Global Experience with Implementation of Clearance

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IAEA International Experts´ Meeting on Decommissioning and Remediation after a Nuclear Accident

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1. History
2. German clearance regulations – too complicated?
3. Removal – release without clearance
4. Specific clearance
5. Alternative long-term interim storage

History

de minimis concept IAEA Safety Series No. 89, 1988:

Dose much smaller than any upper bound set by competent authorities

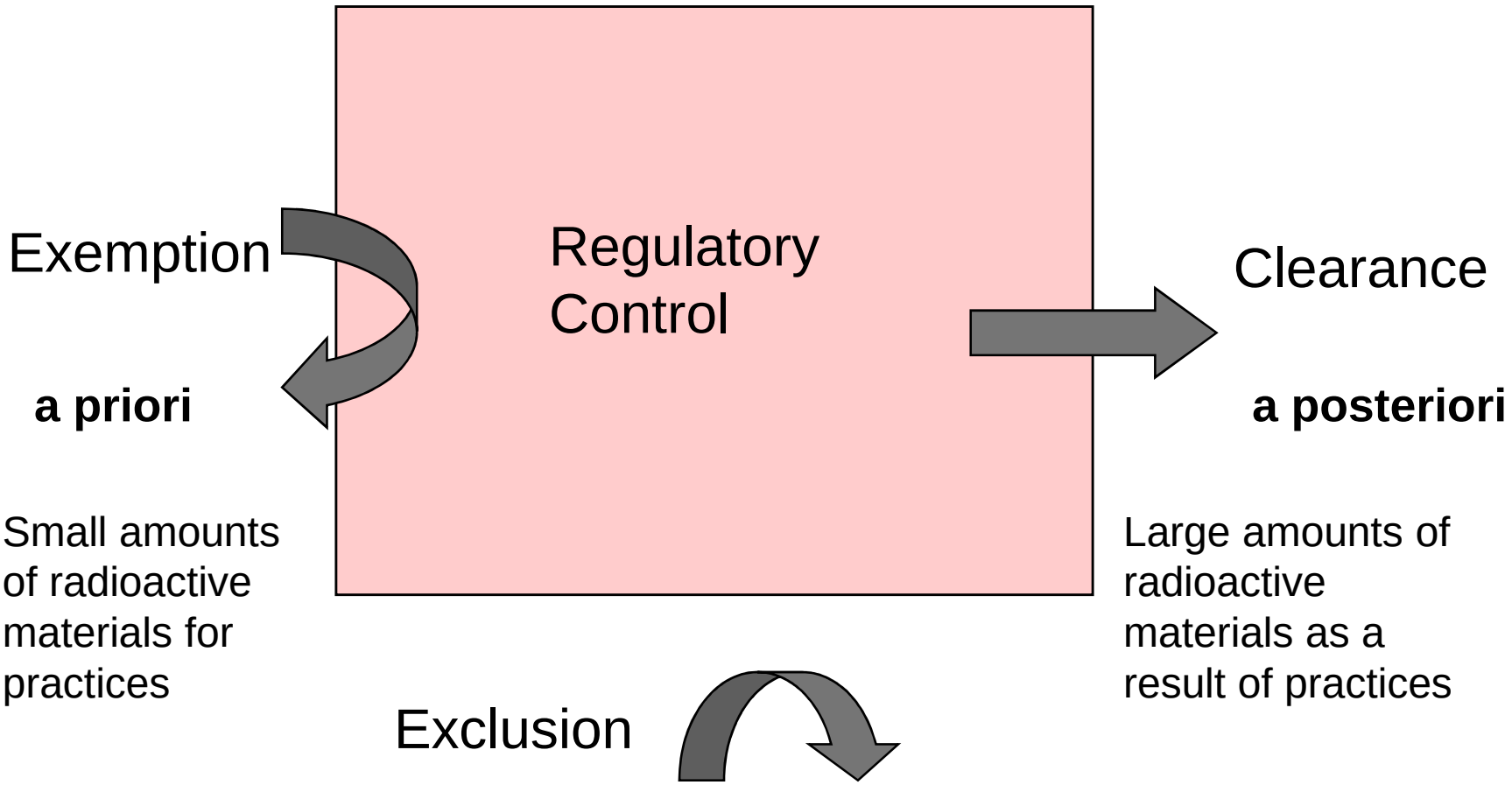
De minimis non curat lex: Law does not take care about trivial things:

The de minimis dose should not be of any regulatory concern.

=> Some 10 µSv/y for the public acceptable

(superseded by actual BSS)

History
Exclusion, Exemption, Clearance



History

Exemption values are given in the BSS, IAEA and EU Directive 96/29, also used in regulations for safe transport of radioactive materials.

- **Realistic scenarios are prerequisite for modelling.**
- **Scenarios: small-scale usage of radionuclides (< 1 kg) in laboratories including disposal of waste (< 1 Mg) contaminated by this practice => Bq and Bq/g-values**

Bulk material: IAEA RS-G-1.7, 2004 => Bq/g-values

- **ingestion of small amounts,**
- **inhalation during work with the material,**
- **direct radiation from the material**

History
Recommendations given by the EC

RP 65: Principles and methods for establishing concentrations and quantities (Exemption Values) below which reporting is not required in the European Directive, 1993
RP 89: Recommended radiological protection criteria for the recycling of metals from the dismantling of nuclear installations, 1998
RP 101: Basis for the definition of surface contamination clearance levels for the recycling or reuse of metals arising from the dismantling of nuclear installations, 1999
RP 113: Recommended radiological protection criteria for the clearance of buildings and building rubble from the dismantling of nuclear installations, 2000
RP 117: Methodology and models used to calculate individual and collective doses from the recycling of metals from the dismantling of nuclear installations, 2000
RP 122: Practical use of the concepts of clearance and exemption –
part I: Guidance on general clearance levels for practices, 2000
part II: Application of the concepts of exemption and clearance to natural radiation sources, 2001

The French solution

- A disposal specially designed for VLLW (In Morvillier, near the centre de l'Aube)
- No universal clearance levels
- Approach based on the zoning of nuclear installations
  - In nuclear waste zone : every waste generated are considered as nuclear waste
  - In conventional waste zone : every waste generated is conventional
- The order of 31th December 1999 made this approach binding to nuclear operators (ASN approves the "waste studies")
- Since 2003 : 75 000 tons of concrete, metallic scraps, former transports casks are disposed of in the Morvillier repository

German Clearance Regulations

Germany has always a need for reducing radioactive waste:

1978 Asse was closed

1994-1997 Morsleben was opened

2019 Konrad will open?

⇒ strategy for strong use of clearance option

Example: 97% of material from decommissioning has to be cleaned for clearance!

IAEA: “In many respects Germany is taking the lead in the application of the clearance concept in the decommissioning of nuclear facilities…”

German Commission on Radiation Protection (SSK) - Recommendations

1987 Reuse/reutilisation of scrap metal (iron)

1992 Reuse/reutilisation of scrap metal (non iron)

1994 Clearance of materials for disposal on public landfill

1995 Release of buildings

1997 Release of land areas

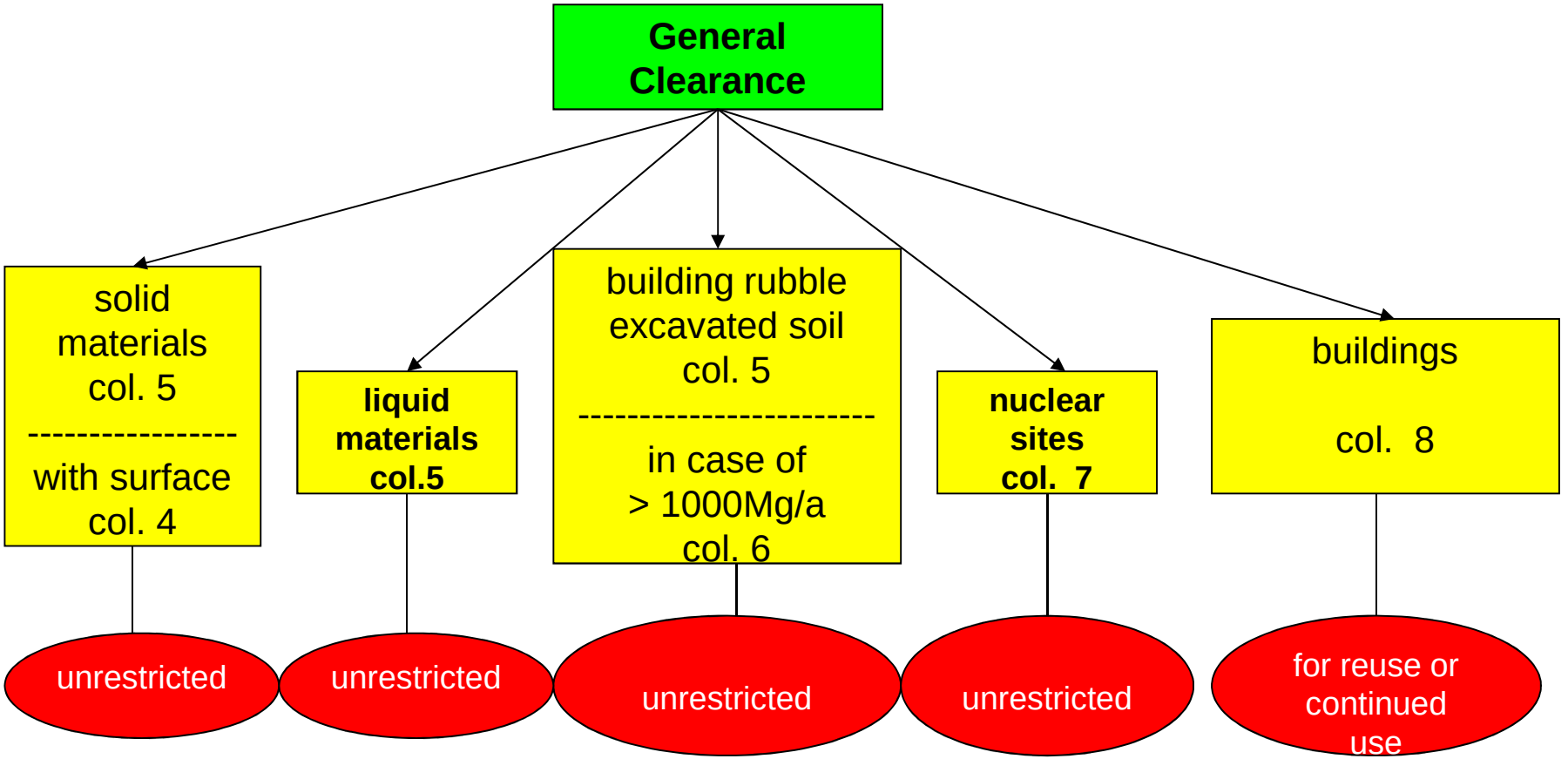
1998 Clearance of materials, buildings and land areas (covering and updating all previous recommendations about clearance)

simple

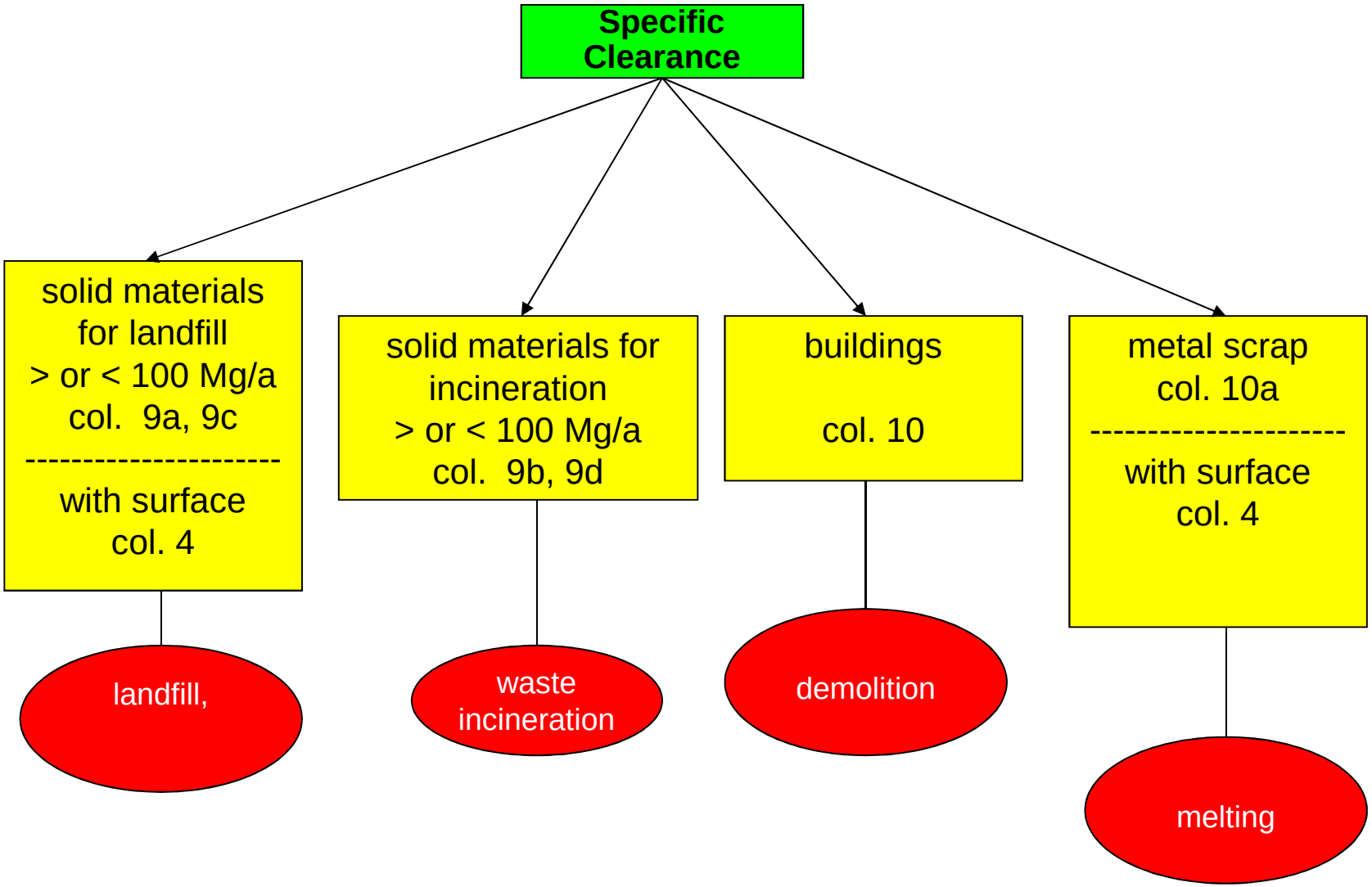
complicated

German regulations … too complicated!?

German Regulations



German Regulations



Nuclide	Exemption level		Surface contamination	General Clearance of				Specific Clearance of			Half-life	
	Activity [Bq]	Specific activity [Bq/g]	[Bq/cm^2]	Solid sub-stances, liquids, with the exception of column 6 [Bq/g]	Building rubble, excavated soil, in amounts over 1,000 Mg/a [Bq/g]	Sites [Bq/cm^2]	Buildings for reuse or continued use [Bq/cm^2]	Solid sub-stances for disposal, with the exception of column 6 [Bq/g]	Buildings for demolition [Bq/cm^2]	Metal Scrap for Recycling [Bq/g]		
1	2	3	4	5	6	7	8	9	10	10a	11	
H-3	1 E+7	1 E+3	100	1 E+3	60	3	1 E+3	1 E+3	4 E+3	1 E+3	12,3	a
Be-7	1 E+7	1 E+3	100	30	30	2	80	200	600	3 E+2	53,3	d
Mn-54	1 E+6	10	1	0,4	0,3	0,09	1	10	10	2	312,2	d
Fe-55	1 E+6	1 E+4	100	200	200	6	1 E+3	1 E+4	2 E+4	1 E+4	2,7	a
Zn-65	1 E+6	10	1	0,5	0,4	0,01	2	10	20	0,5	244	d
Co-60	1 E+5	10	1	0,1	0,09	0,03	0,4	4	3	0,6	5,3	a
Co-58	1 E+6	10	1	0,9	0,2	0,08	1	9	30	1	70,8	d
Ag-110m+	1 E+6	10	1	0,1	0,08	7E-3	0,5	3	4	0,5	249,9	d
Sb-124	1 E+6	10	1	0,5	0,5	0,04	1	5	20	0,5	60,3	d
Cs-137+	1 E+4	10	1	0,5	0,4	0,06	2	10	10	0,6	30,2	a
Cs-134	1 E+4	10	1	0,2	0,1	0,05	0,6	6	5	0,2	2,1	a
Am-241	1 E+4	1	0.1	0.05	0.05	0.06	0.1	1	3	0,3	432,6	a
....												

Table 1: Examples of clearance levels and surface-contamination levels ("+": daughter products included)

Clearance procedures

The licensee has two ways according to **§ 29(2)** RPO

unrestricted clearance

or specific clearance in a

simplified procedure

⇒ clearance values according to annex III

Clearance in

single case procedure

⇒ Single case assessment of compliance regarding the 10 µSv concept with the exemption values as upper limit

too complicated?

Is the administrative burden too high?
Do we need so many specific clearance values at all?

Removal of Materials, Buildings, and Areas

de minimis concept IAEA Safety Series No. 89, 1988:

Dose much smaller than any upper bound set by competent authorities

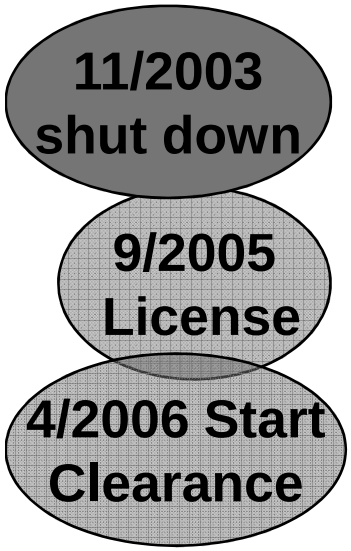
De minimis non curat lex: Law does not take care about trivial things:

The de minimis dose should not be of any regulatory concern.

=> Some 10 µSv/y for the public acceptable

Today: 1/4th of the pages of the German RPO are clearance regulations!
But what is the dose level of „no regulatory concern“?

Comparison of Removal and Clearance at NPP Stade



Year	Removal [Mg]	Clearance [Mg]
2004	3962	-
2005	3601	-
2006	1063	95
2007 (Jan-Apr)	-	220
Sum	8626	315

Dismantling of the turbine hall and neighbouring systems

What is removal?

Scope of Application
Contamination Control, Clearance, Removal

Material not belonging to the scope of the license

⇒ Contamination Control

⇒ no approval by the authority

Material belonging to the scope of the license, activated or contaminated

⇒ Clearance

⇒ approval by the authority necessary

Material belonging to the scope of the license, not activated and not contaminated (outside of the controlled area)

⇒ Removal

⇒ no approval by the authority

Cut-off Criterion

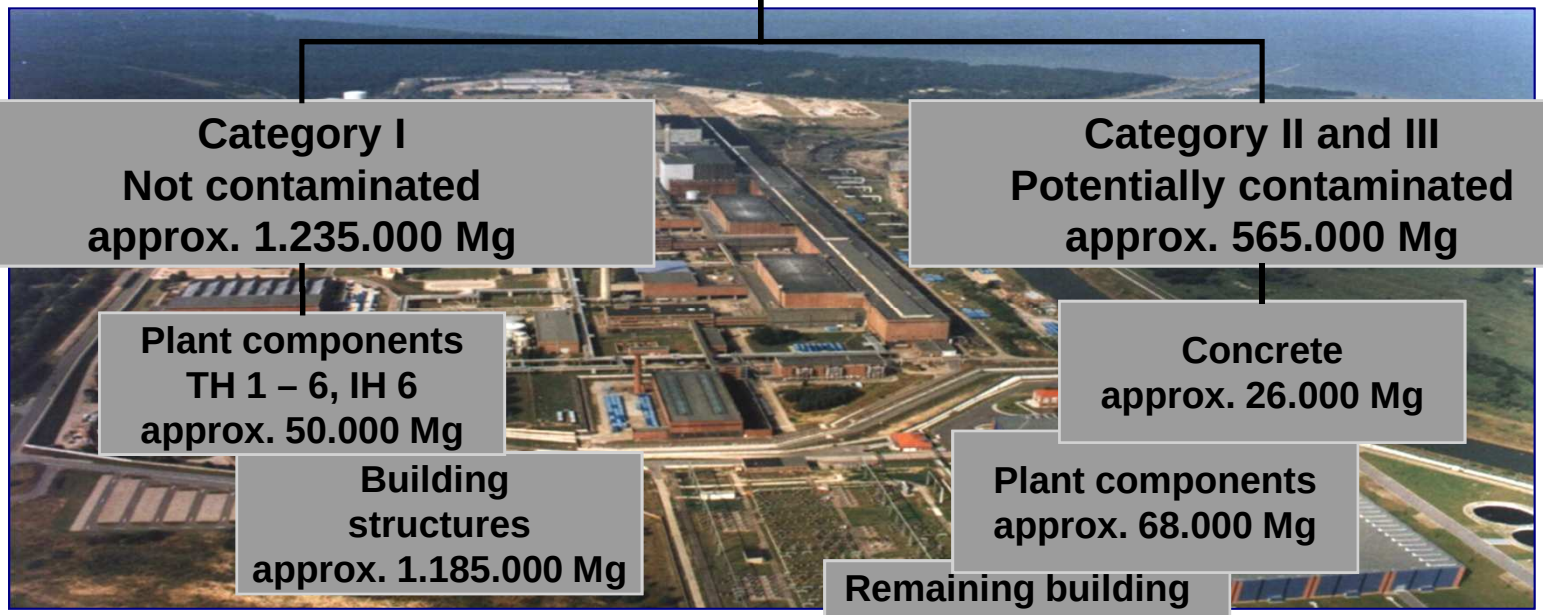
Annex IV RPO: Radionuclides with contribution < 10% to radiation exposure can be neglected

Nuclide	Nuclide-vector NV Bq/g	Clearence - value CV Bq/g	NV/CV	NV/CV ∑(NV/CV)
Co-60	0,05	0.1	0.5	82.71%
Cs-137	0,05	0.5	0.1	16.54%
Fe-55	0,9	200	0.0045	0.75%
∑	1	--	0.6045	100%

In this case Fe-55 can be neglected

Application of Removal

Plant Greifswald site
1.800.000 Mg



Category I
Not contaminated
approx. 1.235.000 Mg

Plant components
TH 1 – 6, IH 6
approx. 50.000 Mg

Building structures
approx. 1.185.000 Mg

Category II and III
Potentially contaminated
approx. 565.000 Mg

Concrete
approx. 26.000 Mg

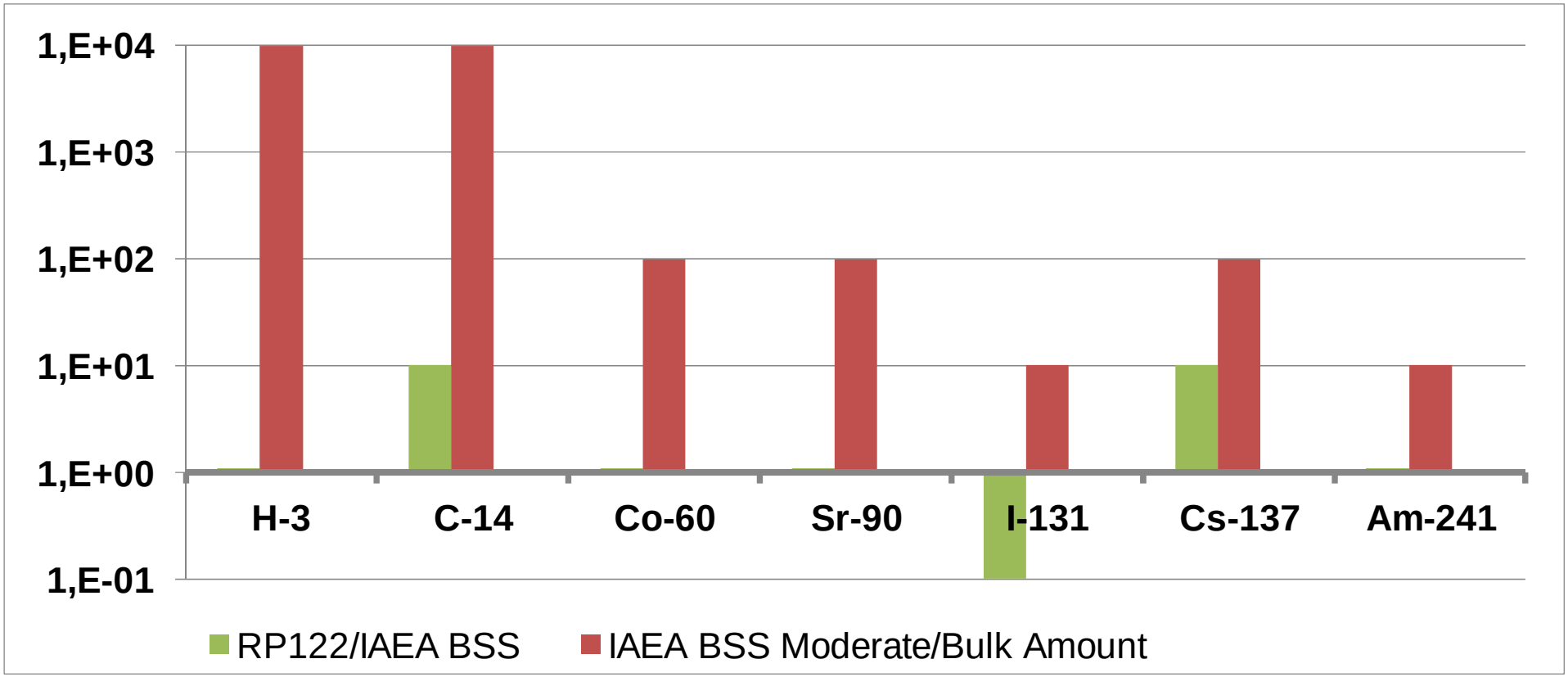
Plant components
approx. 68.000 Mg

Remaining building structures
approx. 471.000 Mg

Removal 2/3

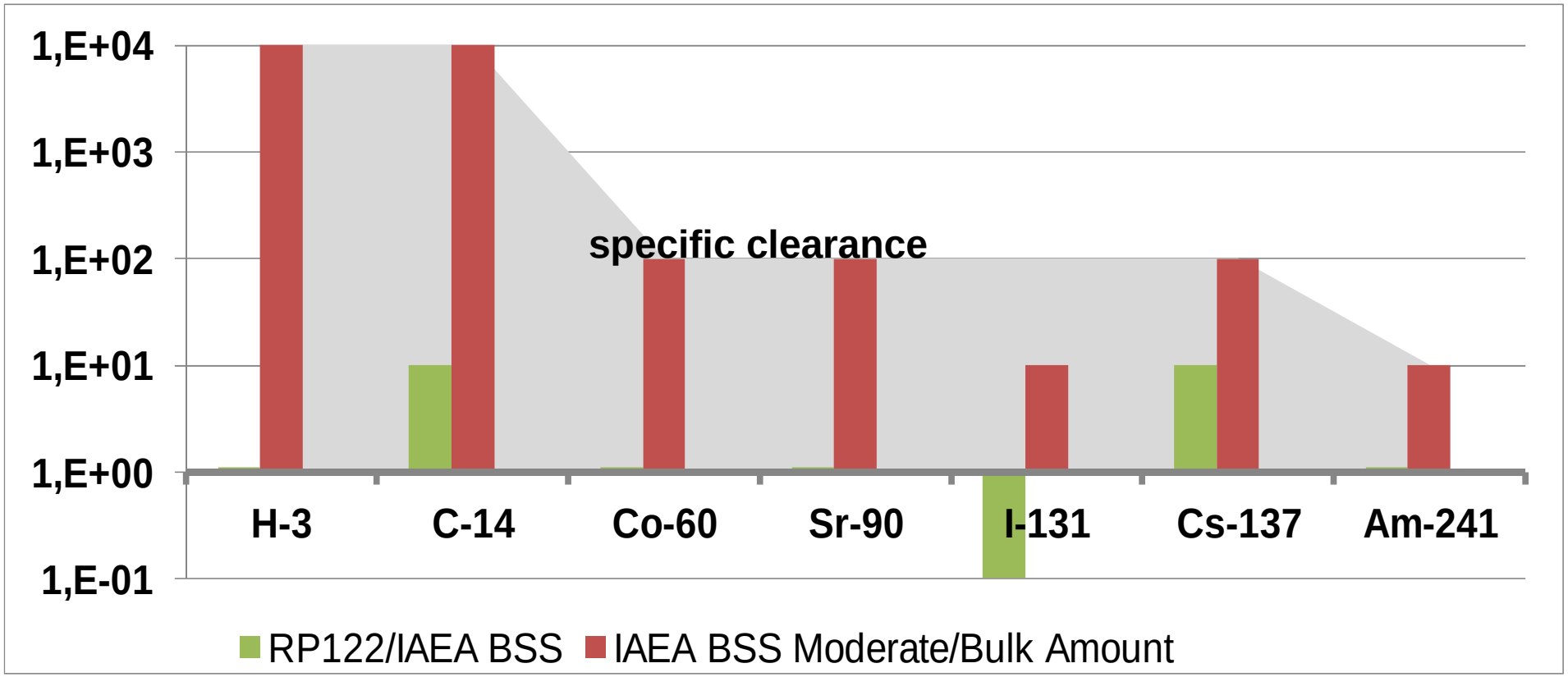
Clearance 1/3

Comparison of EC Clearance values with IAEA BSS values for Clearance of Small Amounts

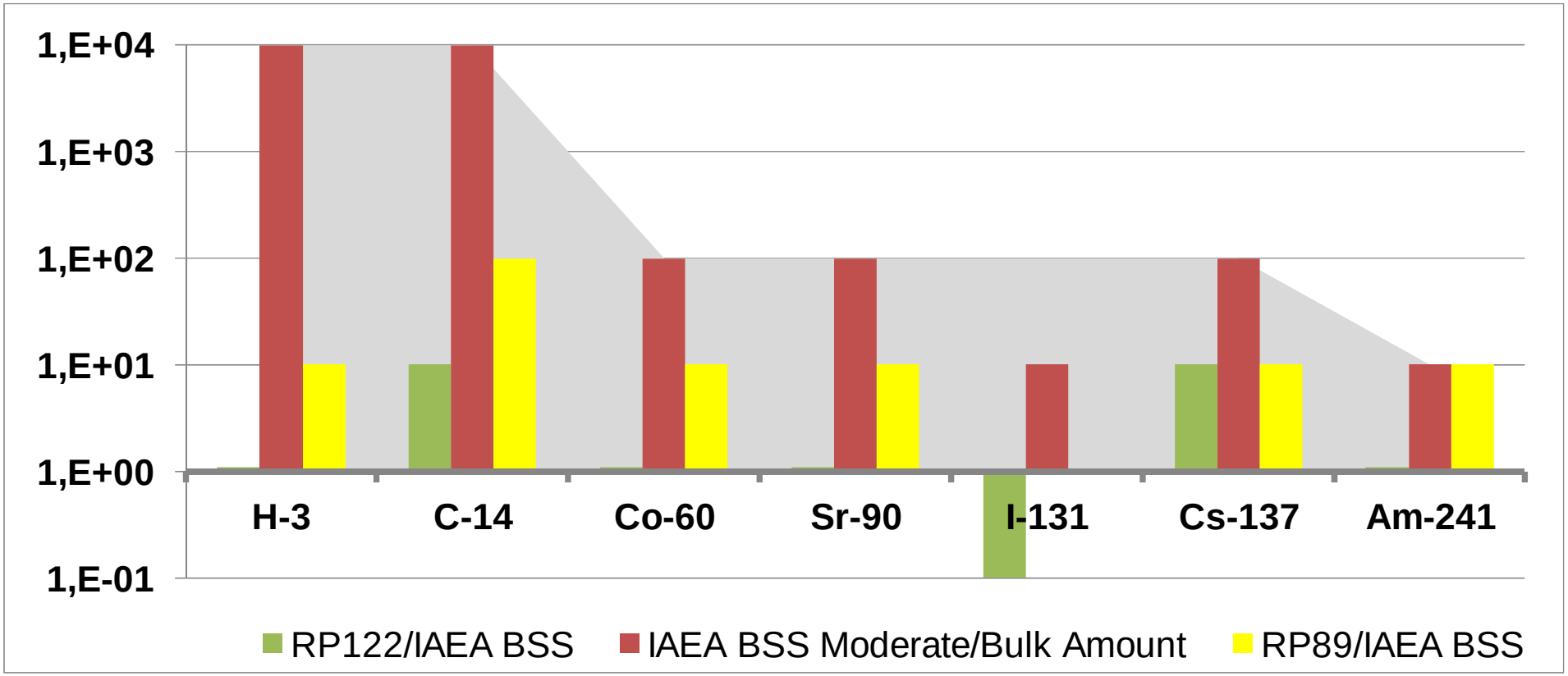


exemption

Comparison of EC Clearance values with IAEA BSS values for Clearance of Small Amounts



Comparison of EC Clearance values with IAEA BSS values for Clearance of Small Amounts



recycling of metal scrap

Mass balance for decommissioning projects

plant	Mass/Mg	General clearance	Recycling, reuse	Disposal, demolition	Radioactive waste
KKS actual total mass	11.734 Mg 100% 101.353 Mg	3.763 Mg 32%	2.852 Mg 24,3%	2.830 Mg 24,1%	2.289 Mg 19,6%
KWW actual	25.867 Mg	15.230 Mg 58,9%	5.250 Mg 20,3%	1.840 Mg 7,1%	3.547 Mg 13,7%
EWN total actual	565.000 Mg 172.647 Mg	27.770 Mg 16%	13.472 Mg 8%	126.273 Mg 73%	5.131 Mg 3%

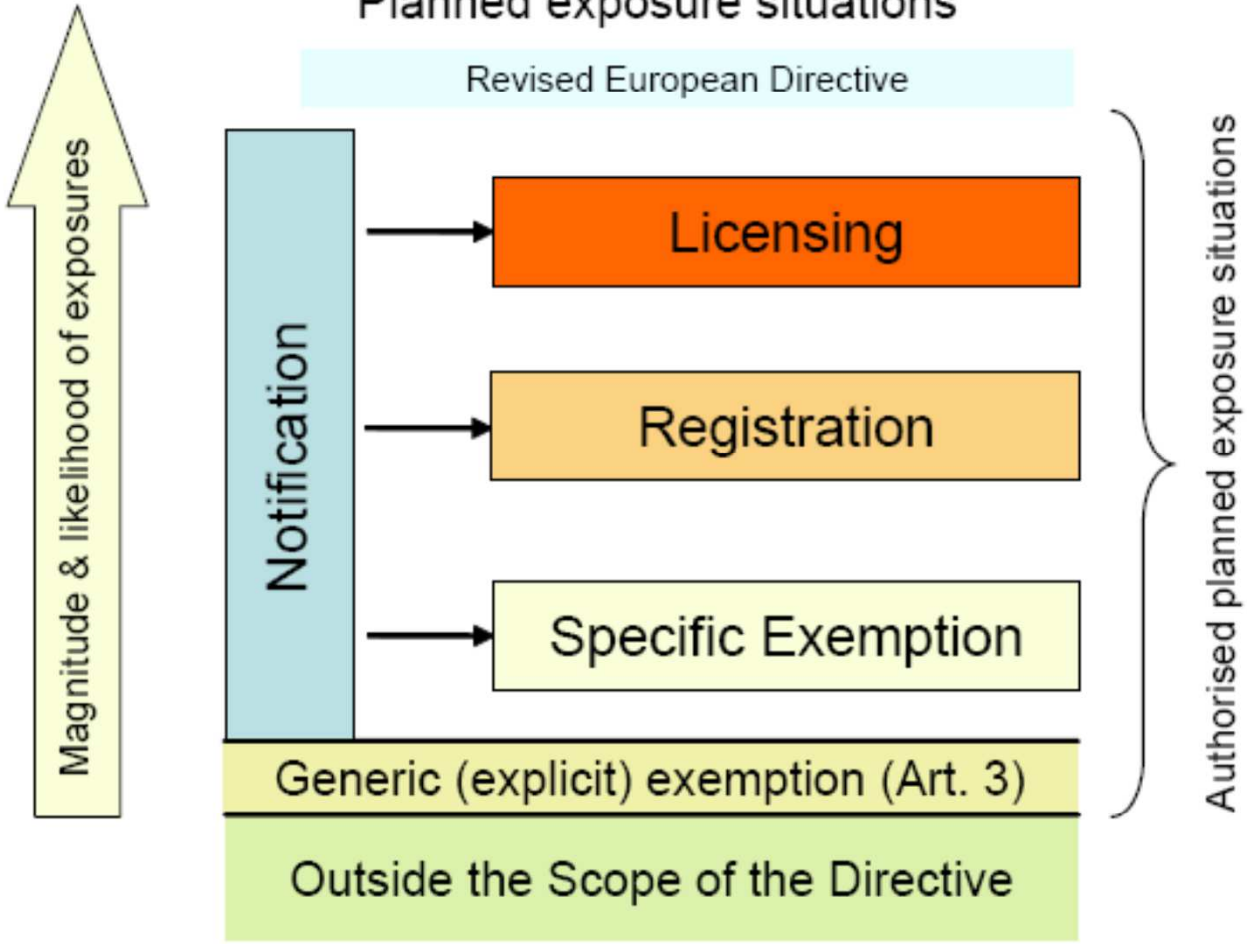
Specific Clearance
Revision of the International Basic Safety Standards for Radiation Protection by IAEA

TABLE I-2. LEVELS FOR EXEMPTION OF BULK AMOUNTS OF SOLID MATERIAL WITHOUT FURTHER CONSIDERATION AND FOR CLEARANCE OF SOLID MATERIAL WITHOUT FURTHER CONSIDERATION: ACTIVITY CONCENTRATIONS OF RADIONUCLIDES OF ARTIFICIAL ORIGIN *(see footnote 45)*

Radionuclide	Activity concentration (Bq/g)	Radionuclide	Activity concentration (Bq/g)	Radionuclide	Activity concentration (Bq/g)
H-3	100	Co-60m	1000	Nb-95	1
Be-7	10	Co-61	100	Nb-97[a]	10
C-14	1	Co-62m	10	Nb-98	10
F-18	10	Ni-59	100	Mo-90	10
Na-22	0.1	Ni-63	100	Mo-93	10
Na-24	1	Ni-65	10	Mo-99[a]	10

Two different values for moderate and bulk amounts of materials. EC wants to have only one set of exemption values for the specific activity (table I-2).

Regulatory Control of Planned exposure situations



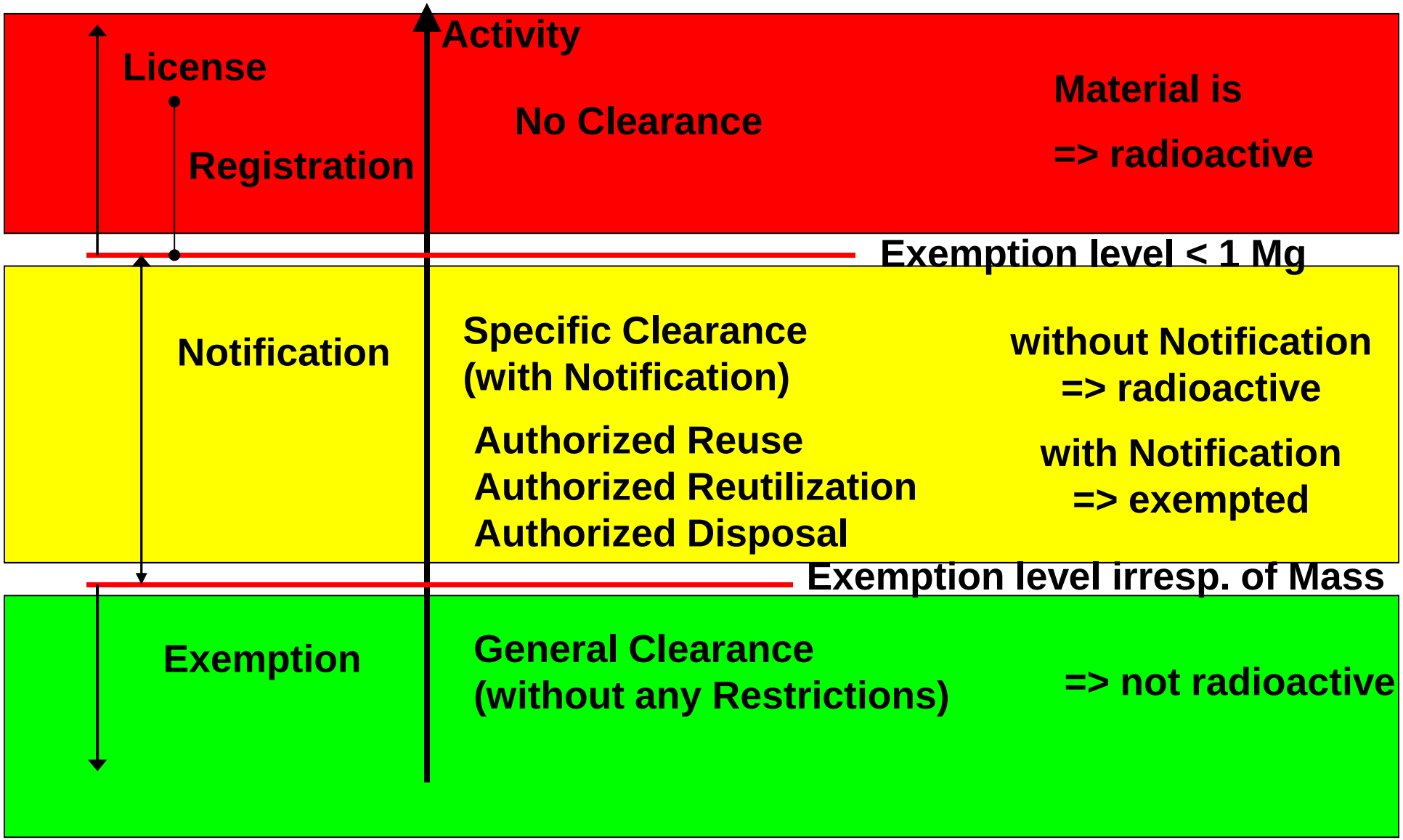
Directorate-General for Energy and Transport

Specific Clearance
Exemption = Clearance

How can we differ between a small amount of material, which was sucessfully cleared, and a bulk amount of material, which passed the clearance control by accident?

The nuclide specific activity might be the same!

A Model for
Graded Approach – Clearance of Materials – Discovery



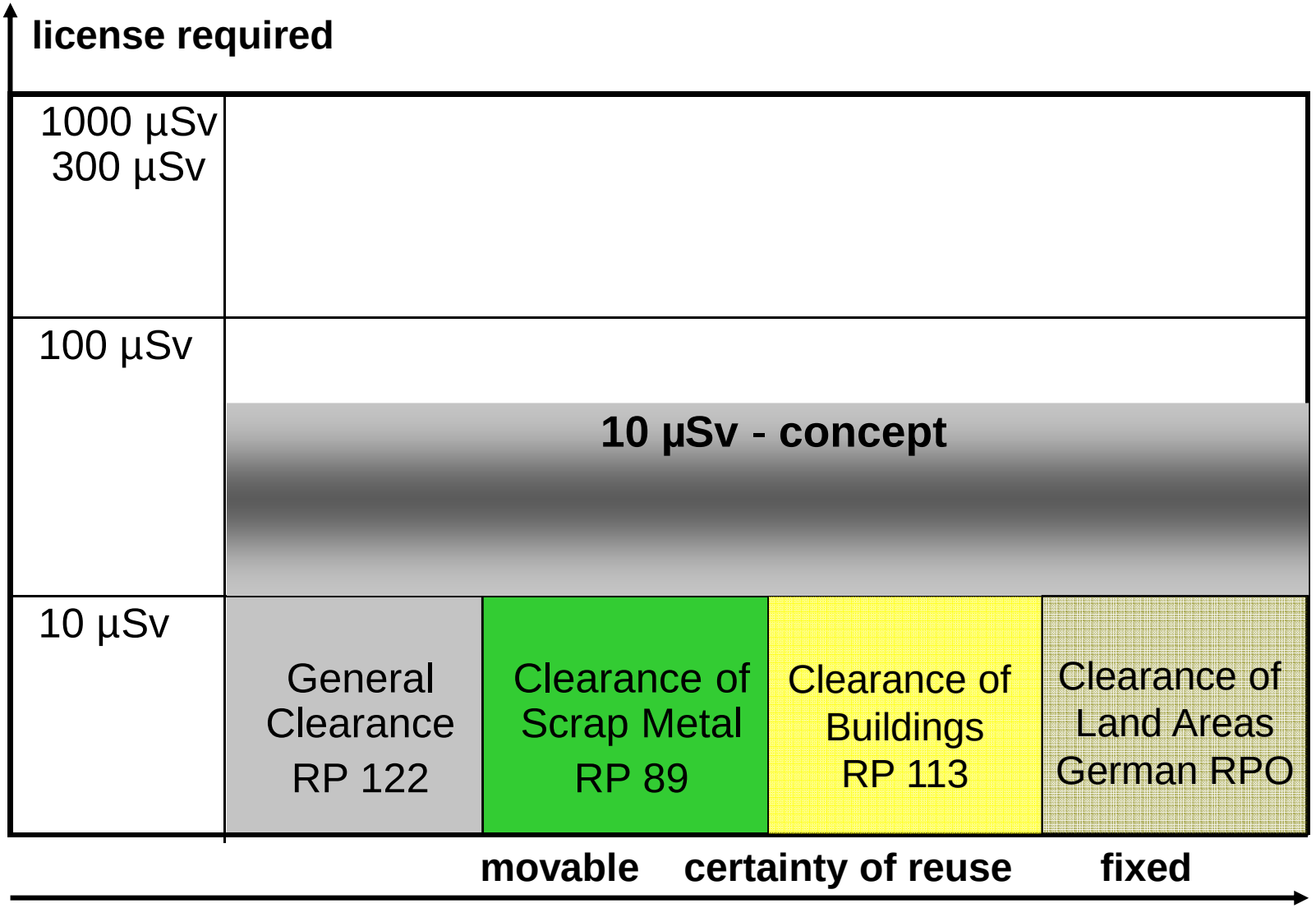
Future Developments
Exemption = Clearance

1. **BSS values as general clearance values are widely accepted.**

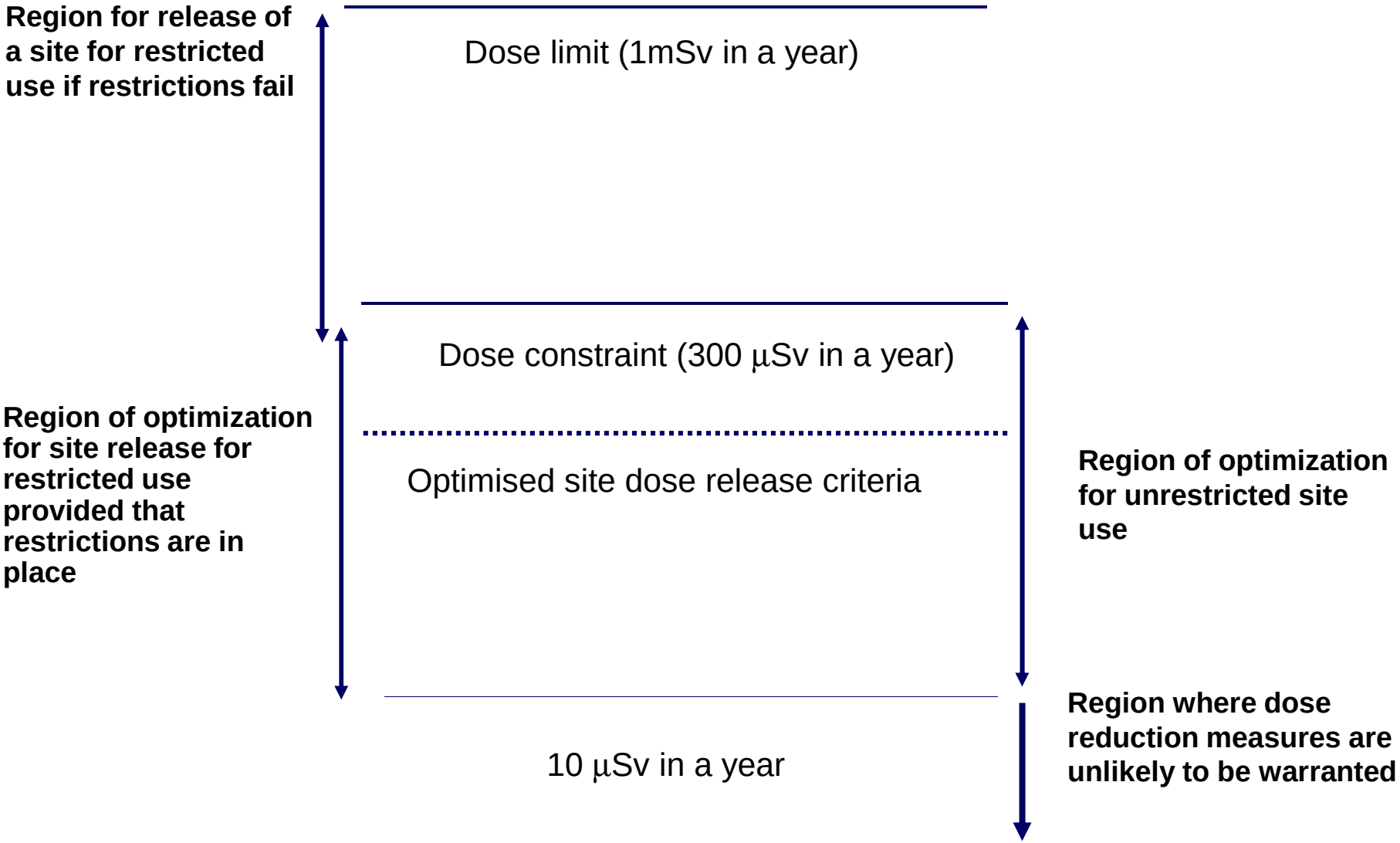
2. **Exemption = Clearance offers a great chance for simplification, but then the simple rule *Above exemption level needs a license* is no longer true.**

3. **We need a clear definition of the rules for using solutions a) for specific clearance or b) above the new exemption values. That should not be written between the lines.**

Concept of Clearance by EC/Germany



Release of Sites (IAEA WS-G-5.1)

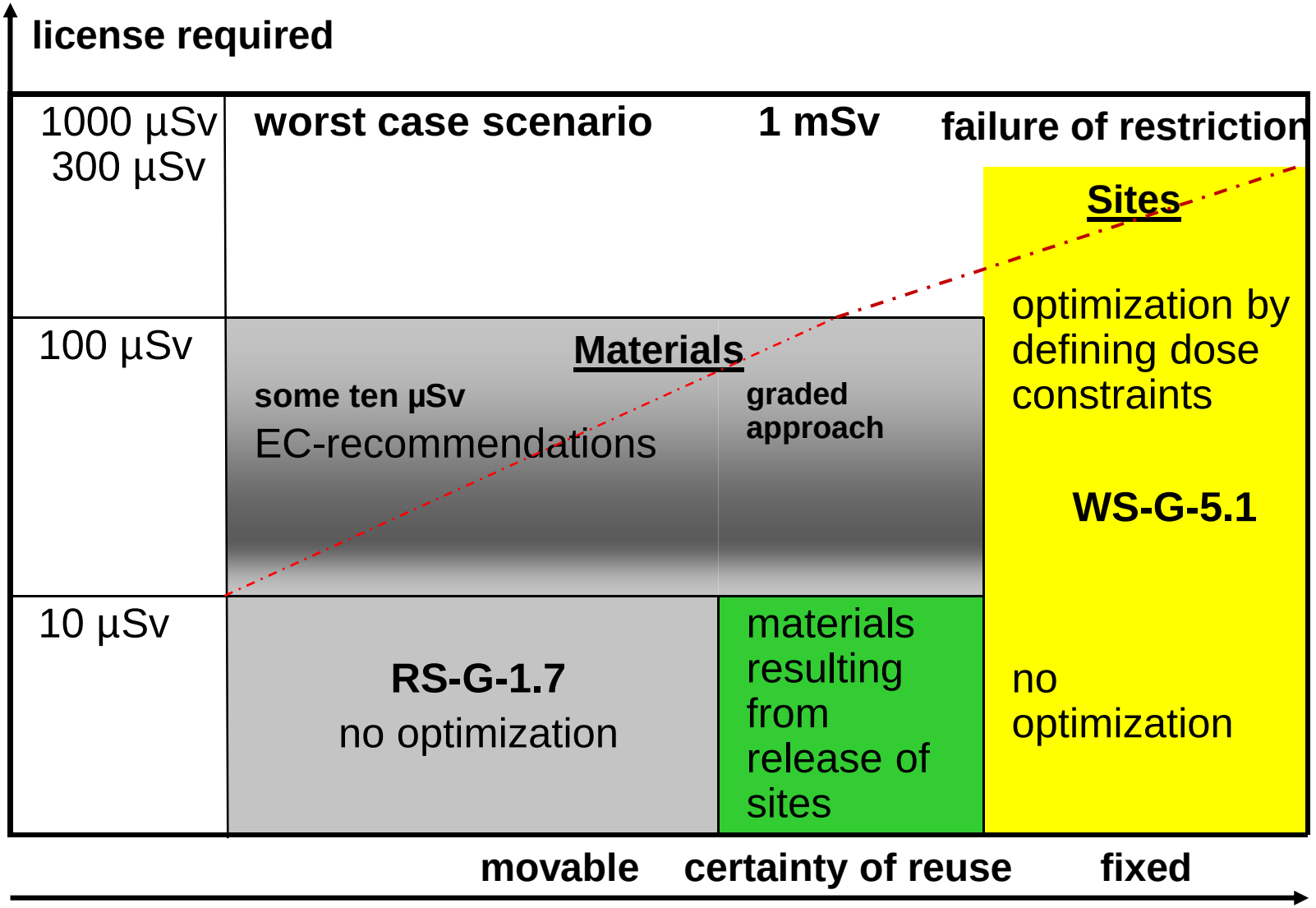


Release of Sites

Concept of WS-G-5.1 applicable for

- Release of sites after normal operation
- Release of sites after successful remediation
  (release of sites never under regulatory control is described in WS-G-3.1)
- Long-term interim storage of contaminated materials (nuclides with short half life)

Concept of Clearance by IAEA
Release of Materials and Sites

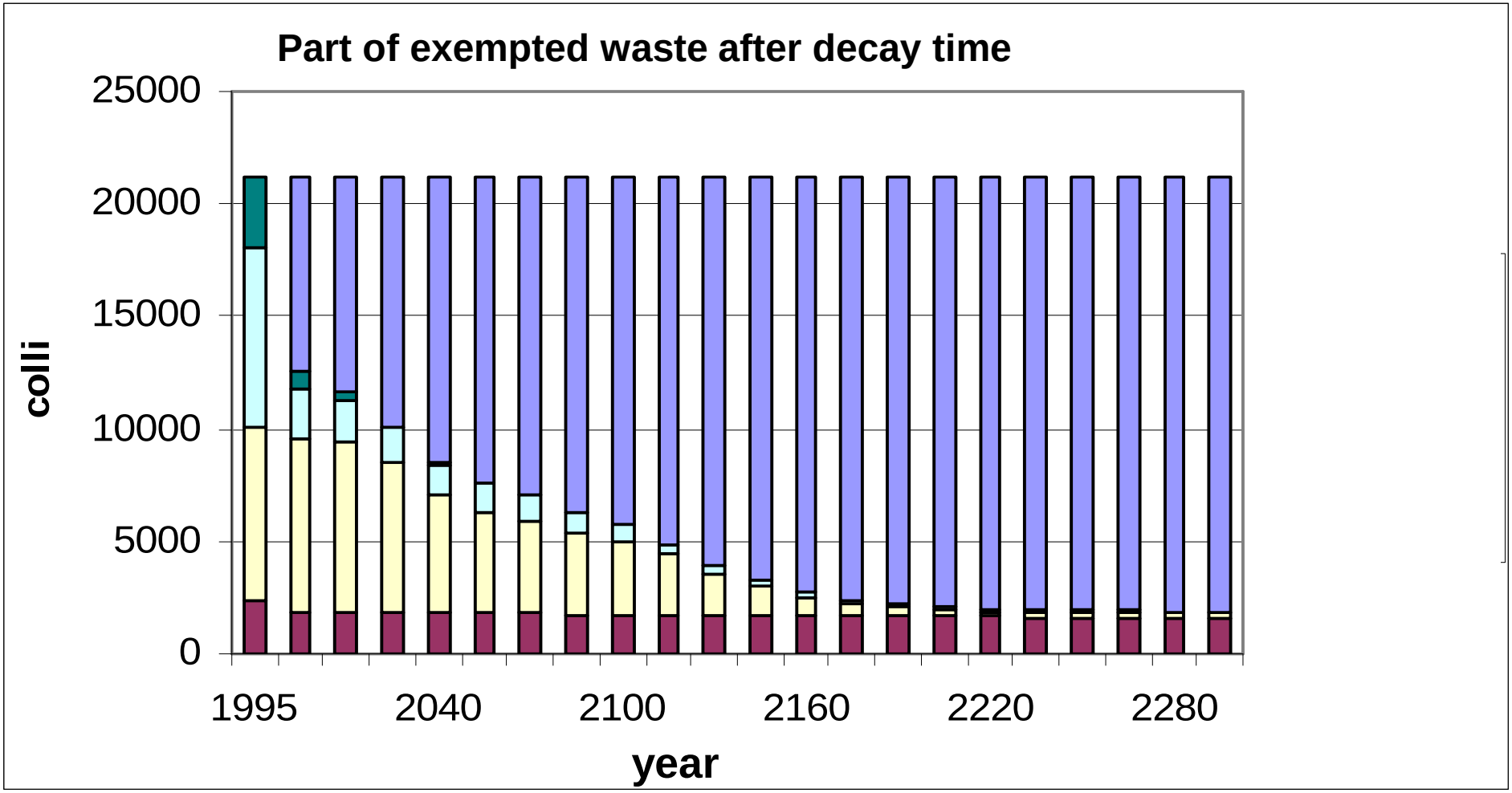


Long-Term Interim Storage

Can the IAEA recommendation for release of sites fill the gap between clearance and disposal facilities?

Which are the disposal solutions for countries with low amounts of radioactive waste without Near Surface Disposal Facility or Deep Geological Repository?

Long-Term Interim Storage: Experience from The Netherlands



Category: :Exempted, T1/2<15y, :T1/2>15y, : NPP waste, : Alpha waste

Long-Term Interim Storage: Experience from The Netherlands

Some 200 producers of radioactive waste, varying from NPP, research facilities, industries and hospitals

Annual amount approx. 200 tonnes

Treatment: supercompaction and cementation, packaging in 220l drums

Storing at COVRA

Starting the C2C approach (cradle to cradle) to declassify most the waste after decaying time of 20 to 100 years

A special procedure for declassifying was installed

- Selection of decayed waste drums
- Dismantling of metal drum
- Crushing the concrete mantle
- Shredding the pellets
- Incineration of burnable waste/reuse of concrete

Specific activity levels for long-term interim Storage and release

Bq/g	Co-60	Sr-90	Cs-137	Am-241
Clearance (BSS bulk amounts)	0,1	1	0,1	0,1
Spec. clearance for landfill (Germany)	6	6	10	1
Spec. clearance for incineration (Germany)	7	40	10	1
Exemption (BSS moderate amounts)	10	100	10	1
Exemption with dose constraint 300 µSv/y	300*	3000	300	30

* Dose rate: approx. 10 µSv/h

Summary

1. Nuclide specific clearance values offer a dose-related limitation. Different values for the main options of clearance give the opportunity for an optimal use (specific clearance). The derivation of specific clearance values are based on national or site-specific data and should not be internationally harmonized.
2. The specific clearance options need a legal framework as these options are mainly used during decommissioning of nuclear facilities.
3. A specific differentiation of what is not contaminated and what is contaminated but acceptable for clearance is helpful for reducing administrative efforts.
4. For low amounts of radioactive waste an own disposal facility is not necessary, if the waste contains mainly short lived nuclides. A long term storage is an appropriate option to use the decay and to reach specific release levels for most of the waste.
5. For this purpose site specific clearance levels can be derived using the IAEA concept for clearance and site release.

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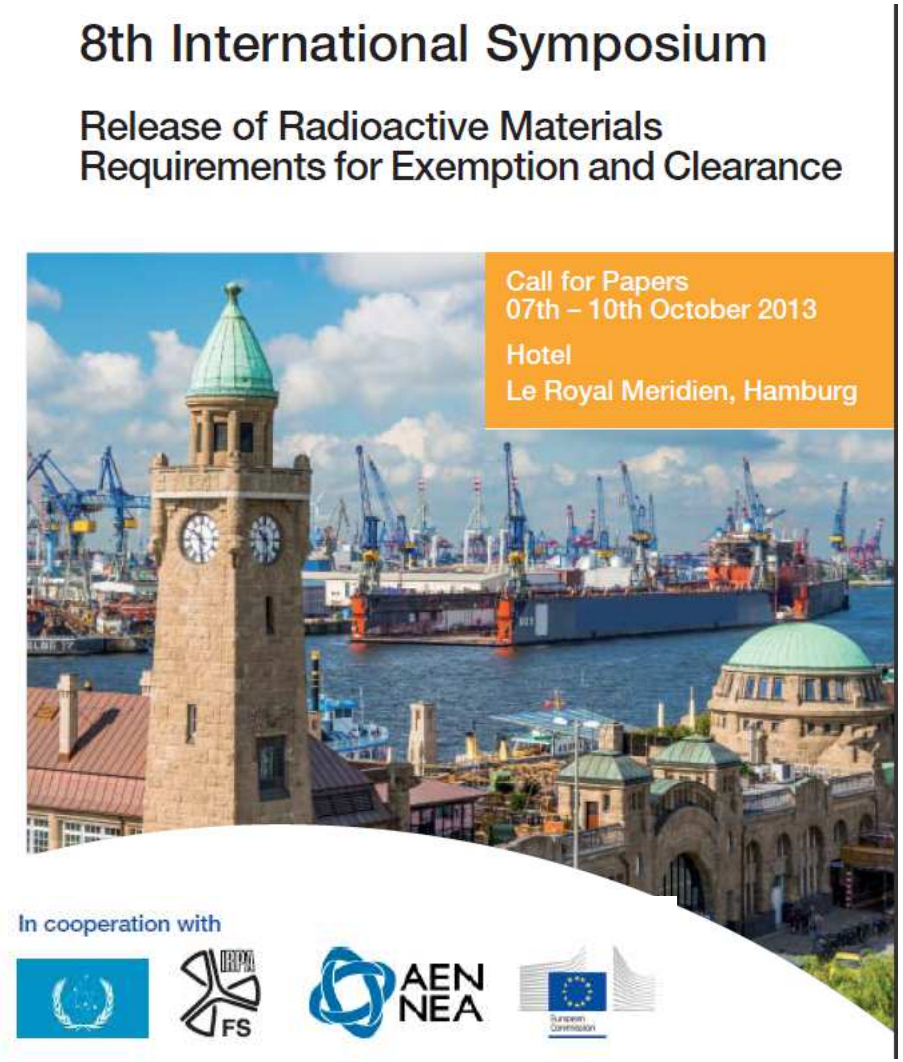
More detailed discussion at



Thank you for your attention and good luck for your projects!