Integrating Science and Society
- Lessons from Low Level Waste Regulations -

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CONTENTS

- INTRODUCTION
  - Integration of Science and Society in setting safety regulations
- Case Study of LLW regulation in Japan and the US
  - International standards
  - Japanese approach (dealing with probability)
  - US approach (EPA vs NRC)
- Lessons for Nanotechnology

Integration of science and society (1)

- Safety regulations are assumed to be “science-based”
  - Harmonization of safety regulations should be proceeded based on scientific evidence
- But, in reality, there are significant differences in safety regulations worldwide
  - Recommendations by international organizations are used as a reference
  - Each country (or each agency) may have different approaches to reach different regulations

WHY??

Integration of science and society (2)

Why regulations differ?

- Uncertainty in science
  - Risk assessment of low level exposure
  - Disagreements among scientists
- Social, cultural, political contexts in setting regulations
  - Risk assessment based on human behavior
  - Bureaucracy, legal/political system, risk perception

Low Level Radioactive Waste (LLW) regulations (1)

- “Clearance Level” regulation
  - 1000 MWe nuclear power plant produces about 500,000 tons of waste
  - Only about 6,000 tons (~1.2%) is believed to be treated as LLW, and the rest can be treated as regular industrial waste
  - How to draw the line between LLW and regular waste?
  - “Clearance level” determines such line

Low Level Radioactive Waste (LLW) regulations (2)

- International Atomic Energy Agency (IAEA) provides international guideline
  - "TECDOC-85" (1996) specifies "basic safety standards [BSS]"
  - It defines "criteria" to define "trivial" radiation level which poses "negligible" risk
  - Based on increased cancer risk of one per million (10-6)/year – this translates to **100 μ Sv/y** (compared to **1,000 μ Sv/y** for individual radiation allowance recommended by ICRP
  - TECDOC-85 recommends **10 μ Sv/y** as clearance level criteria
  - Later re-evaluated and issued as RS-G-1.7 (2004)

Clearance Level in Japan

Japan's "clearance level" regulations

- Based on IAEA **10 μ Sv/y** criteria
- Exposure estimates are based on "deterministic model" (no probability assignment) using "food-chain scenarios" developed for Japanese lifestyle
- As a result, JAEC's clearance level numbers differ significantly from those recommended by IAEA
- In 2004, JAEC reevaluate exposure estimates using new IAEA guideline(RS-G-1.7)

Clearance Level Regulations: IAEA vs Japan

		Clearance Level (Bq/g)	
	RS-G-1.7	Japan (2004)	Japan (1999)
H-3	100	60	200
C-14	1	4	5
Mn-54	0.1	2	1
Co-60	0.1	0.3	0.4
Sr-90	1	0.9	1
Ni-63	100	100	1900

Source: Japan Nuclear Safety Commission (2004)

Clearance Level in the US(1)

US Clearance Level Regulations

- There are three regulatory agencies (NRC. DOE and EPA) responsible for clearance level regulations
- All agencies refer IAEA TECDOC as a reference, but use different approaches and regulatory philosophies to calculate “clearance level.”

Clearance Level in the US(2)

- NRC (Nuclear Regulatory Commission)
  - Defines “Below Regulatory Concern (BRC)” level
  - Based on “ALARA” (as low as reasonable achievable) concept to set safety standards
- EPA (Environmental Protection Agency)
  - Responsible for waste regulations
  - Uses “risk-based standards” using best available technology
  - EPA uses linear non-threshold risk modes and sets upper bound of risks as 10-4 to 10-6 cancer deaths/y.

Clearance Level in the US(3)

- DOE (Department of Energy)
  - Finds uses for “recycled radiologically contaminated metals”
  - Needs to set reference models to determine safety level of recycled metals
  - Issued DOE Order5400.5 based on ALARA principles, but also requires *“cost comparison of options*” (which is implicitly included in both NRC and EPA regulations, but not in Japan)

Clearance Level in the US(4)

- NRC 10 CFR50.2 (decommissioning regulations)
  - Defines “unrestricted use” concept (i.e. clearance level)~ **250 μ Sv/yr**
  - Based on dose-based calculations and ALARA methodology
- EPA
  - Clean Water Act already has **40 μ Sv/y** standards
  - For clearance level, it recommends **150 μ Sv/yr** which corresponds to 3x10-4 increased cancer deaths
  - NRC’s **250 μ Sv/y** standards would lead to 5x10-4 cancer deaths using EPA methodology
- NRC and EPA has Memorandum of Understanding to cooperate each other to reach consensus, but so far no conclusions have been reached

Convergence or Divergence? - Other example-

- Food Irradiation regulation
  - Allowed only when it is judged “safe” (regulated as “food additives”)
  - Now, it is allowed in many countries as a measure to enhance food safety
  - CODEX (international expert panel which recommends food safety standards) states that “food irradiation does not pose significant risk compared with other food safety measures”
  - Food irradiation is not still allowed in Japan (except potato which was allowed in 1970s)

Lessons Learned

- Setting safety regulations for low-level exposure risks is not clear-cut practice
  - Even science-based regulation does not eliminate uncertainty
- International standards are very helpful, but not necessarily lead to universal standards
- Social, political, and cultural factors are embedded in setting safety regulations

Key Questions

- How to deal with uncertainty in assessing the risk?
- How much ‘safety margin’ do we want?
- What is the acceptable risk to the public?
- How should we consider trade-off of different risks, cost/benefit?

These questions inevitably involves non-technical expertise and public input.