A Review of National Dose and Risk Criteria

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R. Ferch

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

Information sources:

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

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 mSv/a ~ 2×10^{-5}/a risk

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)

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

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)

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

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)

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 (~3 mSv/a) or on variability of background

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)

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

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

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

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

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

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?