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# A Review of National Dose and Risk Criteria

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# The LTSC Initiative of the RWMC-RF:

- RWMC's Regulators' Forum formed in 1999
  - Comparative Study of Regulatory Structures
    - Included an initial comparison of long-term radiological protection criteria
  - Long-Term Safety Criteria Group formed to investigate in more detail
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# Information sources:

- ICRP-81(1999), IAEA WS-R-4(2006)
- National criteria based on information from the NEA RWMC Regulators' Forum



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# International recommendations - ICRP

- ICRP-81: 0.3 mSv/a dose constraint (risk on the order of  $10^{-5}/a$ )
    - Beyond a few hundred years, calculated doses are considered as performance indicators, not measures of health detriment
    - Quantitative calculations for  $10^3 - 10^4$  years, stylized or qualitative calculations further into the future
    - Note that with current dose/risk conversion factors,  $0.3 \text{ mSv/a} \sim 2 \times 10^{-5}/a$  risk
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# International recommendations - IAEA

- WS-R-4: 0.3 mSv/a dose constraint, on the order of  $10^{-5}$ /a risk constraint
    - On long time scales the criteria may no longer serve as a reasonable basis for decision making
    - Criteria = targets rather than limits in the long term
    - Appendix suggests comparison with natural background at very long time scales ( $10^6$  yr)
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# National Criteria(1)

- Belgium: 0.1-0.3 mSv/a (high probability),  $10^{-5}/a$  risk (low p) (interim working values)
  - Canada: 0.3 mSv/a (interim working value), timescales guidance under development
  - Czech Republic: 0.25 mSv/a for  $10^6$  yr,  $10^{-6}/a$  probability cutoff
  - Finland: 0.1 mSv/a for several thousand yr, equivalent risk for unlikely events
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## National Criteria(2)

- France: 0.25 mSv/a for  $10^4$  yr, **target** later
  - Germany: 0.1 mSv/a for  $10^6$  yr; dose targets for different classes of likelihood (under revision)
  - Hungary: 0.1 mSv/a,  $10^{-5}$ /a risk for disruptive events,  $10^{-7}$ /a probability cutoff
  - Rep. of Korea: 0.1 mSv/a, 1 mSv for intrusion,  $10^{-6}$ /a risk for disruptive events (under development)
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## National Criteria(3)

- Netherlands: 0.1 mSv/a limit (**target** of 0.04 mSv/a), normal evolution
  - Slovakia: 0.1 mSv/a, 1 mSv/a for intrusion (under development)
  - Spain: 0.1 mSv/a,  $10^{-6}$ /a risk for low probability (under revision)
  - Sweden:  $10^{-6}$ /a risk (0.014 mSv/a) for 1000 y, general consideration of scenarios after that
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# National Criteria(4)

- Switzerland: 0.1 mSv/a,  $10^{-6}$ /a risk for low probability, applied at all times
  - UK:  $10^{-6}$ /a risk **target** at all times, dose constraint of 0.3 mSv/a before withdrawal of control
  - USA: 0.15 mSv/a for  $10^4$  yr, (proposed) 3.5 mSv/a up to  $10^6$  yr (both apply to human intrusion as well as normal evolution)
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# Bases for Criteria (Implied or Explicit)

- ICRP 0.3 mSv/a dose constraint based on radiation protection arguments, often reduced (e.g. to 0.1 mSv/a)
- Absolute risk arguments (e.g. from  $10^{-4}/a$  barely tolerable to  $10^{-6}/a$  broadly acceptable level)
- Arguments based on natural background ( $\sim 3$  mSv/a) or on variability of background

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# Supplementary Criteria

- Dose for normal scenarios, risk for low likelihood (e.g. Finland, Spain, Switzerland)
  - Radionuclide fluxes (Finland at long time scales)
  - Quantitative assessments at long time scales or for low-probability events (e.g. Sweden)
  - Optimization (ALARP) approach (e.g. UK, France at long time scales)
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# Design-based criteria and BAT

- Covered only incidentally in the questionnaire, may include:
    - engineering design requirements
    - complete containment for several 100's of years
    - restrictions on predicted release rates
    - restrictions on the geology
    - BAT or BAT(neec) (Ref EC IPPC Directive)
    - Optimization applied not to calculated doses/risks as in ALARP, but to parameters more directly related to design
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# Treatment of Uncertainties

- Probabilistic, e.g. low-likelihood scenarios
    - e.g. risk criterion replaces dose for low-likelihood events
    - dose limits varying with class of likelihood (normal vs. disruptive, or more detailed classification)
  - Parameter uncertainties
    - e.g. sensitivity analysis, probabilistic analysis
  - Uncertainties inherent in long time scales
    - e.g. unknown characteristics of the receiving population, geological uncertainties, performance modelling uncertainties
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# Other Sources of Differences

- Modelling strategies
    - choice of parameters (design centre vs. conservative, etc.)
    - choice of critical group (or most exposed individual)
    - choice of analysis scenarios
  - Differences of interpretation
    - use of hard limits vs. targets
    - allowances for judgment, application of other lines of reasoning
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# What does it mean?

- Are the readily observed differences in criteria correlated with differences in the actual level of protection?
    - No way of knowing – other uncertainties and differences dominate
    - There is a large national cultural component
    - Comparison with experience in environmental protection
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# Some possibilities for further investigation:

## ■ Ethical questions:

- ❑ Level of protection for distant future – constant or varying? constant duty but varying ability to guarantee?
- ❑ Transfer of burdens, responsibilities and resources to near-future generations

## ■ Socio-political questions:

- ❑ Decision-making in the broad sense vs. regulation
  - ❑ Importance of national culture vs. international standards
  - ❑ Investigation of fundamental protection goals
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# Some possibilities for further investigation:

- Technical questions:
    - Harmonization of limits/constraints?
    - Compliance criteria for distant future?
  - “Complementary” criteria (not dose- or risk-based)
    - BAT?
    - Technical performance criteria (concentrations, fluxes)?
    - Design standards?
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