IRSN
INSTITUT
DE RADIOPROTECTION
ET DE SÛRETÉ NUCLÉAIRE

Enhancing nuclear safety

Transition out of regulatory control and post-closure institutional control - what can be expected in the long term

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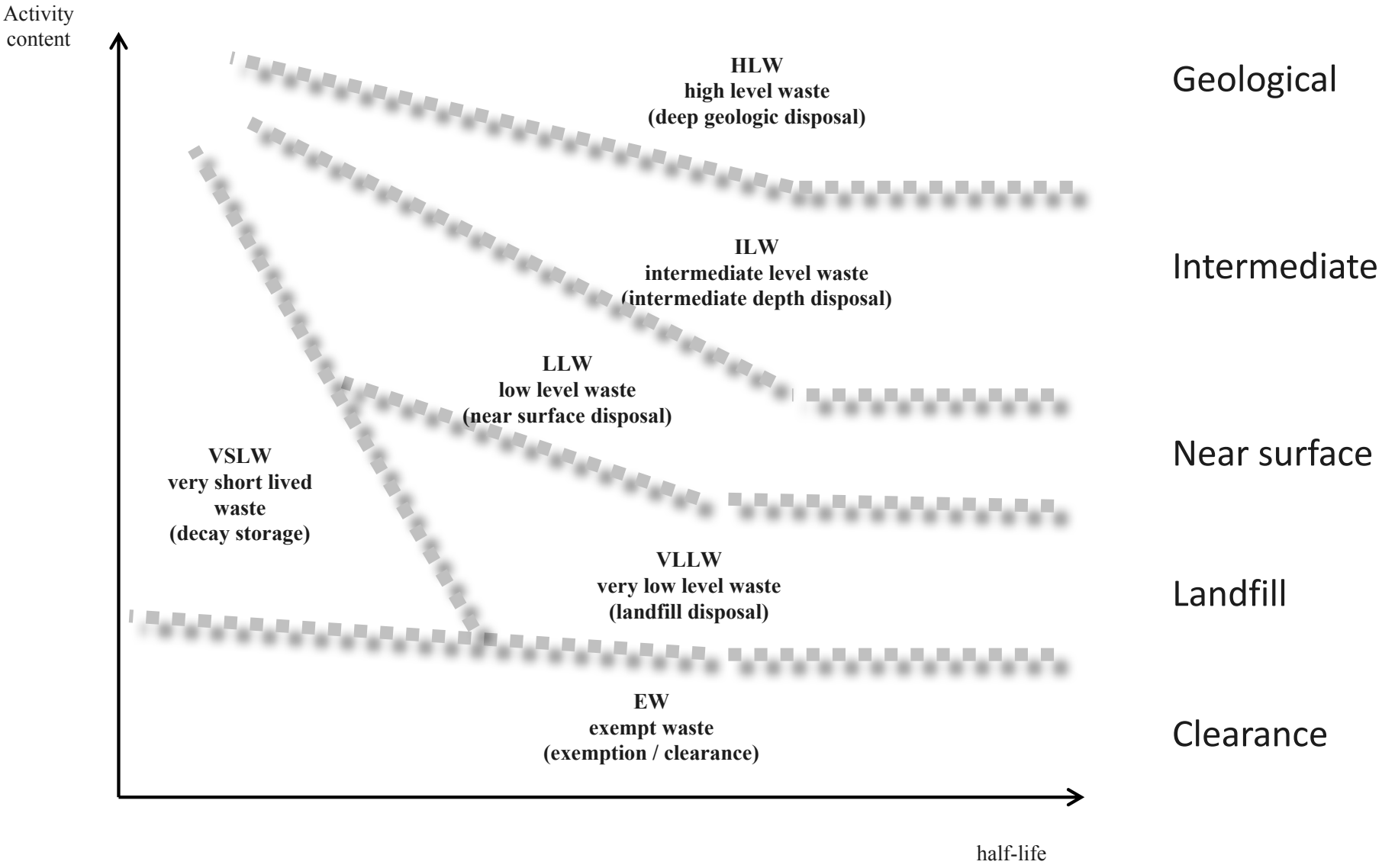
ICRP Workshop on
Surface Disposal of Radioactive Waste

The Celecton Fukushima
Monday, November 6, 2017

- Nature of waste suitable for near surface disposal
- Post closure safety considerations
- Transition from regulatory control

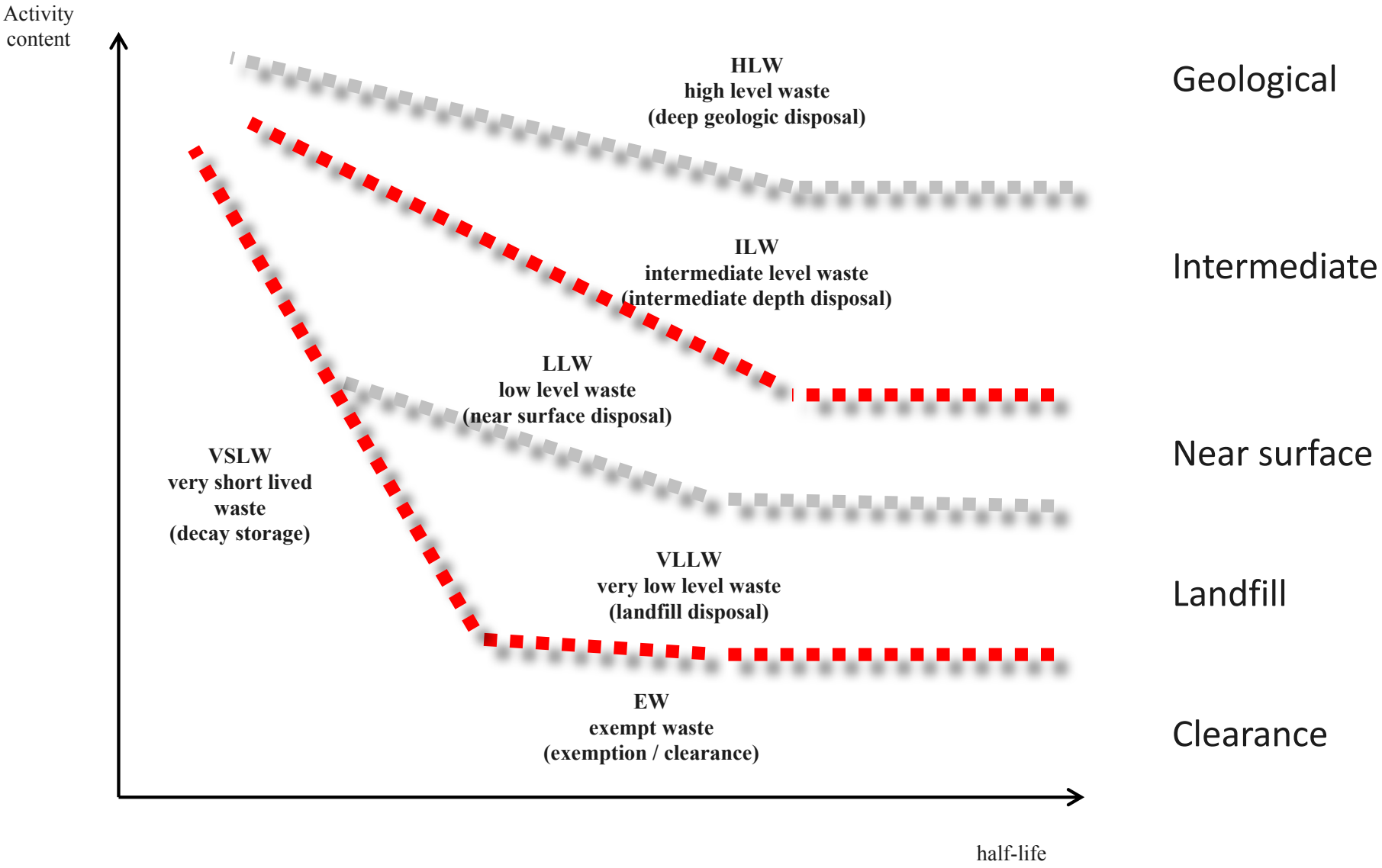

Activity content
HLW
high level waste
(deep geologic disposal)
ILW
intermediate level waste
(intermediate depth disposal)
LLW
low level waste
(near surface disposal)
VSLW
very short lived
waste
(decay storage)
VLLW
very low level waste
(landfill disposal)
EW
exempt waste
(exemption / clearance)
half-life
Geological
Intermediate
Near surface
Landfill
Clearance

- **Exempt waste** meets the criteria for clearance, exemption or exclusion from regulatory control for radiation protection purposes

- **Very short lived waste** can be stored for decay over a limited period of up to a few years and subsequently cleared purposes

- **Very low level waste** does not necessarily meet the criteria of EW, but that does not need a high level of containment and isolation and suitable for disposal in near surface landfill type facilities

- **Low level waste** is above clearance levels with limited amounts of long lived radionuclides ($T_{1/2}$ >30 years) - requires robust isolation and containment for periods of up to a few hundred years and is suitable for disposal in engineered near surface facilities. May include short lived radionuclides at higher levels of activity concentration, and also long lived radionuclides, but only at relatively low levels of activity concentration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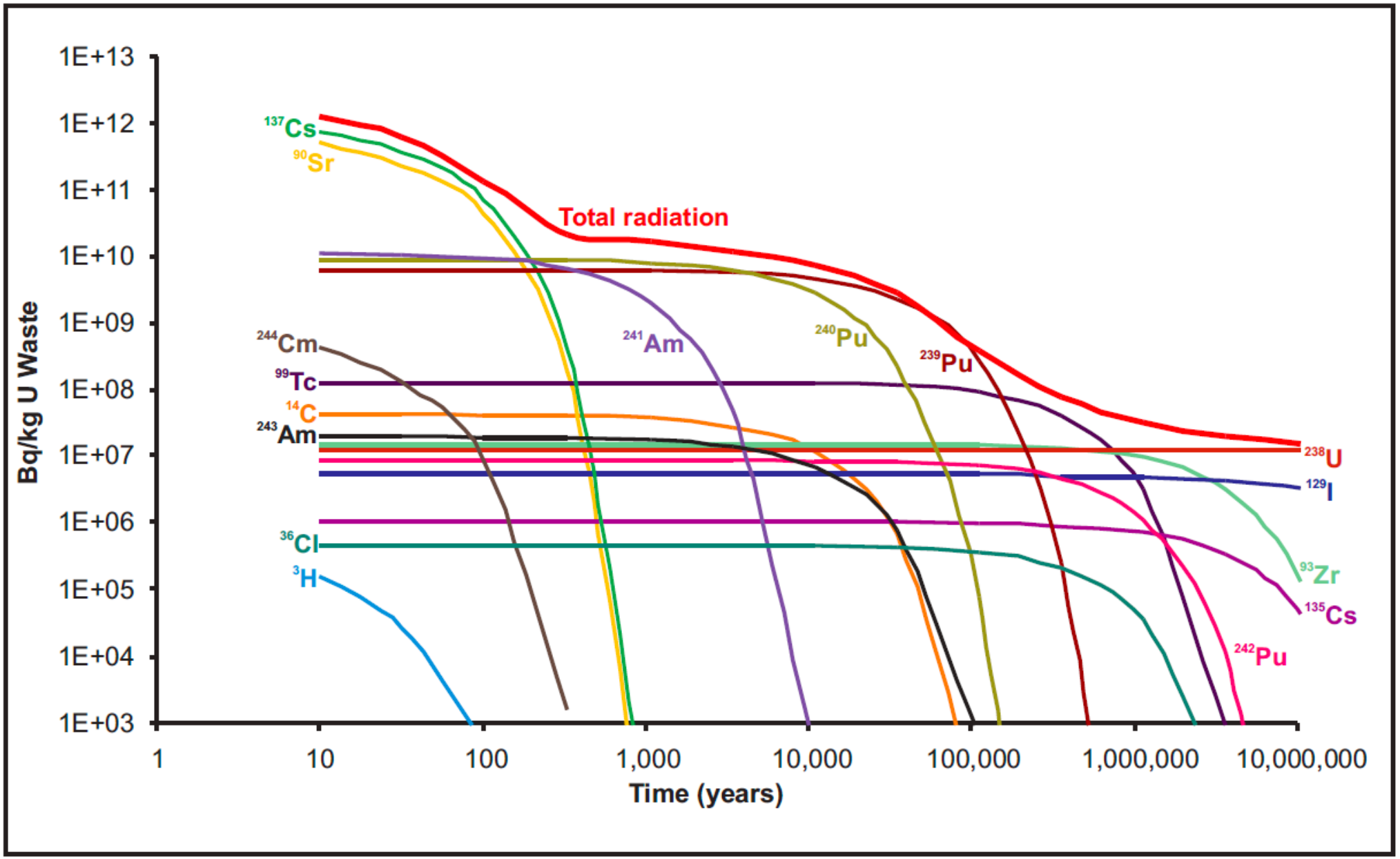
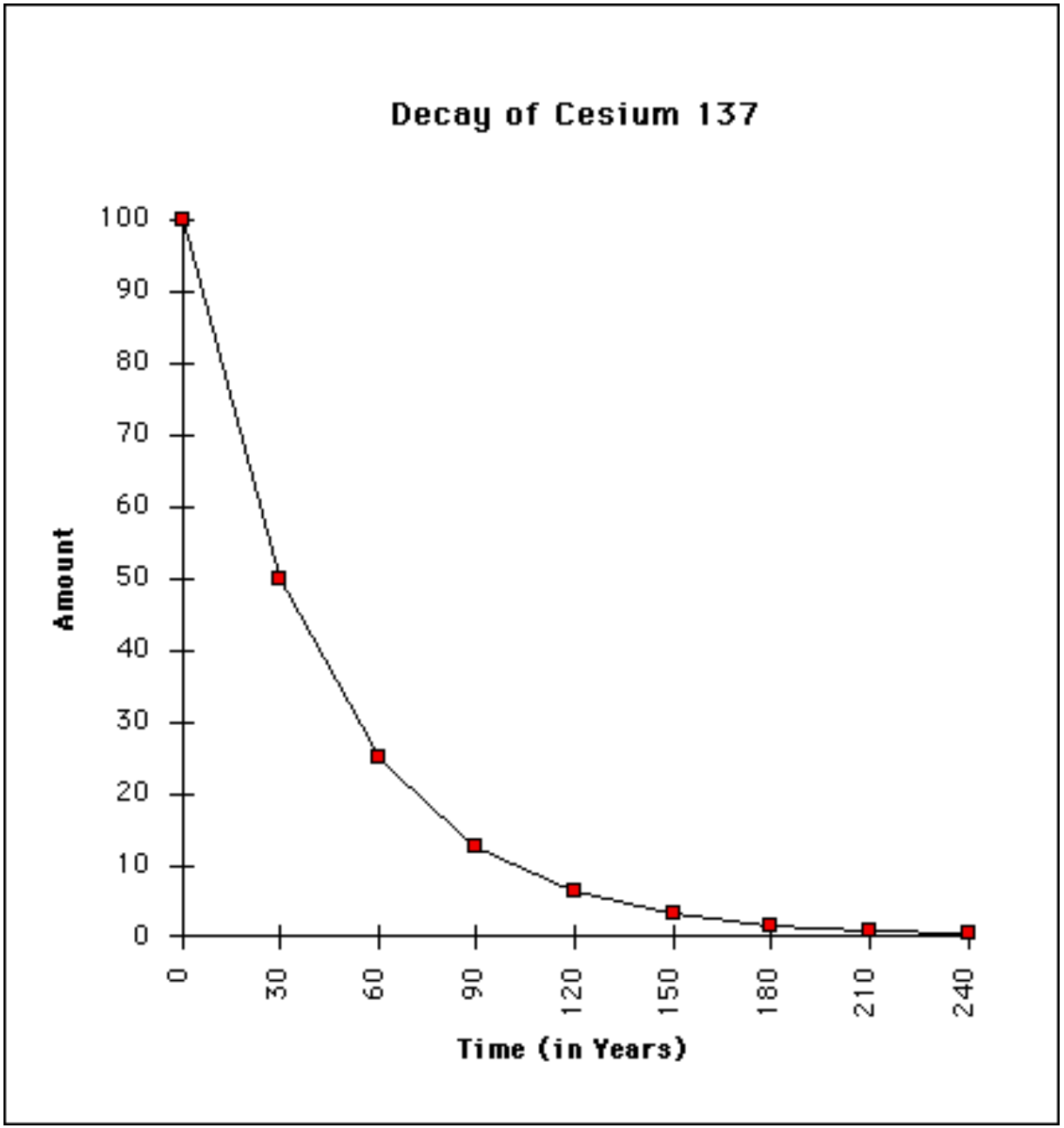

Bq/kg U Waste
1E+13
1E+12
1E+11
1E+10
1E+09
1E+08
1E+07
1E+06
1E+05
1E+04
1E+03
1
10
100
1,000
10,000
100,000
1,000,000
10,000,000
Time (years)
137Cs
90Sr
Total radiation
244Cm
241Am
240Pu
239Pu
99Tc
14C
243Am
238U
129I
36Cl
3H
93Zr
135Cs
242Pu


Decay of Cesium 137
Amount
100
90
80
70
60
50
40
30
20
10
0
0
30
60
90
120
150
180
210
240
Time (in Years)

- Nature of waste suitable for near surface disposal
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- Transition from regulatory control

Post closure safety considerations

- Public exposure from radionuclide migration
  - Optimisation
  - Prospective assessment showing dose and risk constraints respected by inventory restriction, site characteristics and facility design
- Possible exposure from potential human intrusion limited

Protection from exposures associated with human intrusion

- Imposing limits on the radionuclide content and distribution in the facility
- Efforts to reduce the possibility of intrusion events
  - Operational control
  - Post operational control
  - Avoiding valuable resources (mineral, water, agricultural/industrial/residential land)
  - Incorporating robust design features that make intrusion more difficult

Probability of inadvertent human intrusion cannot be determined as it is based on future human actions

Intrusion assumed to occur beyond period of control, but the radiological impact could not be severe due to limits on inventory

- Radiological impact of plausible stylised intrusion scenarios to be considered by decision makers to evaluate
  - Resilience of the disposal system to potential inadvertent intrusion
  - Acceptable level of residual activity in the disposal facility
- Because not possible to establish probability of inadvertent human intrusion considered prudent to assume intrusion will occur
- This corresponds to existing exposure situation and reference level for existing exposure situations of 20mSv recommended

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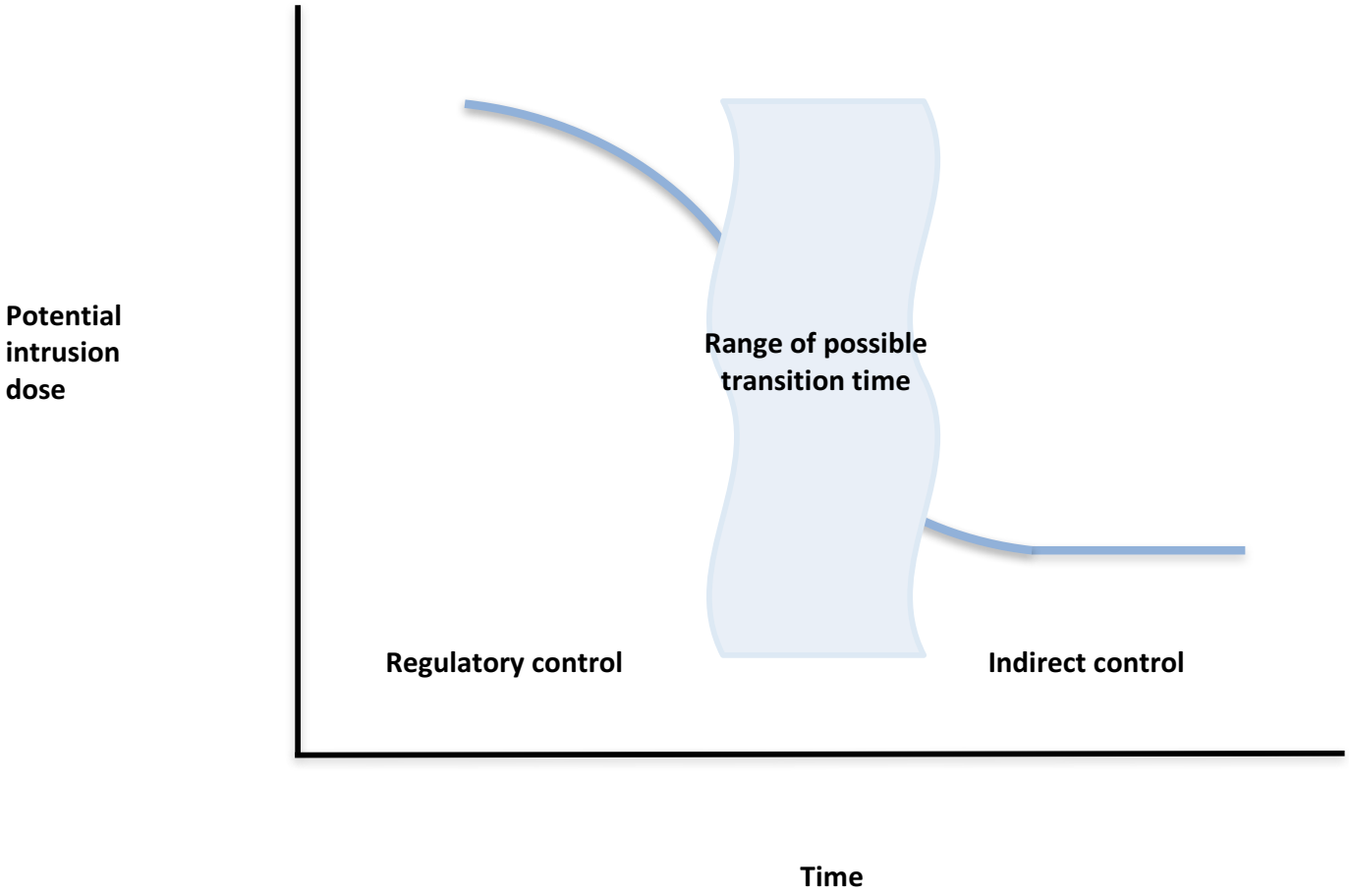
Potential intrusion dose
Range of possible transition time
Regulatory control
Indirect control
Time

	PRE-OPERATION	OPERATIONAL	POST-OPERATIONAL		
RADIOLOGICAL RISK	No waste on site	Inventory increasing compliant with WAC	- Full inventory - Decay decreasing intrusion dose	- Intrusion dose acceptable	Reduced
ACTORS	- Operator - Regulator - Stakeholders	- Operator - Regulator - Stakeholders	- Operator - Regulator - Stakeholders	- Local authority - Stakeholders	None
FACILITY CONTROL	Siting Design Construction	Licensed facility	Licensed facility	Local control	No control
PROTECTION MEASURES and TOOLS	- Design and siting requirements - Safety case WAC development - Licensing process	- Passive containment and isolation barriers - Site access control - Operational control e.g. WAC compliance - Nuclear regulation - Periodic safety case update	- Passive containment and isolation barriers - Site access control - Nuclear regulation - Periodic safety case update	- Passive containment and isolation barriers - Inventory reduced by decay - Land use restrictions	- Passive containment and isolation barriers - Inventory further reduced

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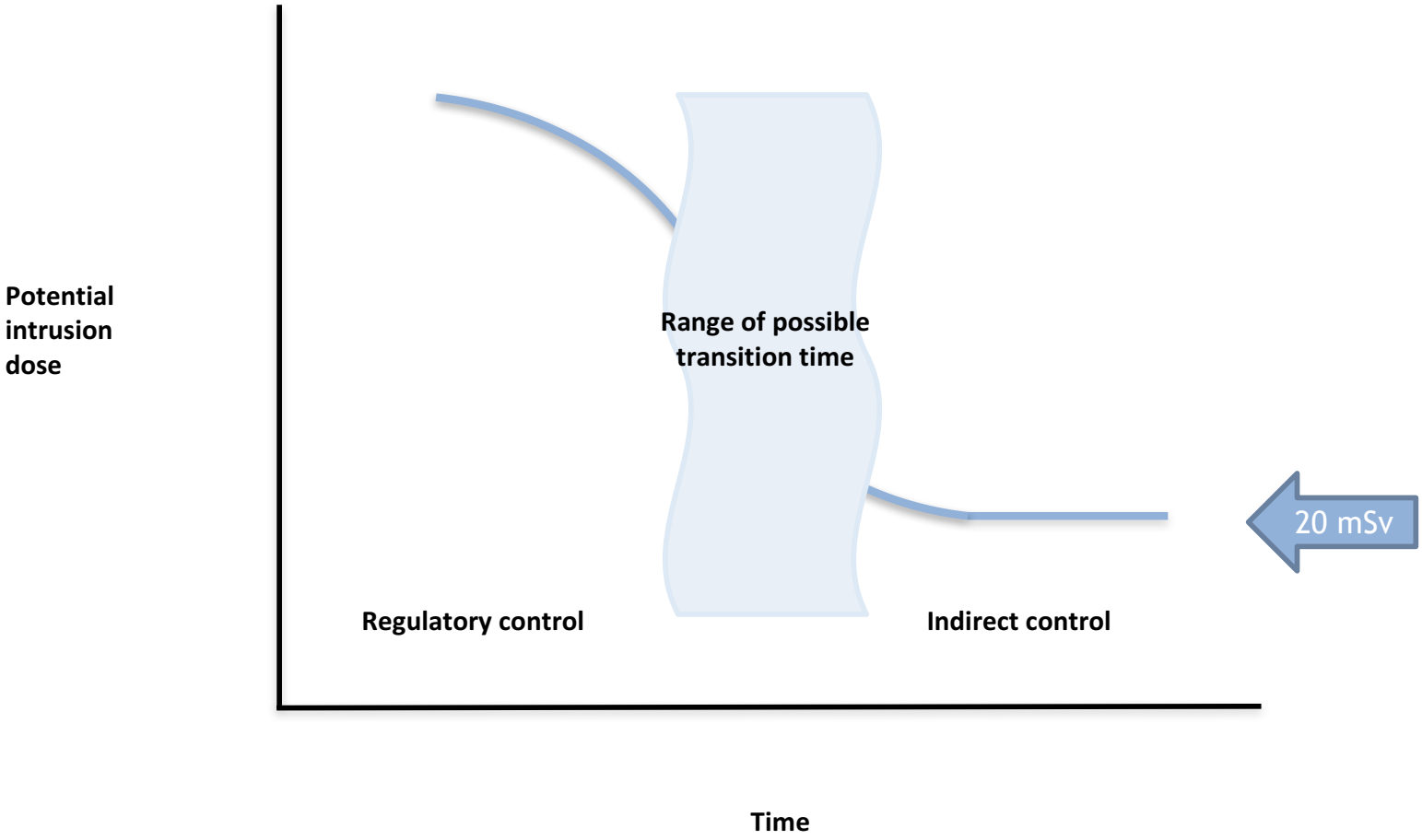
Potential intrusion dose
Range of possible transition time
20 mSv
Regulatory control
Indirect control
Time

- Decision to be made by regulator to remove control (licence termination) in consultation with stakeholders – local authorities and others
- Consideration of possible intrusion dose based on actual disposed inventory
- No reason to stop local control, but consequences acceptable