



Siempelkamp

NIS Ingenieurgesellschaft mbH

*Influence of
Clearance Regulations
on
Decommissioning Projects*

NIS September 2010



Object of the Presentation

*A Try in 7 Steps to Analyse
the Effects of Clearance Regulations
on Decommissioning and
Dismantling of Nuclear Facilities*

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Preliminary Notes

The cost figures shown in the presentation were calculated based on the German Reference Study "Decommissioning of NPP with Light Water Reactors"*

The analysed effects of Clearance Regulations on the decommissioning and dismantling are represented exemplarily and can certainly not show all the very complex aspects of influences

The results of the analysis carried out are not based upon exact release limits but show trends in the form of:

Less Restrictive ← Clearance Level → More Restrictive

* Stilllegungstechnik für ausgediente Kernkraftwerke mit Leichtwasserreaktoren" 30.06.2000 Vereinigung Deutscher Elektrizitätswerke – VDEW – e.V.

Analysis Task 1

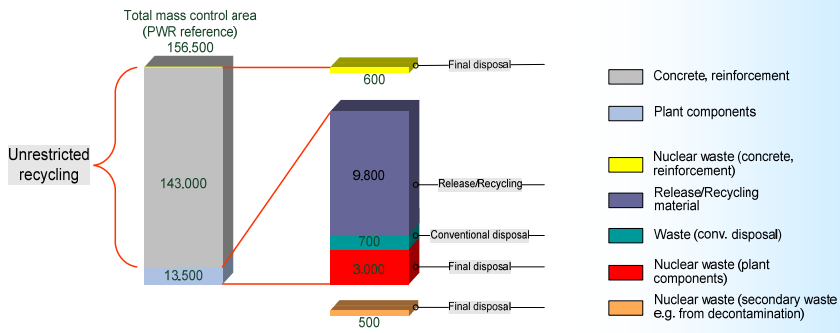
Definiton of the Range And Meaning

How much material will be effected ?

How much radioactivity is concerned ?

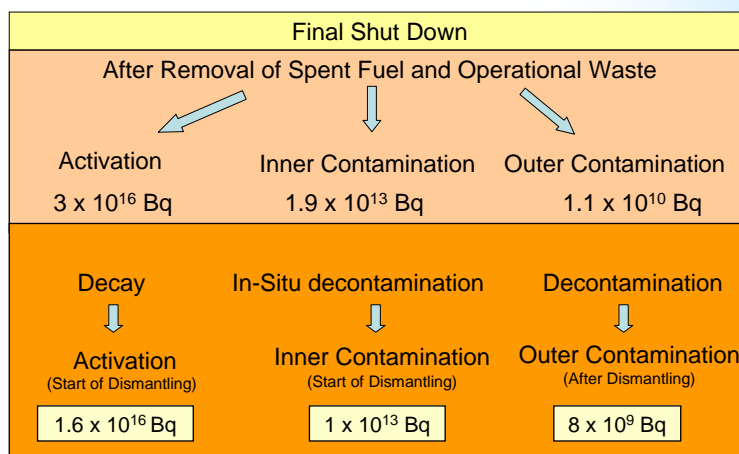
Mass to be Removed

Mass Distribution PWR [Mg]



VGB October 2004

Radioactivity to be Removed



Technical/Radiological Inventory

Activated:	RPV + Internals Biological Shield	1.000 Mg 1.200 Mg	} 1.6 x 10 ¹⁶ Bq
Contaminated:	Systems, Components	5.800 Mg	
Contaminated:	Equipment Building Structures	5.500 Mg 143.000 Mg (62.000 m ²)	} 8 x 10 ⁹ Bq

Technical/Radiological Inventory

	Total Mass	Rad. Waste	Can be Released ?
RPV + Internals	1.000 Mg	800 Mg	200 Mg
Biological Shield	1.200 Mg	500 Mg	700 Mg
Contaminated Systems	5.800 Mg	800 Mg	5.000 Mg
Contaminated Equipment	5.500 Mg	400 Mg	5.100 Mg
Building Structures	143.000 Mg**	1.100 Mg	2.900 Mg
Secondary Waste	-	500 Mg	-
			13.900 Mg

** 139.000 Mg can be released anyway

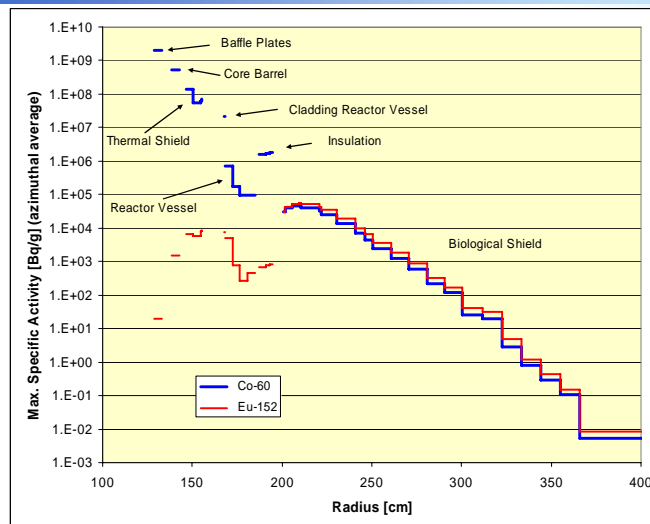
**Mass concerned by Clearance Requirements
in D&D Projects**

Analysis Task 2

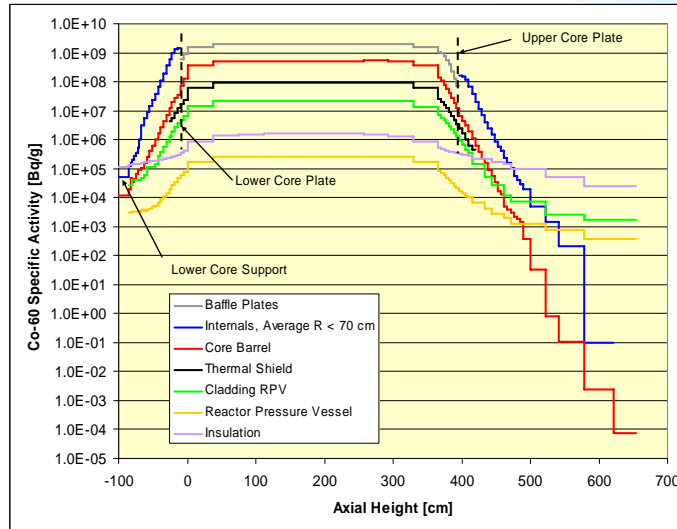
Activated Area RPV, Internals, Biological Shield

How much material will be concerned ?

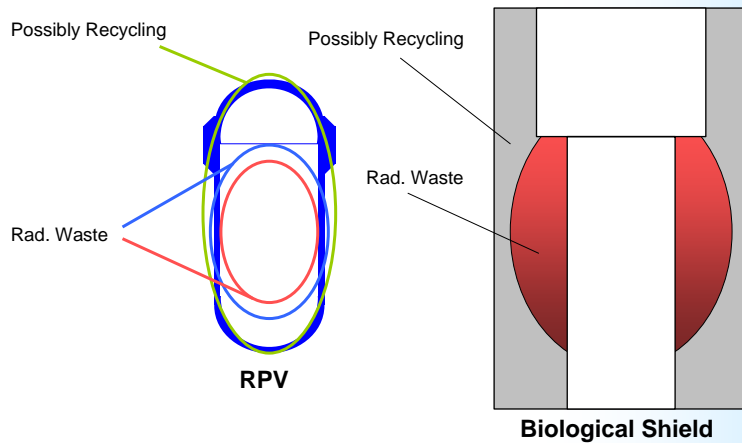
Radioactivity Levels in the Activated Area



Radioactivity Levels in the Activated Area



Radioactivity Zones in the Activated Area



Consequences on Activated Material

	Rad. Waste	Released											
A	RPV + Internals	800 Mg	200 Mg										
	Biological Shield	500 Mg	700 Mg										
<table border="1"> <tr> <td>Co 60</td> <td>0,1 Bq/g</td> </tr> <tr> <td>Eu 152</td> <td>10 Bq/g</td> </tr> <tr> <td>Cs 137</td> <td>0,5 Bq/g</td> </tr> <tr> <td>H 3</td> <td>100 Bq/g</td> </tr> <tr> <td>Ni 63</td> <td>100 Bq/g</td> </tr> </table>				Co 60	0,1 Bq/g	Eu 152	10 Bq/g	Cs 137	0,5 Bq/g	H 3	100 Bq/g	Ni 63	100 Bq/g
Co 60	0,1 Bq/g												
Eu 152	10 Bq/g												
Cs 137	0,5 Bq/g												
H 3	100 Bq/g												
Ni 63	100 Bq/g												
B	RPV + Internals	1.000 Mg	-										
	Biological Shield	1.200 Mg	-										
			Limits Reduced										
C	RPV + Internals	1.000 Mg	-										
	Biological Shield	1.200 Mg	-										
	Building Structures	1.200 Mg	-										
			Limits more Reduced										

Consequences on Activated Material

	Container	Packaged Mass kg	Number of Containers	Container Cost T€	Storage Volume m³
A	RPV Internals				
	GB Typ II/160 (Typ A)	160.000	267	9.866	352
	GB Typ II/160/040 (A)	110.000	256	13.722	338
	GB Typ II/160/080 (B)	60.000	75	5.531	99
	GB Typ II/160/140 (B)	30.000	130	11.206	172
	Stahlbl. Typ II	440.000	90	540	416
Biol. Shield	Stahlbl. Typ II	500.000	125	750	578
Total		1.300.000	943	41.615	1.954
B	RPV Internals				
	GB Typ II/160 (Typ A)	190.000	317	11.715	419
	GB Typ II/160/040 (A)	120.000	279	14.969	369
	GB Typ II/160/080 (B)	60.000	75	5.531	99
	GB Typ II/160/140 (B)	30.000	130	11.206	172
	Stahlbl. Typ II	600.000	123	736	567
Biol. Shield	Stahlbl. Typ II	1.200.000	300	1.800	1.386
Total		2.200.000	1.224	45.958	3.011
C	RPV Internals				
	GB Typ II/160 (Typ A)	190.000	317	11.715	419
	GB Typ II/160/040 (A)	120.000	279	14.969	369
	GB Typ II/160/080 (B)	60.000	75	5.531	99
	GB Typ II/160/140 (B)	30.000	130	11.206	172
	Stahlbl. Typ II	600.000	123	736	567
Biol. Shield	Stahlbl. Typ II	1.200.000	300	1.800	1.386
Building Structures	Stahlbl. Typ III	1.200.000	136	1.227	630
Total		3.400.000	1.360	47.185	3.641

Consequences on Activated Material

Development of dismantling costs

		Cost T€	ManHours h
A	RPV and Internals Personal Cost	39.700	179.000
	Biol. Shield Personal Cost	12.300	115.000
	Total	52.000	294.000
B	RPV and Internals	42.400	206.000
	Biol. Shield	15.200	145.000
	Total	57.600	351.000
C	RPV and Internals	42.400	206.000
	Biol. Shield	15.200	145.000
	Building Structures	4.800	36.000
	Total	62.400	387.000

Analysis Task 3

Contaminated Components

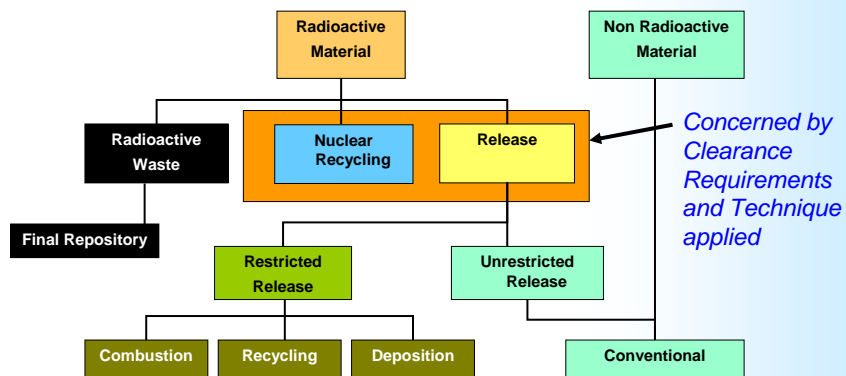
How much material will be concerned ?
Which techniques are applicable ?

Technical/Radiological Inventory

	Total Mass	Rad. Waste	Can be Released ?
RPV + Internals	1.000 Mg	800 Mg	200 Mg
Biological Shield	1.200 Mg	500 Mg	700 Mg
Contaminated Systems	5.800 Mg	800 Mg	5.000 Mg
Contaminated Equipment	5.500 Mg	400 Mg	5.100 Mg
Building Structures	143.000 Mg	1.100 Mg	2.900 Mg
Secondary Waste	-	500 Mg	-

Mass Concerned by Clearance Requirements in D&D Projects

Possible Treatment

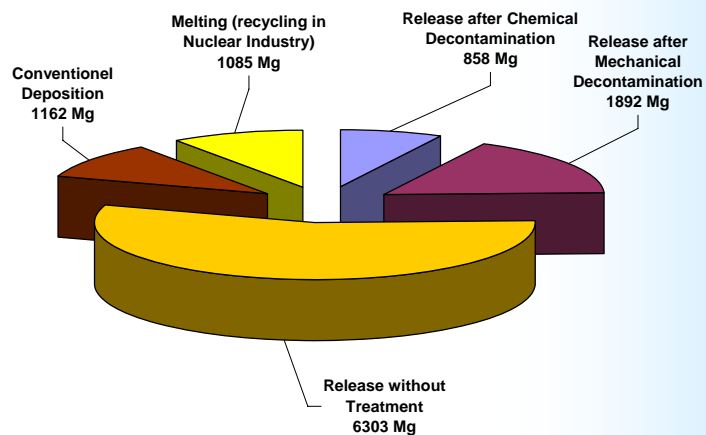


Decontamination Techniques

		<u>Applicable to</u>
Mechanical:	HP Waterjet Blasting Sand, Ice, Steel Balls	Accesible Surfaces Air Borne Contamination
Chemical:	Acid Acid+Ultra Sonic	All Surfaces Easily Removable Contamination Limited Depth
Electro-Chemical		Easy Geometry Metal Components

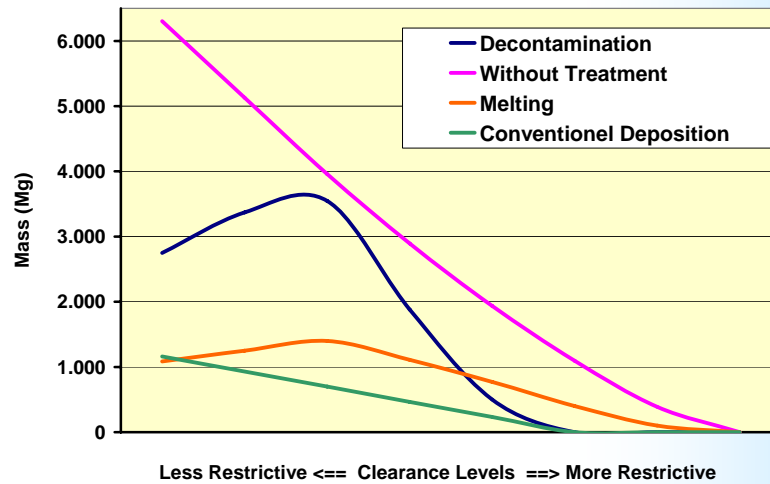
Consequences on Contaminated Material

Calculated based on actual German clearance levels



Consequences on Contaminated Material

Development of decommissioning material

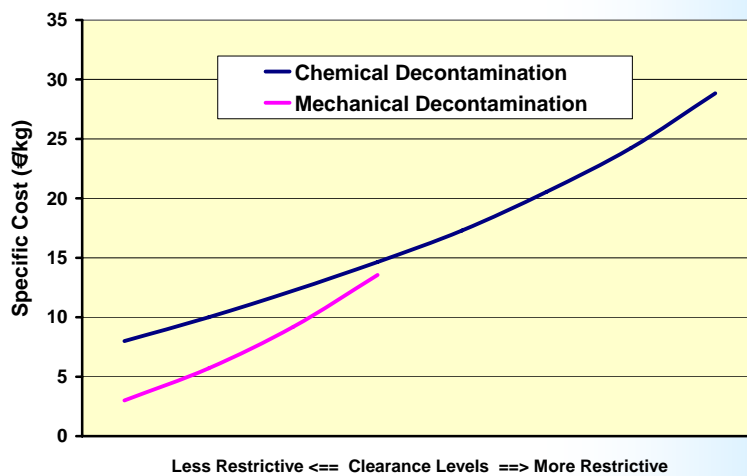


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Consequences on Contaminated Material

Development of specific cost values



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Analysis Task 5

Building Structures

*Which purpose do the release serve ?
How much material will be effected ?
Which strategy is applicable ?*

Surfaces Range and Meaning

	Floor	Wall	Ceiling
Surface of the Contolled Area Buildings (m²)	12.640	38.260	11.140
Contamination (Bq/cm²)	10 - 50	10 - 50	10 - 50
Part of Surfaces to be Removed	85%	8%	10%
Concrete to be Removed (Mg)	500	150	50

Removal of Surfaces

Type of Release

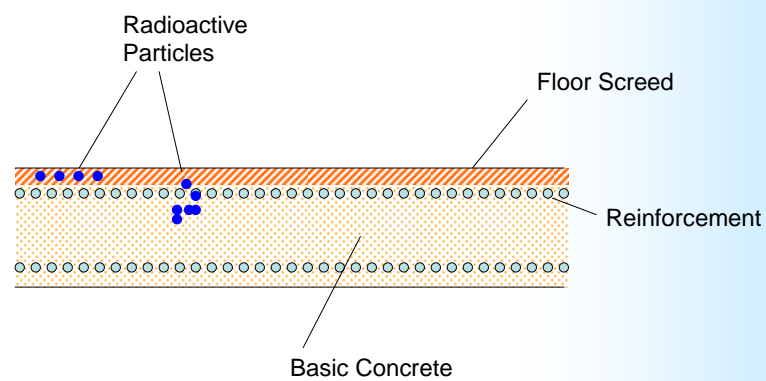
- Reuse for unlimited purposes
- Demolishing

Strategy Applied

- Decontamination at the existing structure
- Nuclear dismantling and release of the concrete rubble

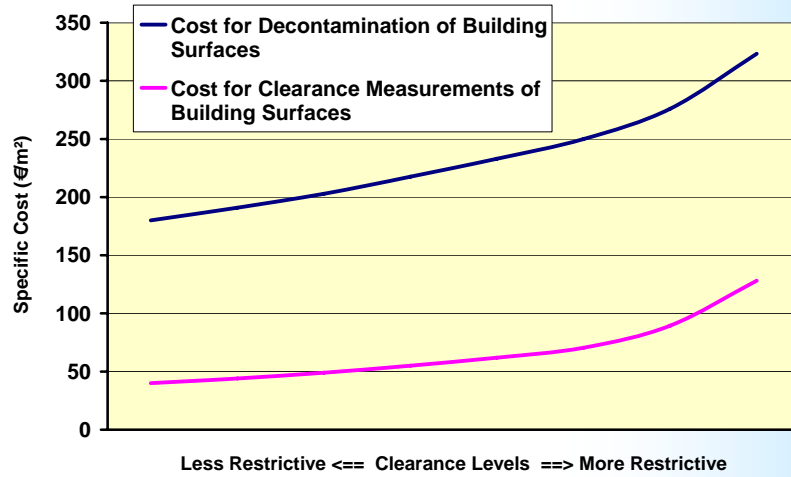
Contamination of Surfaces

Kinds of contamination



Consequences on Surfaces

Development of specific cost values



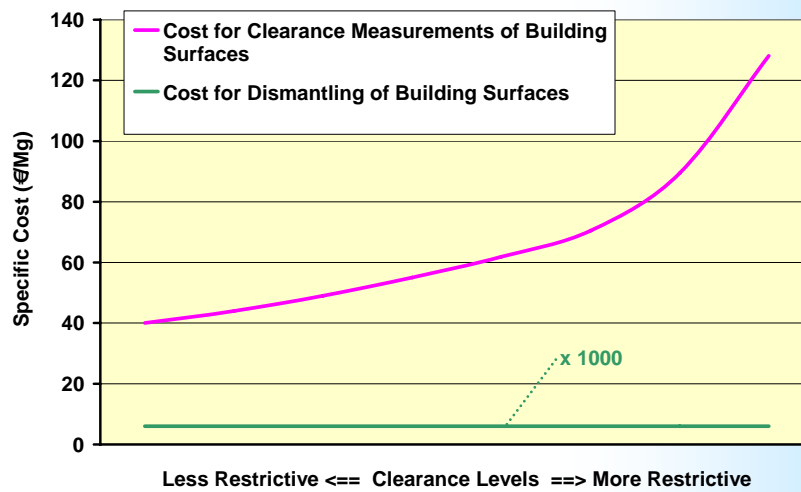
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Consequences on Building Surfaces

Development of specific cost values



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Analysis Task 6

Area Surfaces

*Which purpose do the release serve ?
How much effort is necessary?*

Area Surface - Size and Range

- **Area Surfaces**
some 10.000 m² up to 400.000 m²
- **Mass of additional Equipment**
(Safety Fence, Street Material, etc.)
some 1.000 Mg up to 50.000 Mg
- **Number of Measuring Points**
1 / 10m² up to 1 / 4m²
- **Number of Samples (evaluated in Laboratory)**
1 / 50m² up to 1 / 10m²

Consequences on Area Surfaces

Effects on measurements for area surfaces

Less Restrictive ← Clearance Level → More Restrictive

Decrease
Decrease

Number of Measuring Points
Cost per Measurement

Increase
Increase

Decrease
Decrease

Number of Samples
Cost per Sample

Increase
Increase

10 €/m²

25 €/m²

50 €/m²

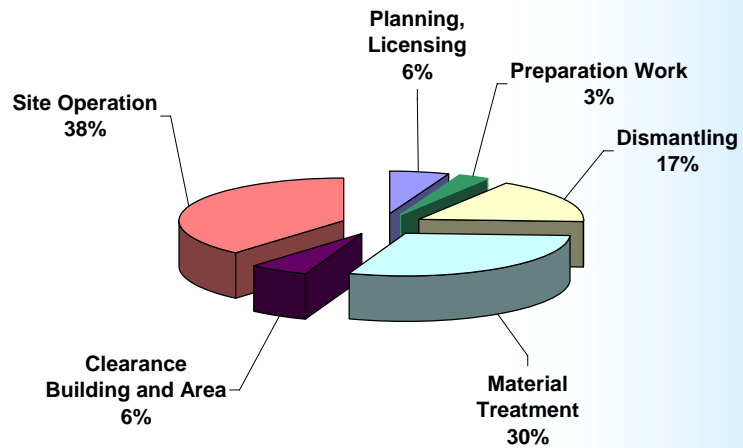
Analysis Task 7

Summary

Decommissioning Cost
Time Schedule

Summary

BWR costs in groups (actually total cost 505 Mio€)



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Summary

Effects on D&D costs groups

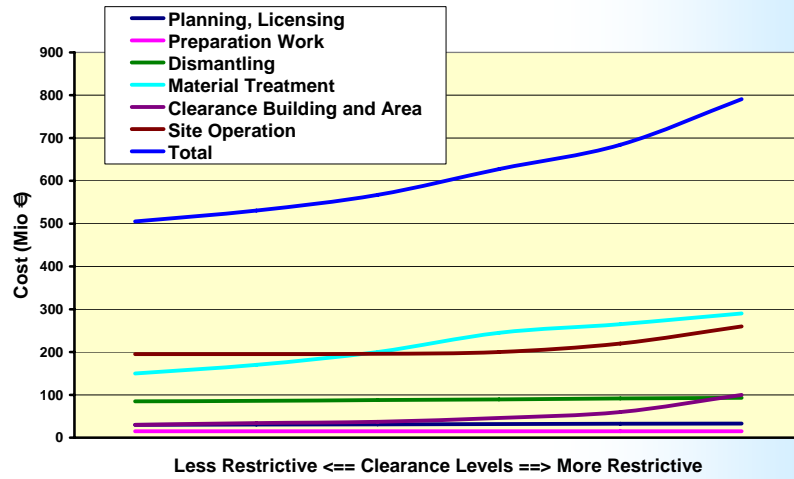
Clearance Level	→ More Restrictive	Effects on D&D Costs
Planning, Licensing	Detailness, Optimisation, Strategy	→ Insignificant Increase
Preparation Work	No Effect	
Dismantling Activated	Mass Amount, Selection of Material	→ Insignificant Increase
Material Treatment	Applicability of Techniques, Specific Cost of Treatment, Mass Distribution	→ Increase, Change in Strategy
Clearance Buildings and Area	Rise of Expenditure, Mass Amount	→ Increase, Change in Strategy
Site Operation	Prolongation of Project Time	→ Increase

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Summary

Development of the total cost

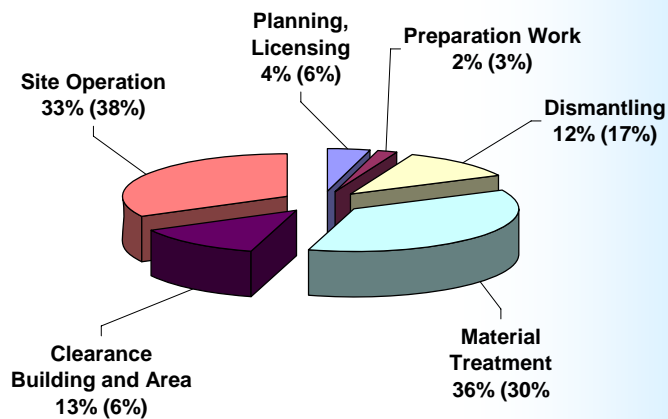


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Summary

BWR costs in groups (estimated maximum cost 800 Mio€) (values in brackets are repeated by page 33)



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