Management of very low level radioactive waste in Europe – application of clearance (and the alternatives)

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Overview

- Definition of clearance
- International regulations
- Examples for the classification of radioactive wastes
- Examples for the management of VLLW and clearance
- Overview on the applied clearance levels
- Summary
- Addendum: Non-contaminated items
- Addendum: Mixed waste – what happens after clearance?

Definition of Clearance

Definition of clearance

- „Clearance is defined as the removal of radioactive materials or radioactive objects within authorized practices from any further regulatory control by the regulatory body“ (IAEO RS-G-1.7)

- „Administrative act regulating the removal of materials, objects, buildings and sites, plants or systems that are activated or contaminated with radioactive substances and remaining from practices [...] from the regulations of the atomic act, its subsidiary ordinances and administrative decisions“ (German RPO)
  For use, recycling, disposal, possession or transfer to third parties as non-radioactive substances

- This is a juristic fiction, declaring a substance to be non-radioactive according to the law despite its physical (low) radioactivity

International Regulations

International Regulations – IAEA RS-G-1.7

- Dose for a member of the public in the range of 10 µSv/a
- Single events with low liklihood can be accepted if < 1 mSv/a effective dose and < 50 mSv/a skin dose
- 1 manSv/a collective dose
- No mass restriction
- 100% exhaustion of the clearance levels assumed; all applications
- Values are based on several international studies, the lowest values for every nuclide were chosen to ensure universal applicability
- Up to the tenfold of the given level, the national regulator may decide not to apply any regulation (graded approach)
- Application of guide is not mandatory - „may be used“

International Regulations - EU

- EU – RP 89 – Metals
  - Steel, aluminium & copper or their alloys
  - Recycling or direct reuse
  - Mass restricted to 10 000 Mg/a; local markets
  - 100% exhaustion of the clearance levels assumed

- EU – RP 113 – Buildings and Rubble
  - Unrestricted clearance (reuse or demolition)
  - Restricted clearance of buildings (demolition only)
  - Unrestricted clearance of rubble
  - 200 000 Mg (controlled area of a commercial NPP); local markets
  - 33% exhaustion of clearance levels assumed (100% for rubble)

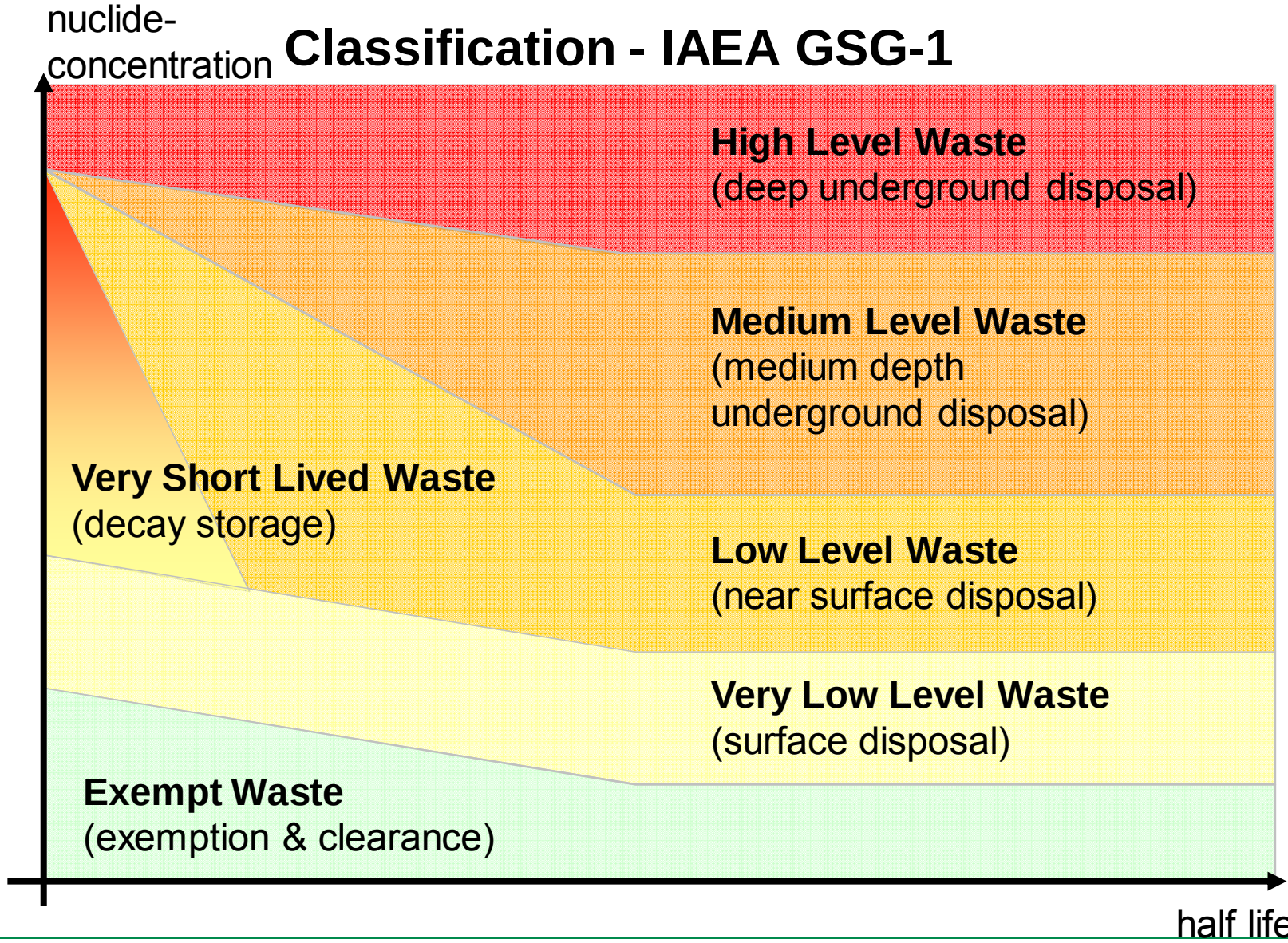
- EU – RP 122 – Materials
  - Szenarios for external radiation, inhalation, ingestion and skin contamination
  - No explicit mass restrictions, some 1000 t are covered by model
  - 100% exhaustion of clearance levels assumed

Classification of Radioactive Waste

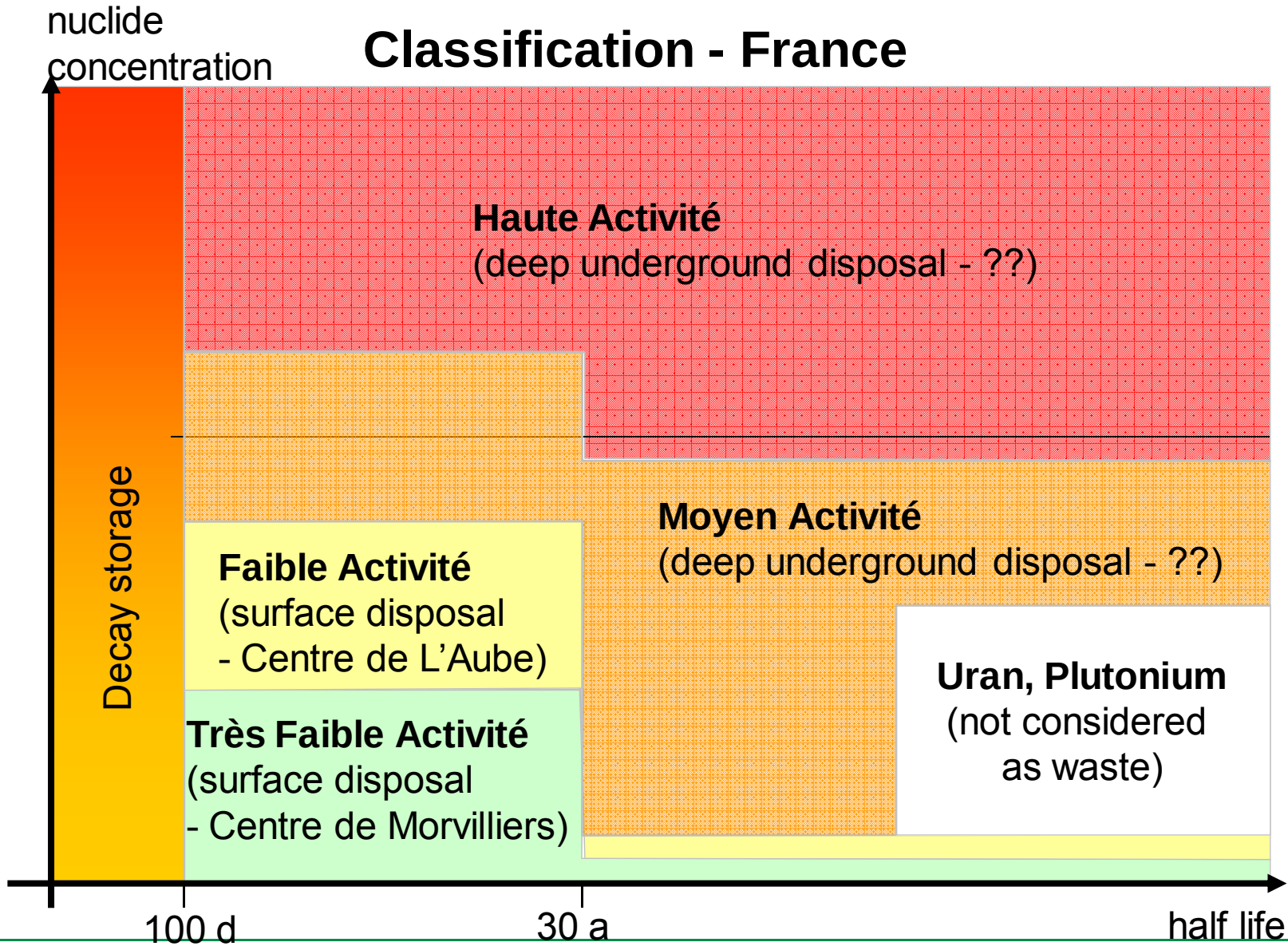
Classification of Radioactive Waste

- The classification of radioactive waste can be defined [IAEA GSG-1]
  - depending on its origin
  - depending on its half-life
  - depending on its radiation level
  - depending on its disposal pathway
- The latter is recommended by the GSG-1, the classification thus dependent on national repository strategies and availability
- This implies a link between waste characterisation scheme an clearance application

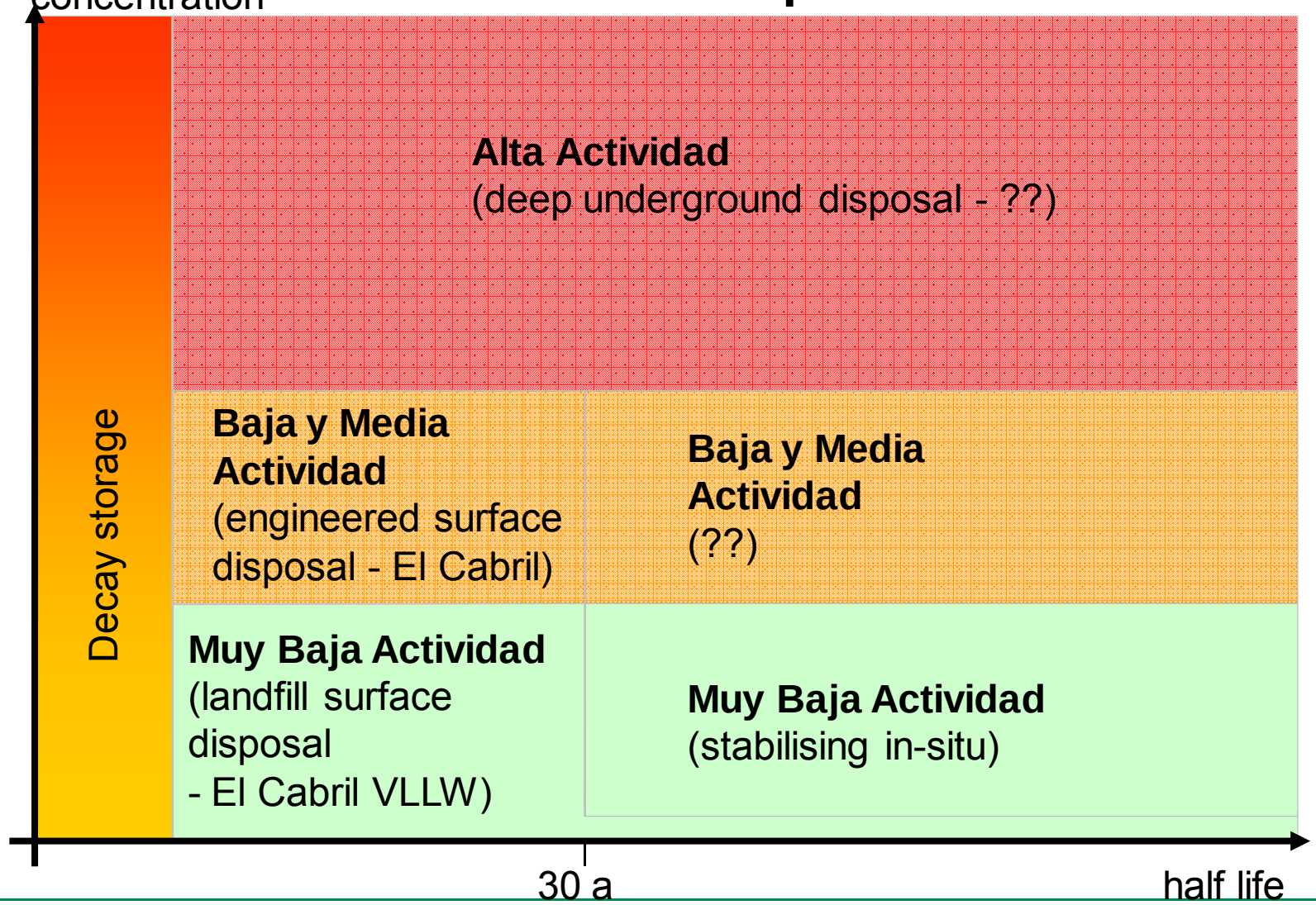
Classification - IAEA GSG-1



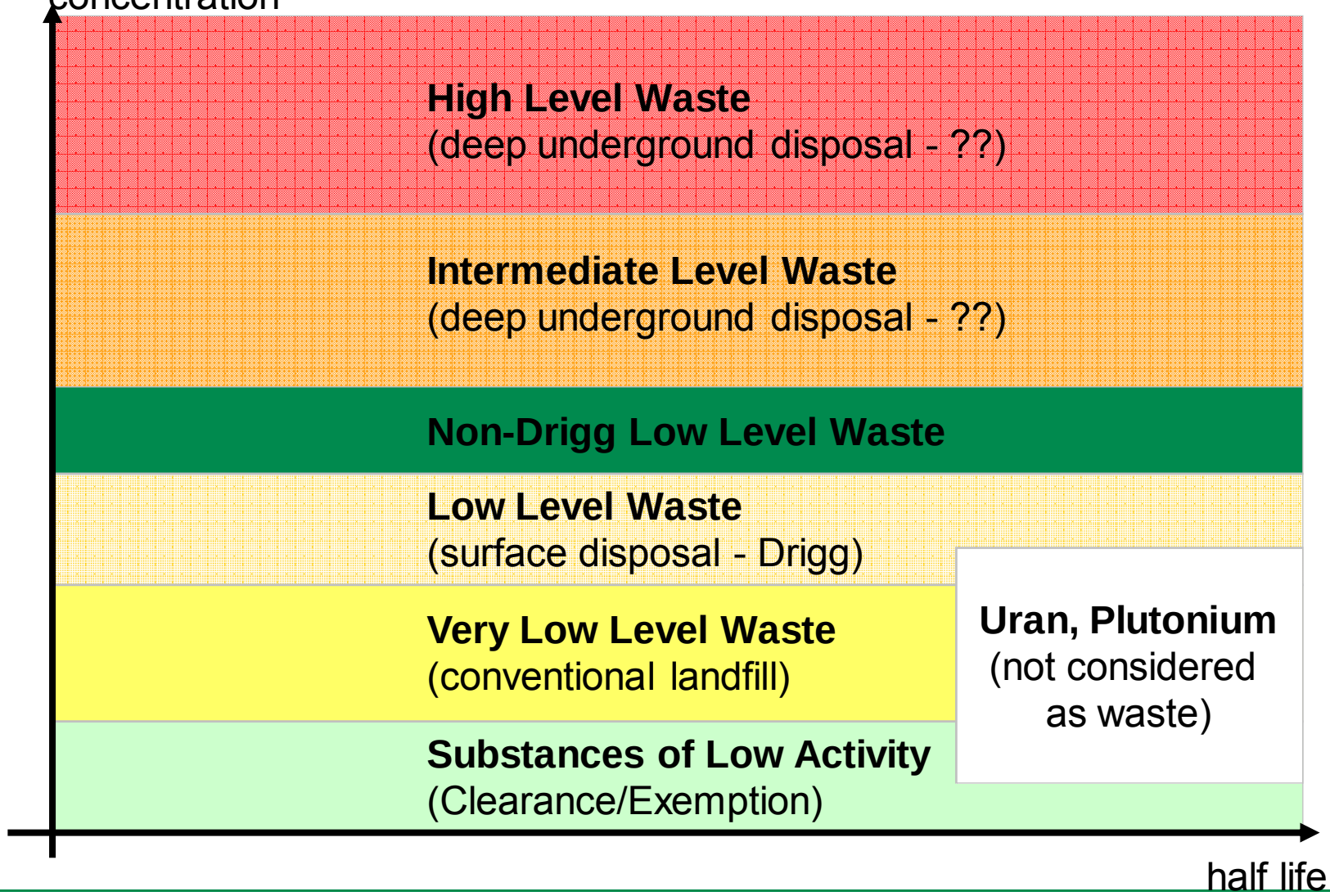
Classification - France



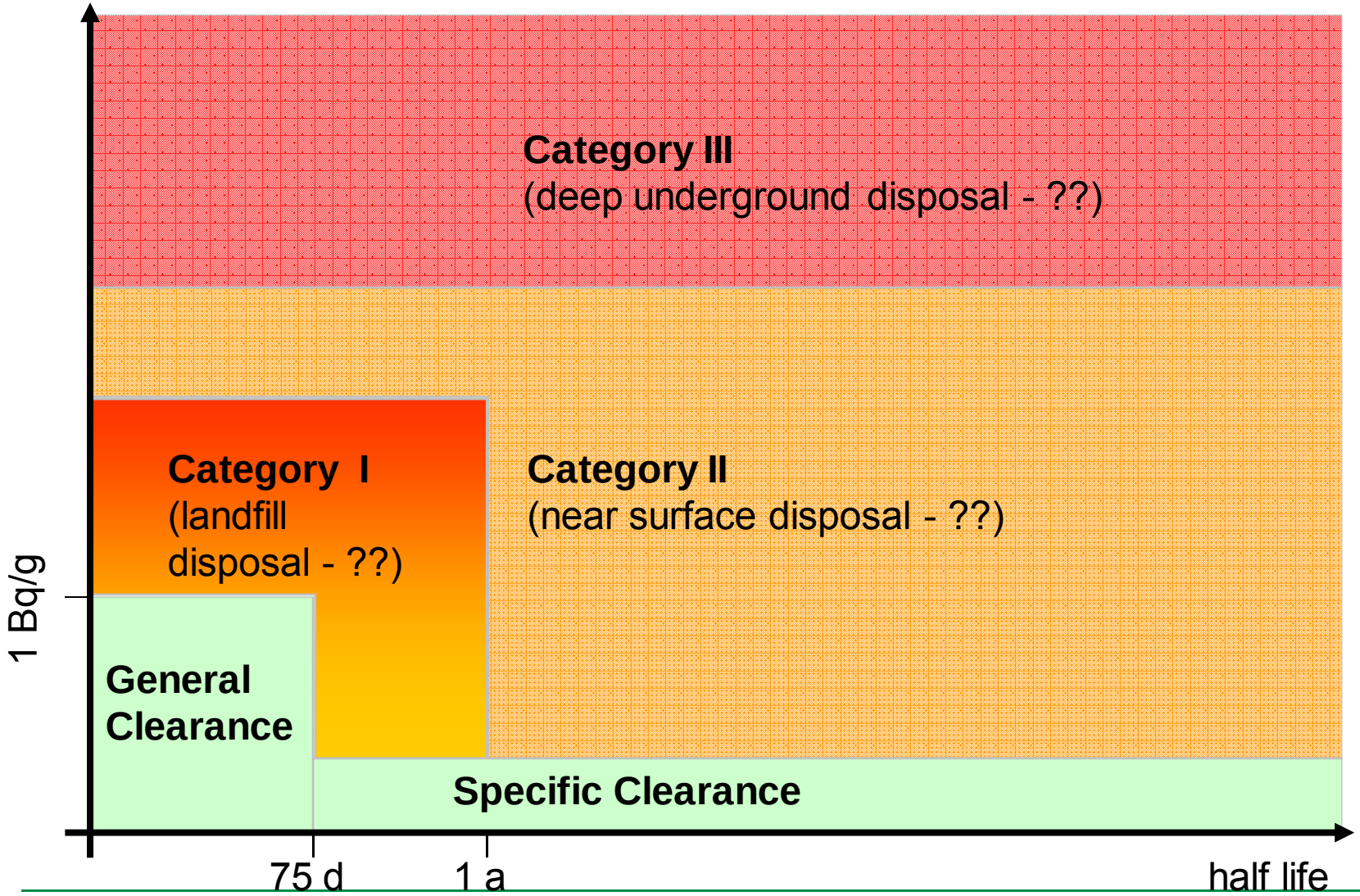
Classification - Spain



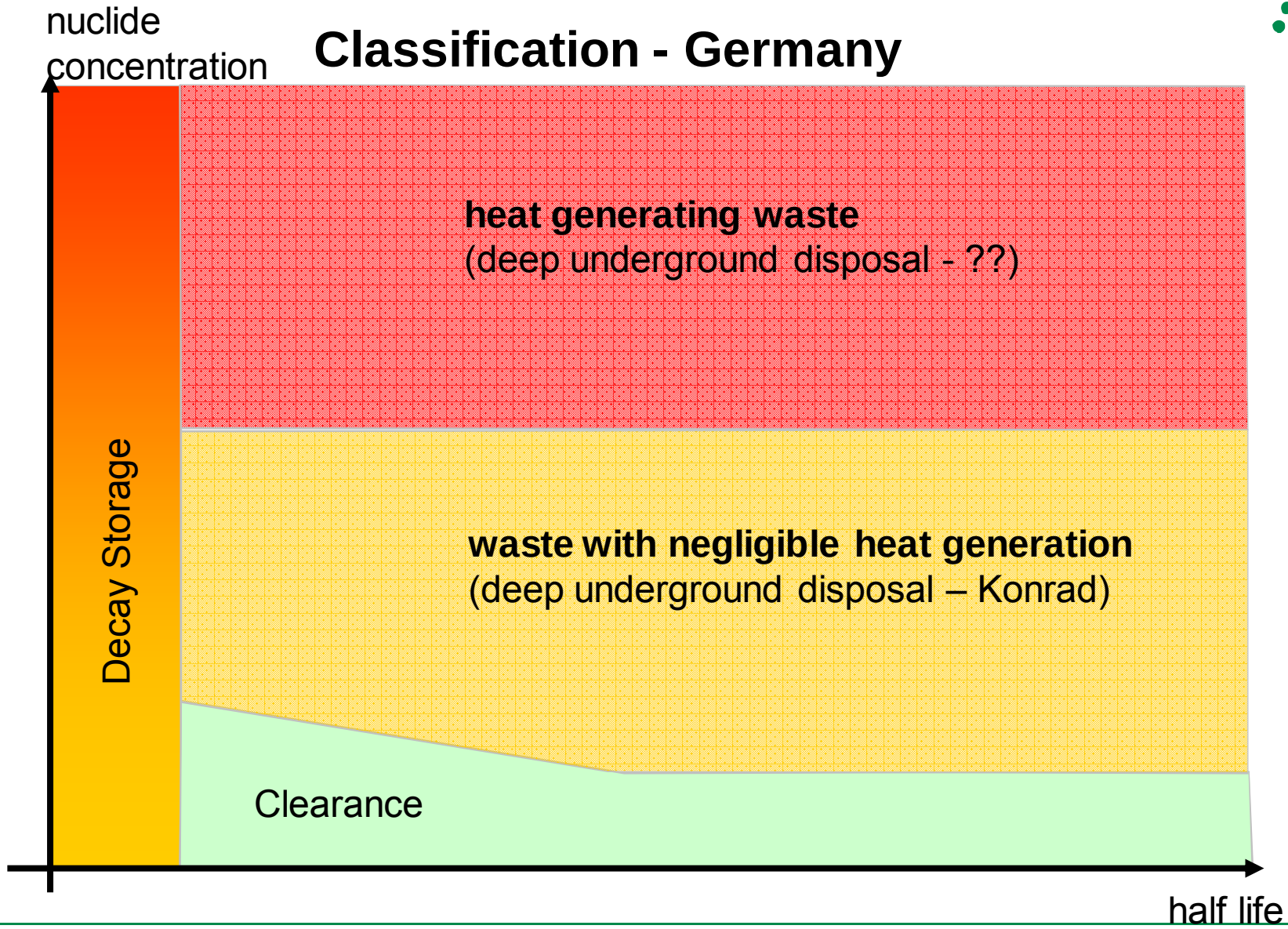
Classification – United Kingdom



Classification - Italy



Classification - Germany



Waste Classification Summary

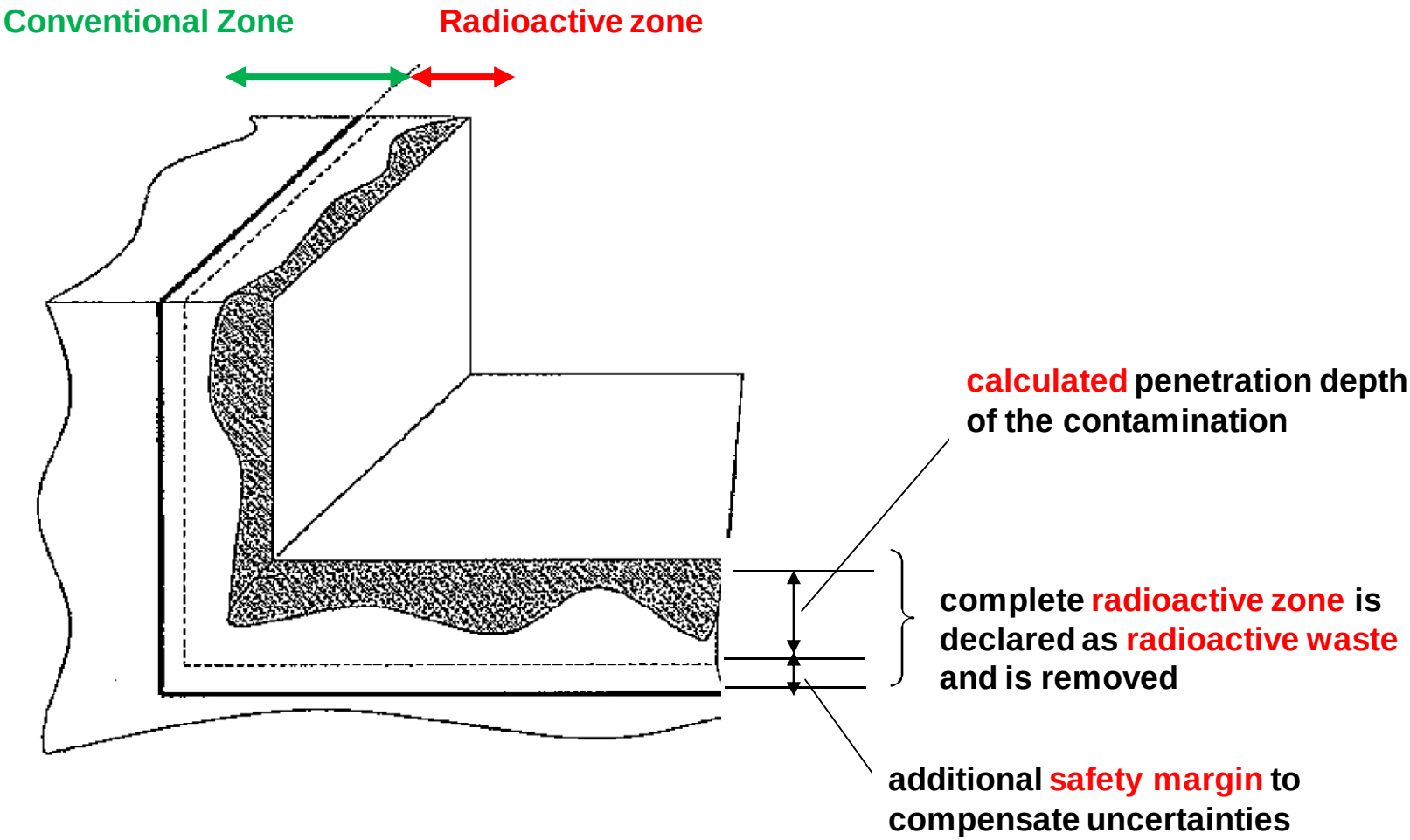
- Many different classification scheme
- All are more or less in line with IAEA GSG-1
- In most countries differentiation is made with regard to activity as well as with regard to half life
- Near surface/surface disposal requires limitation of long-lived nuclide content

Examples for Clearance Regulations (and regulations not applying clearance)

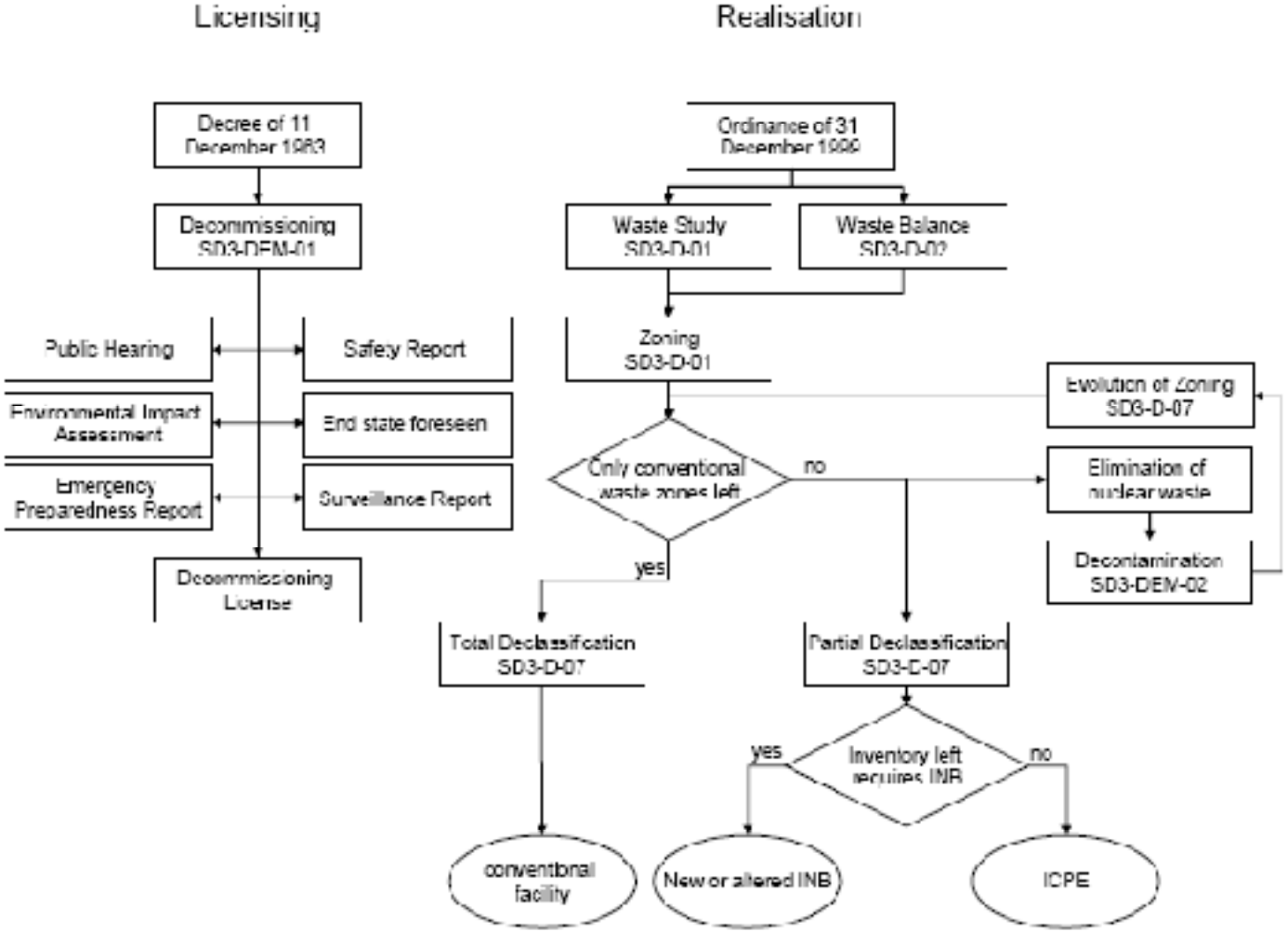
France

- Differentiation between non-radioactive and radioactive zones (Zoning) is carried out before any activity. It is based on a priori considerations and the operational history
  - With aid of physical and chemical considerations, a maximum penetration depth is determined
  - Together with an additional safety margin this part is declared as radioactive Zone and is removed as radioactive waste
  - Measurements are carried out to warrant for the non-radioactive nature of the remaining structures
  - These are then declared as non-radioactive (conventional) zone
- Waste from radioactive zones is always radioactive waste
- Waste from non-radioactive zones is conventional waste, but will be controlled when leaving the facility
- Clearance of sites and buildings is realised by removal of the radioactive zone

France- Zoning



France – Release of Sites



Spain

- Clearance is regulated on a case-by-case basis (usually for dedicated waste streams during the licensing of decommissioning)
- The levels are derived from EU-levels, but are in each case confirmed by Consejo de Securidad Nuclear (CSN)
- For small amounts from research and medicine (< 3 Mg) the levels from IAEA TecDoc 1000 are adopted in Spanish regulations
- VLLW are now also disposed of on a landfill-like repository on the El Cabril site near Cordoba
  - The total inventory of El Cabril remains unchanged

Sweden

- Clearance of metals is following EU-RP 89
- Clearance of oils and materials from operation (SSI 1996:2)
  - Surface activity concentration
    - 40 kBq/m² beta and gamma-emitters, 4 kBq/m² alpha emitters
  - Bulk activity concentration
    - 500 Bq/kg total activity concentration, <100 Bq/kg alpha emitters
  - Disposal on on-site or on municipal disposal facilities
    - 5 kBq/kg total activity concentration, 0,5 kBq/kg alpha emitters
    - Reuse must be excluded
- New regulation was announced since 2007, combining the lowest levels from IAEA and EU regulations but still is not in force
- Additional regulation for non-contaminated materials

United Kingdom

- General Clearance 0.4 Bq/g (Substances of Low Activity- SoLA)
- Radioactive Substances Act (RSA93) lists levels for several elements (!) (0.4-11 Bq/g) below which the materials are exempted
- Addtional exemption orders exempt certain materials or waste from certain industries
- The levels are also applied for clearance of these materials
- On a case-by-case basis there is the possibility of a restricted clearance for the disposal on municipal landfills (e.g. Clifton Marsh)

UK – Release of sites

- Release of sites regulated in the Nuclear Installations Act (NIA 1965) if there is “ceased to be any danger from ionising radiations from anything on the site or, as the case may be, on that part thereof”.
- the “no danger” criterion has been elaborated by a HSE document :
  - < 20 µSv/a no further effort necessary to minimise dose
  - < 300 µSv/a acceptable, if all efforts have been taken to minimise dose; may involve restrictions for use
  - < 1 mSv/a acceptable in case all restrictions fail

Italy

- A general exemption criterion is in force in Italy, (Lgs. Decree 230/1995), which can also be used for clearance:
  - activity concentration ≤ 1 Bq/g, and
  - half-life < 75 days
- If compliance with either of the two is failed, clearance requires an authorization on a case-by case basis.
- Release of sites on case-by-case basis

Germany

- Clearance is regulated in § 29 StrlSchV
- There are 4 series of levels for unrestricted and 3 series of levels for restricted clearance
- Applicable for all materials from practices that may be contaminated or activated
  - This can never be excluded from any material, areas and buildings having been part of a controlled area
  - If contamination or activation can be excluded for materials, areas and buildings in the monitored area, § 29 StrSchV is not applicable.
- No direct regulation exists for the release of sites, this is done via subsequent clearance of all remaining soil and buildings

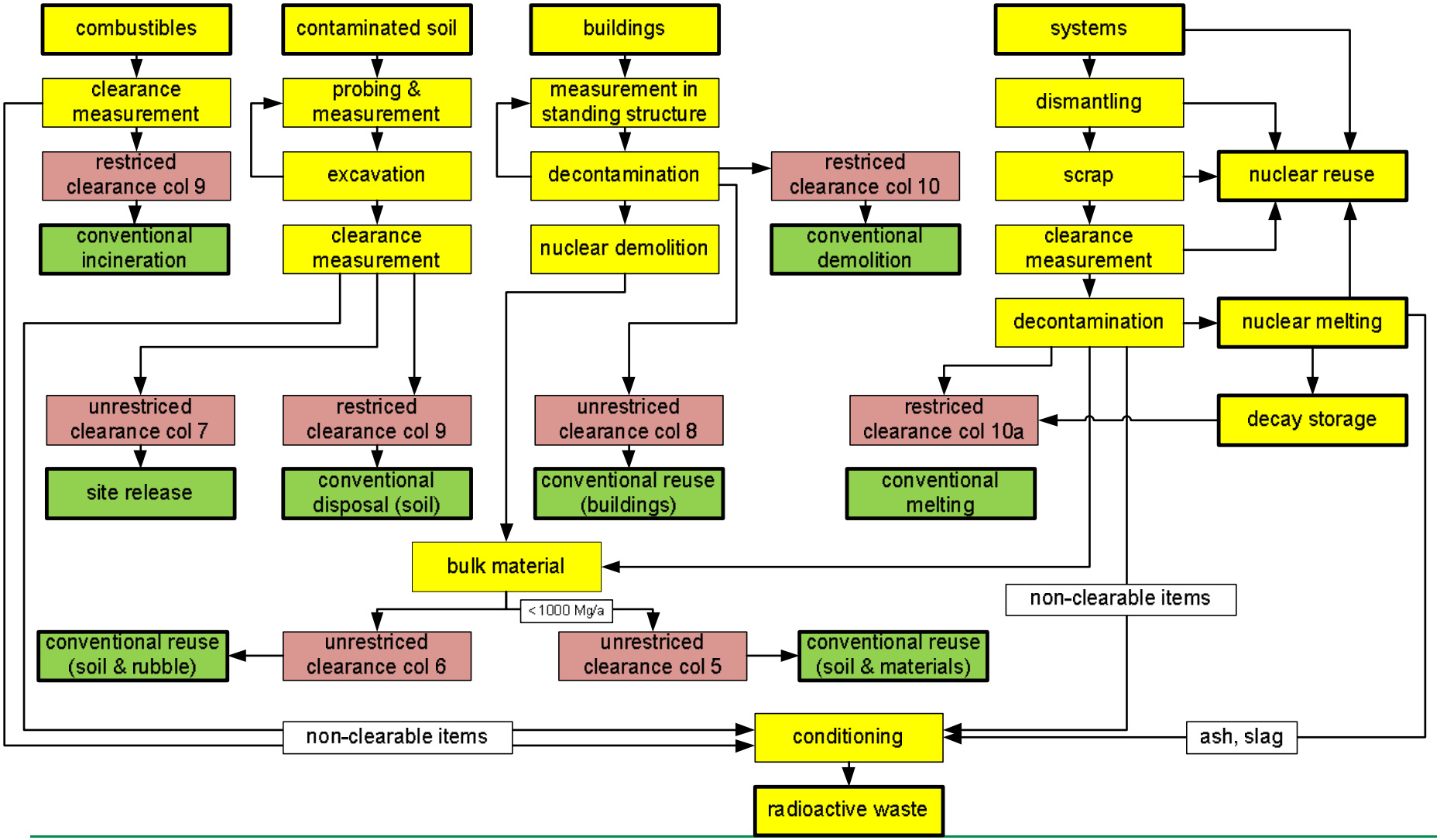
Germany – Release of sites

- A site will not be formally released from regulatory control, but it will be declared, that the necessity for a license has been elminiated and the license is terminated.

- Usually this is done step by step for each area or building on site.

- Soil may be cleared and remain on site.

German Clearance Regulations



Application in EU

Application – Countries having no operational NPP

	Decom	Clearance defined	Generic Clearance	Case-by Case	Own levels	IAEA levels	EU levels
AT							
CY							
DK							
EE							
EL							
IE							
LU							
LV							
MT							
PL							
PT							
IT							

Applications – Countries with operational NPP

	Decom	Clearance defined	Generic Clearance	Case-by Case	Own levels	IAEA levels	EU levels
BE							
BG							
CZ							
DE							
ES							
FI							
FR							
HU							
LT							
NL							
RO							
SE							
SI							
SK							
UK							

Summary

Summary (I)

- Depending on the disposal options the classification of radioactive waste differs especially in the region of low level and very low level waste
- In countries with cheap, landfill-like VLLW disposal options, clearance is less important
- Clearance was already established in many countries with a substantial nuclear programme before international regulations were set up
- These countries tend not to apply international levels directly, but use their domestic levels
- Many countries allow single case decisions, when evidence is given that the dose constraints will be met

Summary (II)

- Scenarios for the derivation of nuclide concentrations from the given dose constraint are driven by domestic markets and specifics
- As international regulations must be far more conservative with regard to these specifics, their values tend to be lower than domestic ones
- A further harmonisation may be useful for transboundary movement of cleared material, it is not required with regard to dose constraints
- Collective doses can be lower if clearance is not applied, but VLLW disposal scenarios may result in the same range (transport to central facilities)

Addendum: Non-Contaminated Items

Non-Contaminated Items

- Many countries also have provisions for the release from regulatory control of non-contaminated items

- This can be a very important pathway for materials, buildings and areas inside monitored, but not inside controlled areas

- Evidence for the non-contaminated nature must be given by final status measurement

Difference in null-hypothesis

- Clearance:
  homogeneous and representative sample is below the defined clearance levels

- Non-contaminated items:
  set of representative samples does not vary significantly from natural background on site
  (can get tricky for fuel cycle facilities in surroundings with elevated natural background)

- Differences in null-hypothesis must be taken into account when taking samples and applying statistics

Addendum: Mixed Waste

Mixed waste & clearance

- Clearance is only applicable to the specific radiation protection regulations
- Other regulations may keep the material under regulations e.g. for hazardous waste
- Very common problem for
  - PCB-containing decontamination paint layers
  - Asbestos from insulation
  - Concentrates and ashes containing heavy metals

Example PCB (I)

- PCB-containing decontamination layer was used in several facilities in Germany
- PCB has diffused into the first layer of concrete
- Resulting waste from scabbling has up to 50 000 ppm PCB
- PCB is restricted in the Konrad repository to < 100 ppm (collateral clause on hazardous substances in Konrad license)
- PCB incineration is only allowed in special facilities

Example PCB (II) - Pathways

- Nuclear incineration (destroys PCB) then disposal of ashes in Konrad repository
  - Campaign must be authorised by BfS
  - Incineration plant must be capable and licensed to treat PCB
  - Will only be applicable for large amounts

Example PCB (III) - Pathways

- Unrestricted clearance
  - requires removal of hot spots (small amounts of material are tolerable in radioactive waste)
  - the material falls under the provisions of the hazardous waste regulations (KrWAbfG)
  - state hazardous waste agencies will decide on further disposal of material (usually incineration)
  - material will remain under conventional control

Example PCB (III) - Pathways

- Restricted clearance
  - for disposal (hazardous landfill site, hazardous material repository)
  - for incineration
  - higher radionuclide levels may be feasible
  - compliance with 10 µSv/a-concept must be proven, thus elevated efforts for the authorisation process

Example PCB (IV) - Conclusions

- Several pathways are feasible
- Which one to choose will depend on
  - Radiation protection optimisation (ALARA)
  - Cost optimisation (depending on national regulations and options: disposal cost for VLLW waste is very high in Germany, but not in France...)
  - Timeline (it may be faster but more expensive to remain in the nuclear field also with regard to other hazards)
- Separation of radiological and other hazards is best option, if feasible

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