 Guide Rail

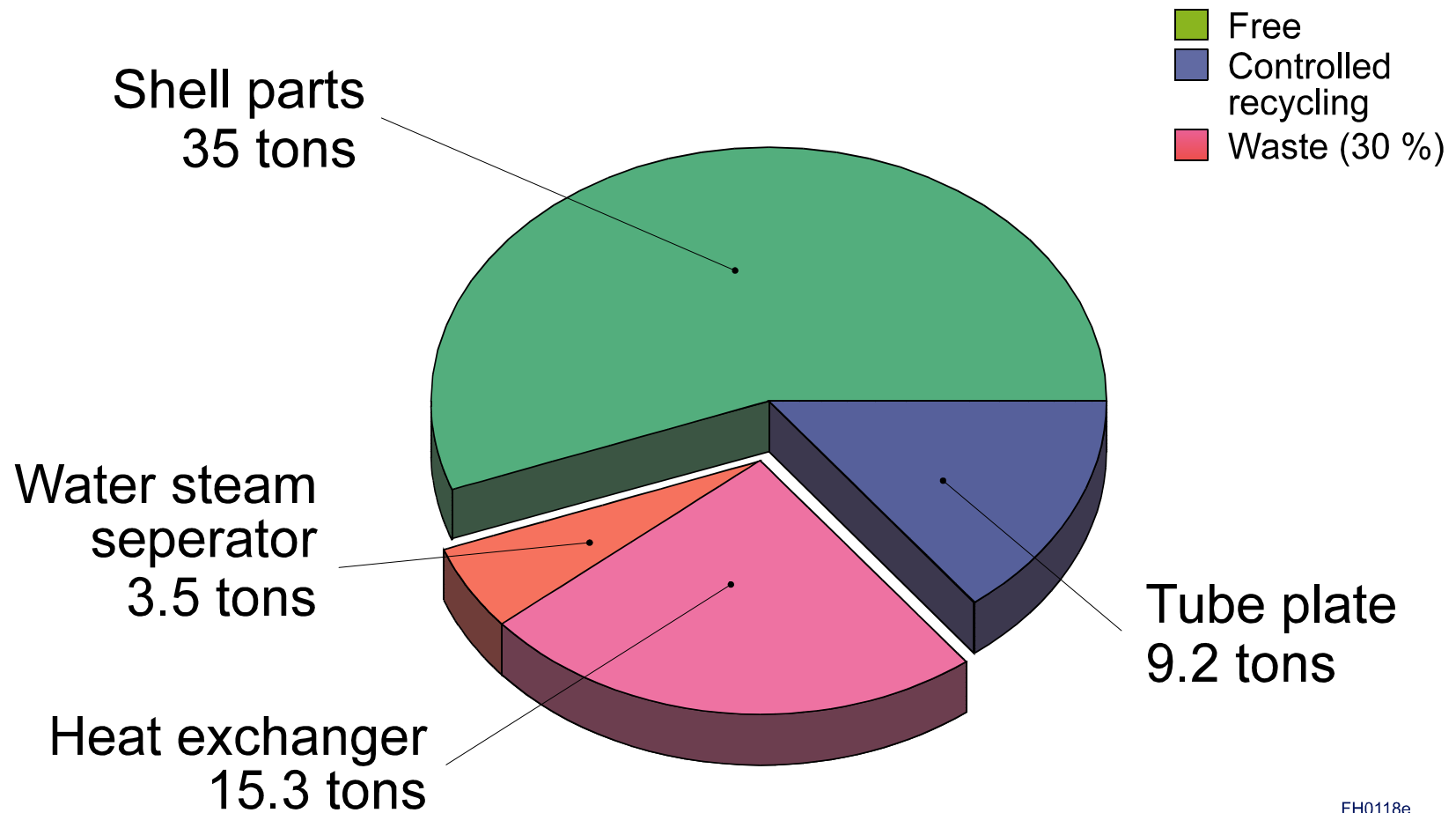
4 Place of Cut

Ice-Sawing of a Steam Generator





Material Balance of a Steam Generator

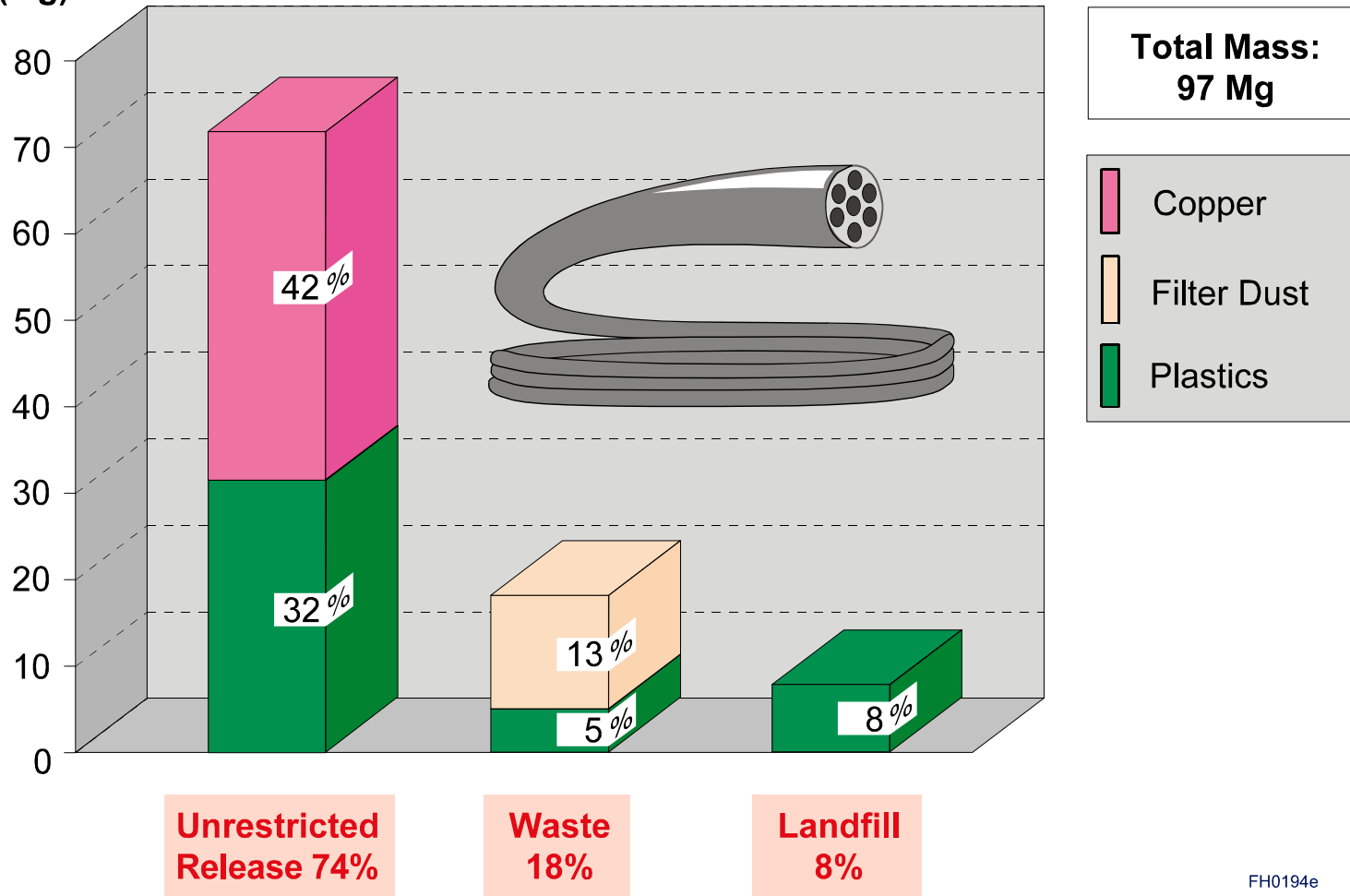


FH0118e



Recycling Campaign for Electric Cables

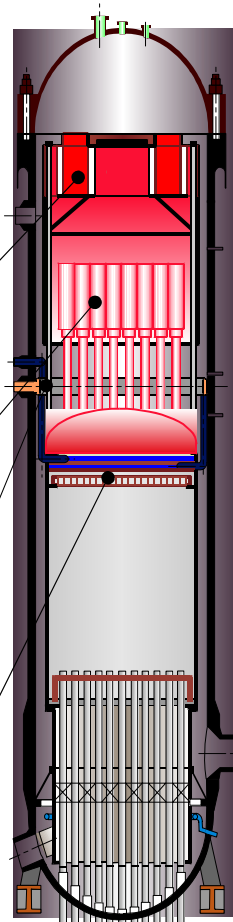
Mass (Mg)



Example for activated Material: Decommissioning of RPV Internals



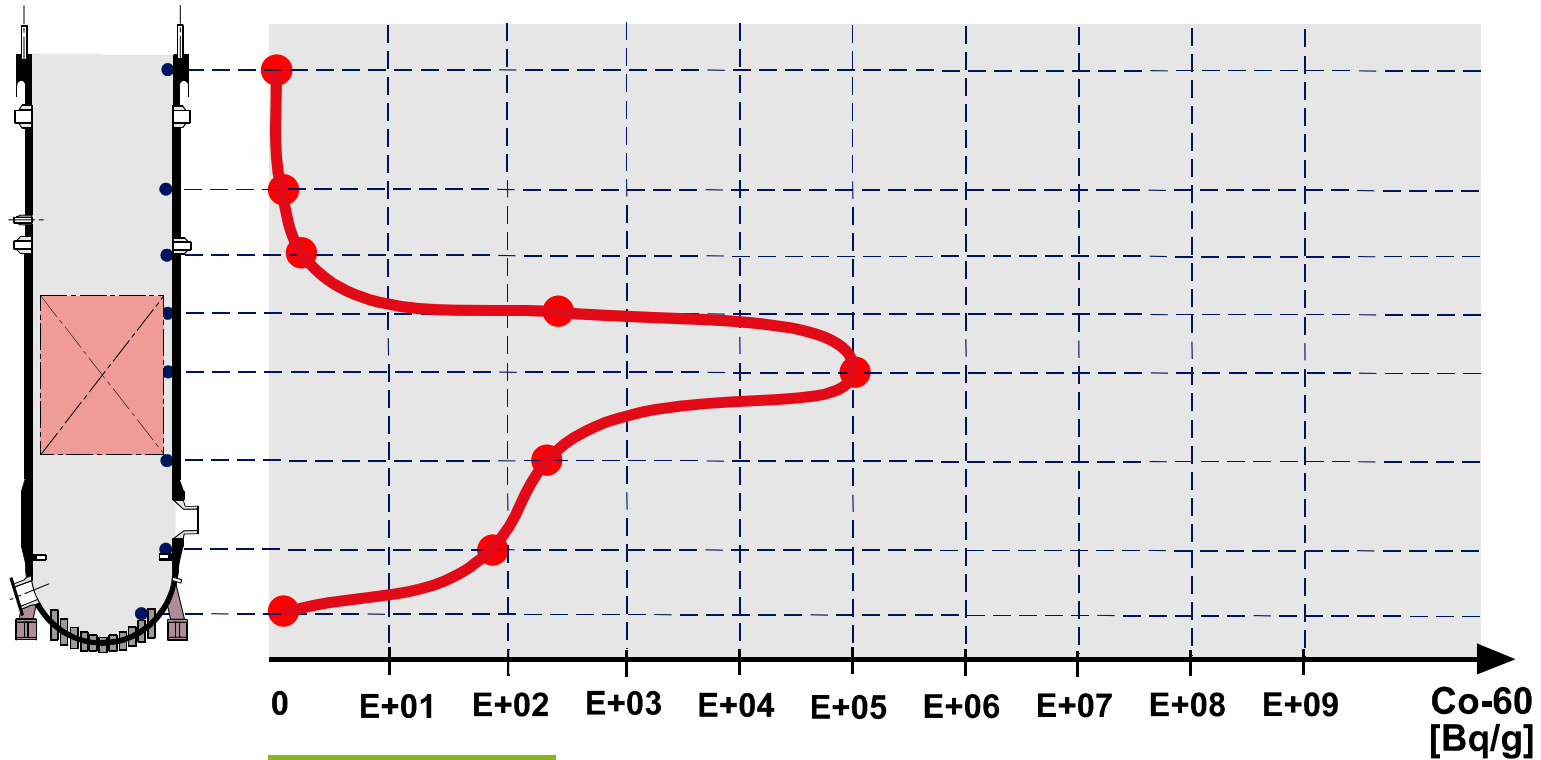
spec. Activity Co-60 [Bq/g]	Component	Mass [tons]	Activity Co-60 [Bq]
1.2 E+04	Steam Dryer	7.1	8.5 E+10
1.3 E+06	Water Steam Separator	13.5	1.7 E+13
< 1	Feedwater Sparger*	0.3	3.0 E+05
7.7 E+08	Top Guide	1.3	1.1 E+15



* 1976 replaced



Classification of RPV Material



MELTING

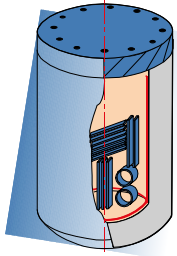
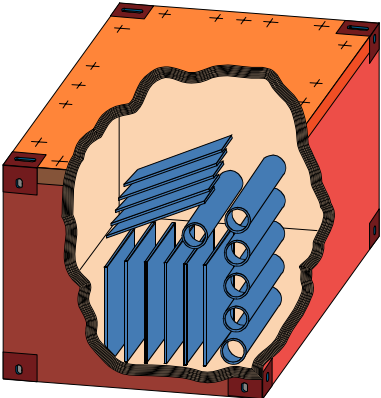
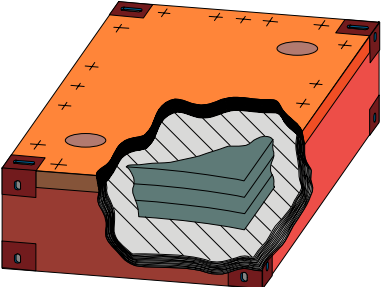
ERAM (200- or 400-l-drums)

KONRAD (onion cast container)

KONRAD (standard waste container)

FH0248

Container for Final Storage

	Mosaik Type II	Container Type VI	"Onion" cast container
<p>Total weight 20 Mg</p> <p>Wall thickness 150 mm</p>			
Dimensions [m]	$\varnothing 1.06 \times 1.5 = 1.3 \text{ m}^3$	$2.0 \times 1.6 \times 1.7 = 5.4 \text{ m}^3$	$2.0 \times 1.6 \times 0.85 = 2.7 \text{ m}^3$
Load volume [m³]	0.5	3.1	1.2
Dead weight [Mg]	6.0	18.3	10.8
Max. payload [Mg]	0.6	1.7	8.8

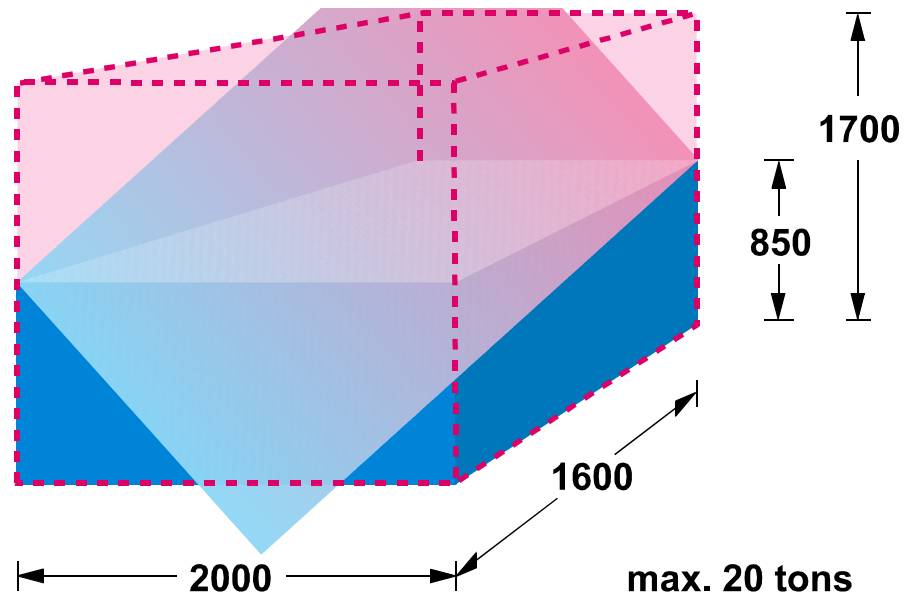




New Waste Container

Container Typ VI

New waste container



Payload volume 1.2 m³
Payload 9.2 tons

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Prototype of a Onion Cast Container

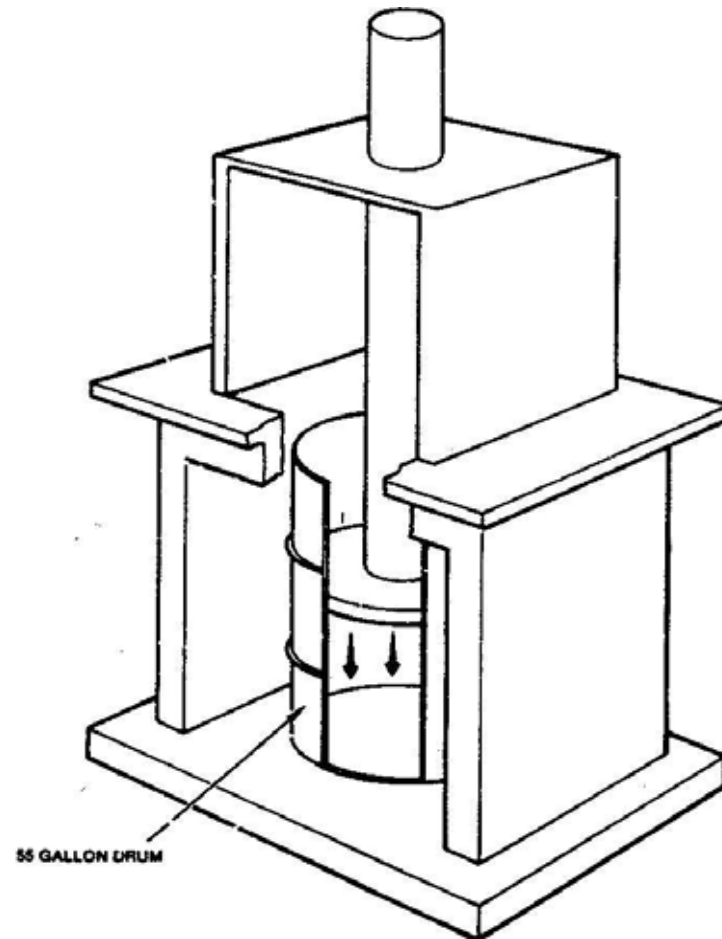




Waste Conditioning Methods

Material	Possible Treatment	Internal Packaging and Transportation	External Packaging and Transportation
mixed material, e.g cable, electric components, small parts	(super-) compaction	pellets	container for pellets (suitable for final disposal)
metallic components	measurements for unrestricted release	small containers (boxes)	Container
	decontamination		
	melting	200-1 drums	
	final disposal	small containers (boxes)	container for final disposal
isolation material	(super-) compaction	pellets	container for pellets (suitable for final disposal)
concrete: blocks, debris	decontamination	small container	container (suitable for final disposal)
	release		
	final disposal		
secondary wastes: protection cloths, foils, etc.	incineration or similar processes	bags	container for final disposal (after super-compaction of ashes)

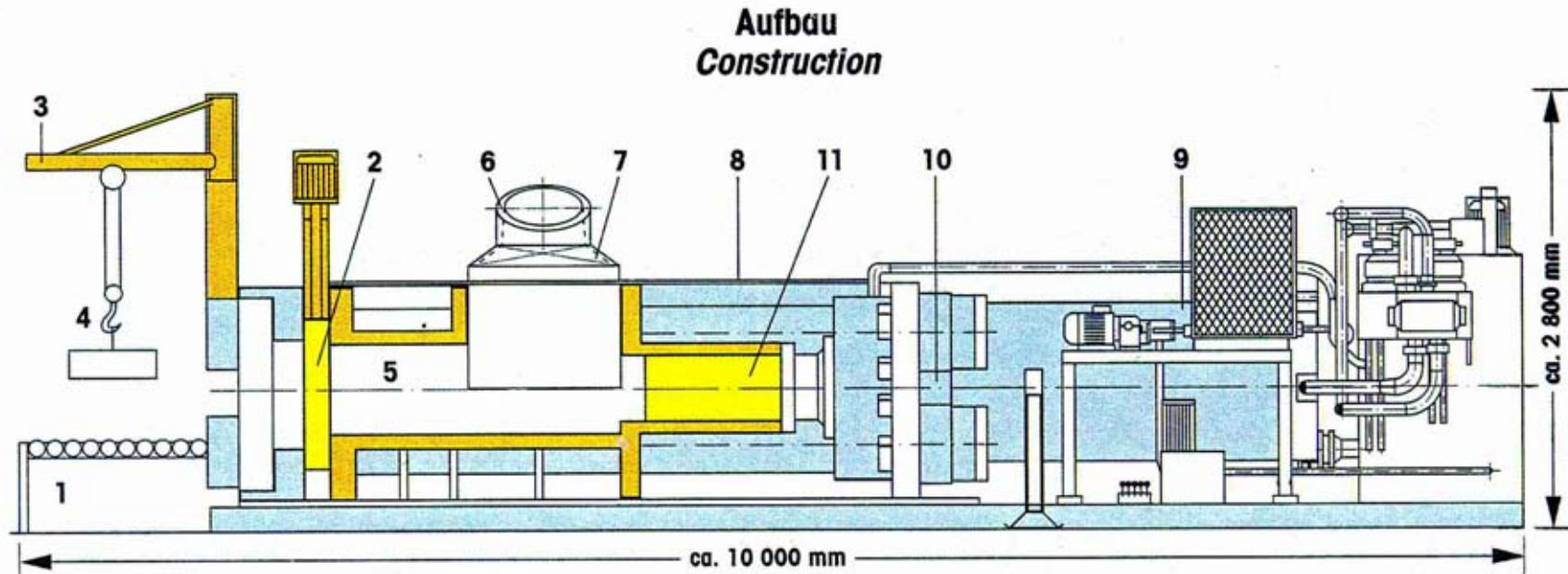
In-drum Compactor



Burnable Waste Compactor



FAKIR - Supercompactor



FAKIR
Hochdruck-Hydraulikpresse zur
Volumenreduzierung von leicht
kontaminierten festen Abfällen

FAKIR
*Hydraulic Super Compactor for
the volume reduction of slightly
contaminated solid waste*

1 Auswurfseite
Exit

2 Schiebetür
Sliding door

3 Schwenkbarer Kran
Jib crane

4 Greifer
Grab

5 Preßkammer
Compaction chamber

6 Kippvorrichtung
Tipping device

7 Einfülltrichter
Charger

8 Arbeitsbühne
Working platform

9 Hydraulikaggregat
Hydraulic system and controls

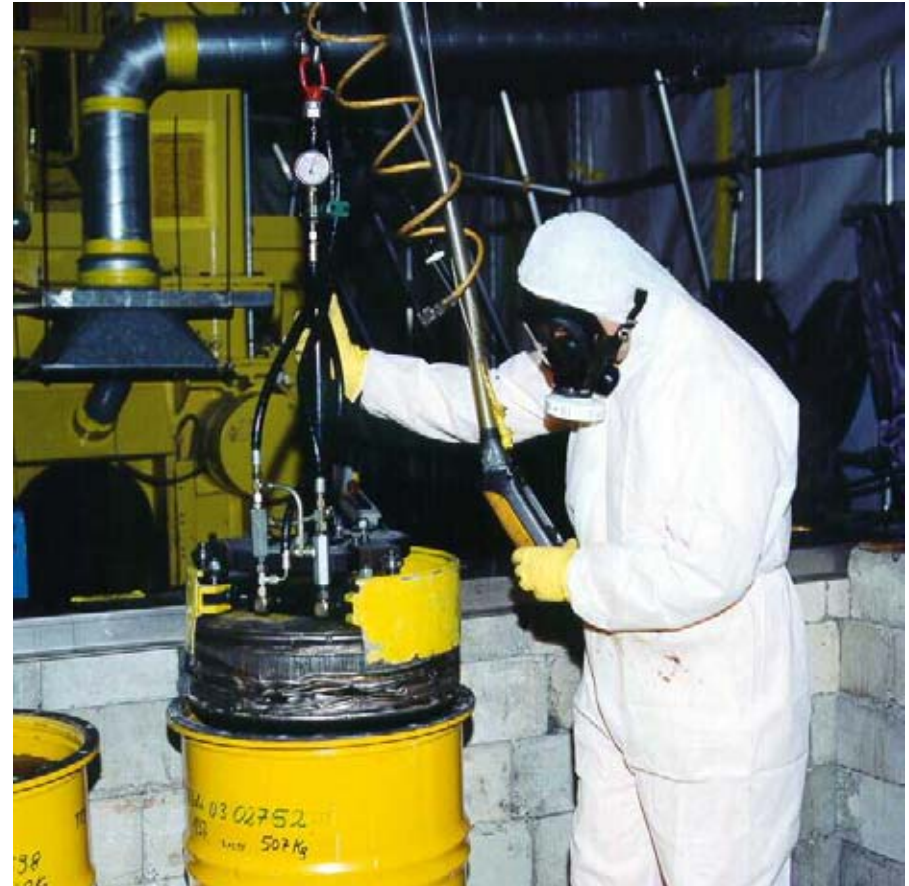
10 Hydraulikzylinder
Hydraulic cylinder

11 Preßstempel
Ram

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FAKIR - Supercompactor





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PETRA - Pellet Drying Plant

