International survey on the classification of areas

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Study for ASN (2011) with the participation of the European ALARA Network and ISOE

ASN demand

- **Objectives:**
  - Establish **a synthesis of the RP rules regarding demarcation and access to controlled and supervised areas**
    - Belgium, Spain, USA, Finland, UK, Sweden, Switzerland
  - *Test the application of existing rules through ~12 case studies in the nuclear, non-nuclear (e.g. NDT) and medical sectors*

Process

- Analysis of the regulatory frameworks
  - Laws & Decrees
  - Specific Regulatory Guidances
  - Procedures (Technical Guidances)
- Sources:
  - Web
  - European ALARA Network (EAN) survey
  - ISOE survey
  - + Interviews (RP Authorities in the UK, Switzerland, Finland)

Regulatory frameworks

- Unique regulatory ‘cap-text’, not so much detailed (i.e. establishing general principles as they are stated in the Euratom Directives), valid for all sectors,
- Complementary regulatory guidance for each sector
- The controlled area is not often sub-divided, except in the nuclear sector
  - The sub-division of the controlled areas in the nuclear installations are fixed either by RP authorities (e.g. Spain, Finland, USA) or operators (e.g. Sweden)
  - Operators can opt for stricter rules than those fixed by Law
  - Usually, no subdivision of the controlled area in the medical sector (except. Spain, France)

General objective of the classification of areas

- Rarely explicit
- **Clear link with the dose limitation principle:** the area must be controlled if the dose limits could be exceeded (in specific circumstances)
  - Prevent or limit the probability and magnitude of radiation incidents and accidents (i.e. potential exposures)
  - Identification of areas that necessitate specific access & surveillance procedures

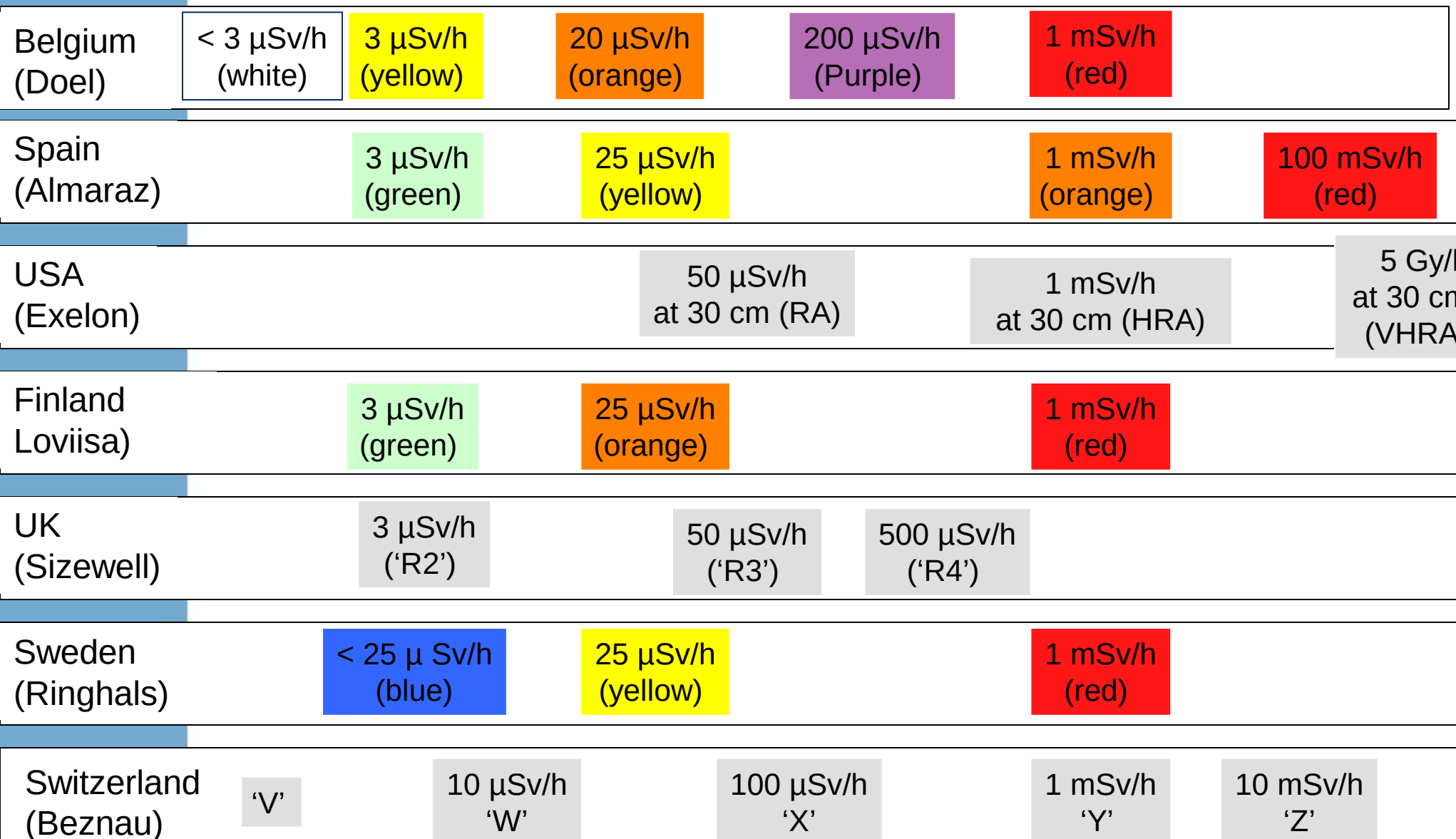
- **Tenuous link with the optimization principle (i.e. ALARA dose reduction in routine circumstances)**
  - UK: '*to help ensure that the measures provided are effective in preventing or restricting routine and potential exposures' (…) 'the area design requirements and access controls should always aim to keep exposures ALARP'*
  - Switzerland: « Limit and control exposures to radiations »

Criteria for the designation of areas (applied to all sectors)

CRITERIA	Belgium	Spain	USA	Finland	UK	Sweden	Switzerland
Potential Effective Dose	✓	✓		✓	✓	✓	✓
Potential Equivalent Dose	✓	✓	✓	✓	✓	✓	
Max. Dose rate	✓				✓		
Potential Absorbed Dose			✓				
Max. Air contamination			✓				✓
Max. Surfacic contamination							✓
Protective suits or equipment (whatever the risk level)		✓		✓	✓		

Conservative exposure scenarios (maximum dose rates, maximum occupancy rates of 250 d/y, 40 h/w., 8 h/d, etc)

Dose rate criteria used in the nuclear sector (NPPs)



Airborne activity criteria used in the nuclear sector (NPPs)

Belgium (Doel)	No criteria			
Spain (Almaraz)	AC < 0.1 DAC (green)	AC > 0.1 DAC (yellow)	AC > 1 DAC (orange)	AC >10 DAC (red)
USA (Exelon)	Airborne Radioactivity Area AC > 0.3 DAC			
Finland Loviisa)	AC ≤ 0,3 DAC (green)	AC > 0,3 DAC (orange)	AC ≥ 30 DAC (red)	
UK (Sizewell)	Contamination controlled area C3 *(other values for specific nuclides)* :	β : AC > 10 (min) - 40 (max) Bq/m^3 α : AC > 0,01 (min) - 0,04 (max) Bq/m^3		
Sweden (Ringhals)		AC < 1DAC (blue)	AC > 1 DAC (yellow)	AC > 10 DAC (red)
Switzerland (Beznau)	AC < 0.1 LV (with low probability) (Zone I yellow)	AC < 0.1 LV (Zone II yellow)	0.1 LV < AC < 10 Zone III (red)	AC > 10 LV Zone IV red)

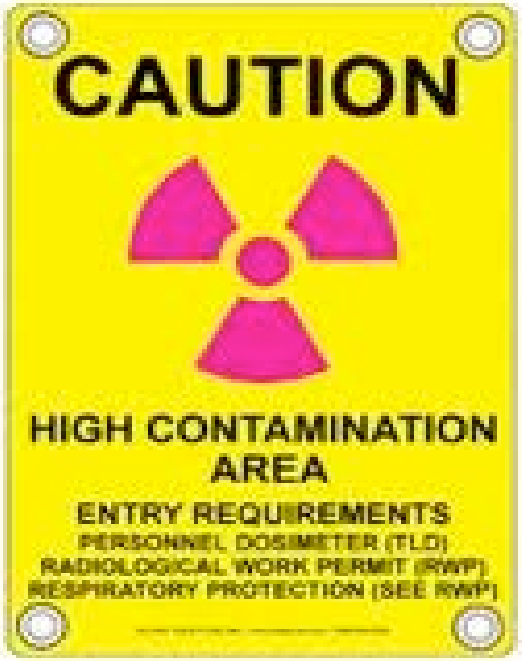
Surface contamination criteria used in the nuclear sector (NPPs)

Belgium (Doel)	β/γ ≤ 0.4 Bq/cm² (green)	β/γ > 0.4 Bq/cm² 3 sub areas : 0.4 - 4 / 4 – 40 / 40 – 400 (yellow)		β/γ ≥ 400 Bq/cm² (red)
Spain (Almaraz)	β/γ < 4 Bq/cm² α < 0.4 Bq/cm² (green)	β/γ < 40 Bq/cm² α < 4 Bq/cm² (yellow)	β/γ < 400 Bq/cm² α < 40 Bq/cm² (orange)	β/γ > 400 Bq/cm² α > 40 Bq/cm² (red)
USA (Exelon)	Contaminated Area		β/γ > 1000 dpm/100 cm2 α > 20 dpm/100cm2 alpha	
Finland Loviisa)	β/γ ≤ 4 Bq/cm² α ≤ 0.4 Bq/cm² (green)	β/γ < 40 Bq/cm² α < 4 Bq/cm² (orange)		β/γ > 40 Bq/cm² α > 4 Bq/cm² (red)
UK (Sizewell)	Contamination controlled area C2 *(other values for specific nuclides)* :		β/γ > 4 Bq/cm² α > 0.4 Bq/cm²	
Sweden (Ringhals)	β/γ < 40 kBq/m² α < 4 kBq/m² (blue)	β/γ < 1000 kBq/m² α < 100 kBq/m² (yellow)		β/γ > 1000 kBq/m² α > 100 kBq/m² (red)
Switzerland (Beznau)	SC < 1 LV (with low probability) (Zone I yellow)	AC < 10 LV (Zone II yellow)	SC < 100 LV Zone III (red)	SC > 100 LV Zone IV red)

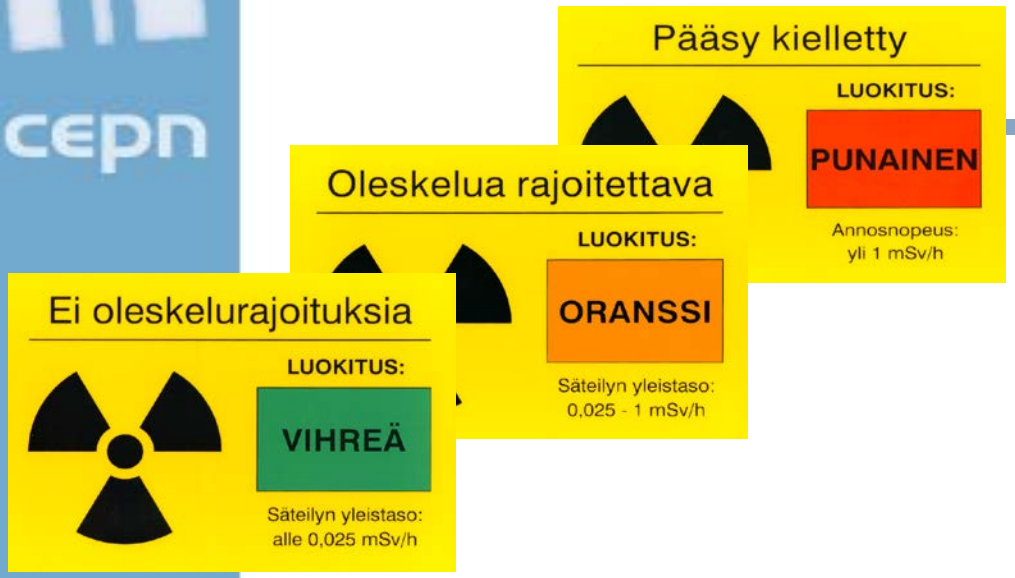
Signs in Spain

- Trefoils (4 colours)
- Risk of irradiation indicated with a ‘shining’ symbol
- Contamination indicated with a dotted background

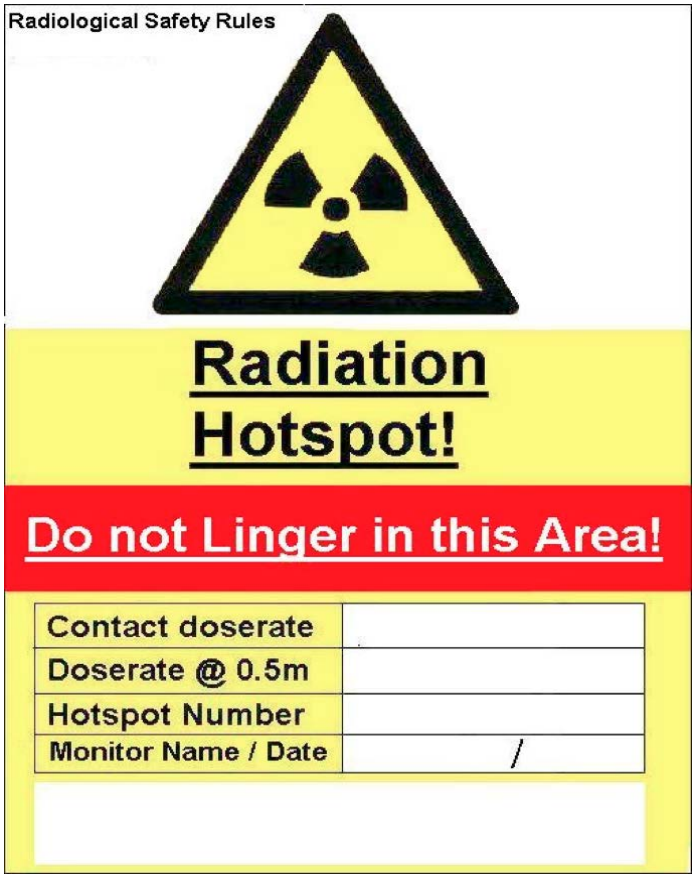
Signs in the USA



Signs in Finland



Signs in the UK



Conclusion

- Regulatory framework valid for all sectors
  - Main criterion is, most of the time, the potential effective dose (using a conservative approach)
  - Real dose assessment (ALARA procedure) at workplace is generally disconnected of the principles that steer the classification of area (≠ in France)
  - Other domain-specific criteria
- Non harmonization between countries, in terms of
  - Criteria (type, levels)
  - Designation of areas (colours, VWXYZ, R1/2/3…)
  - Signs, etc.
- This can be problematic for transient workers.
  - Training of new workers is particularly needed
  - It calls for harmonization (at least at the European level)