

Developing a Strategy for Effective Management of NORM

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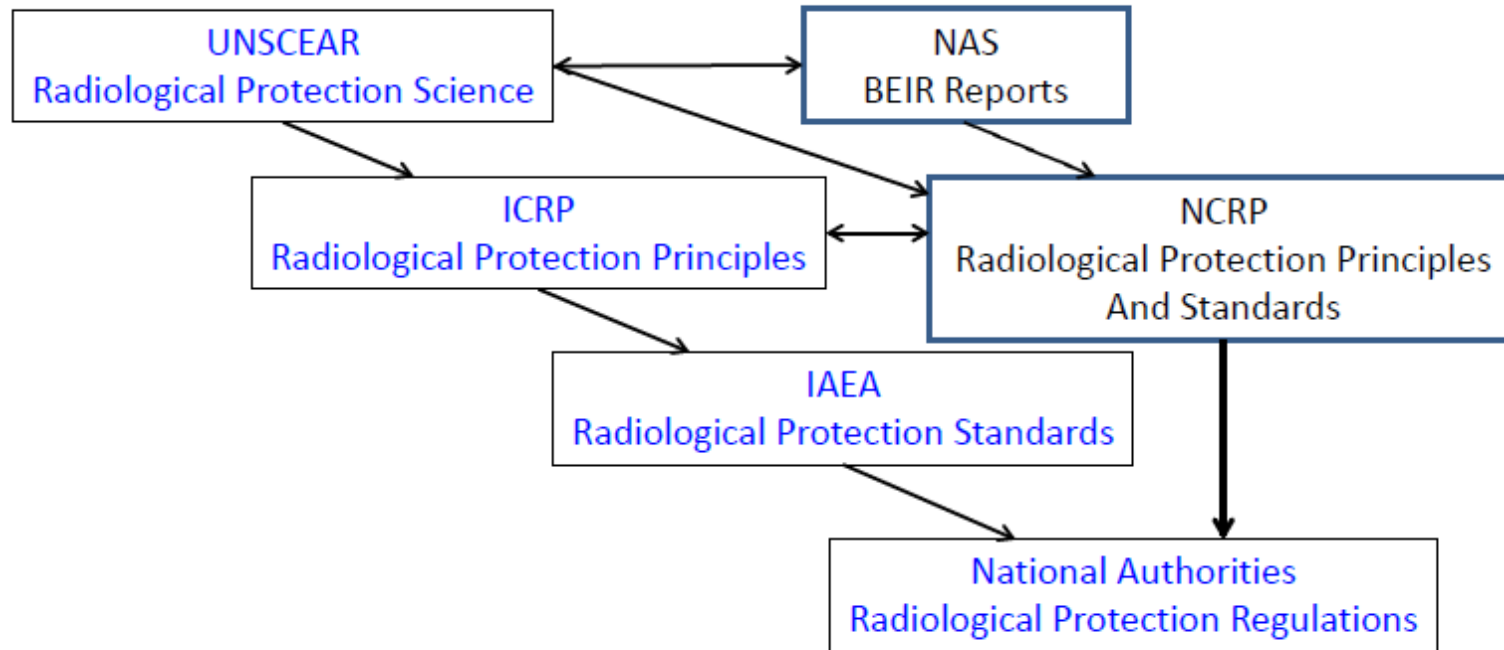


Disclaimer

- Usual disclaimers apply.
- This presentation does not represent the policy or position of the EPA, ICRP, IAEA, NCRP, CRCPD, HPS, or any other organization I am affiliated with through employment or as a volunteer.
- It is my opinion only. I am not a lawyer.
- The intent is to engage in meaningful exchange of ideas with interested parties on the application of radiation protection principles to naturally occurring radioactivity.



Hierarchy of organizations



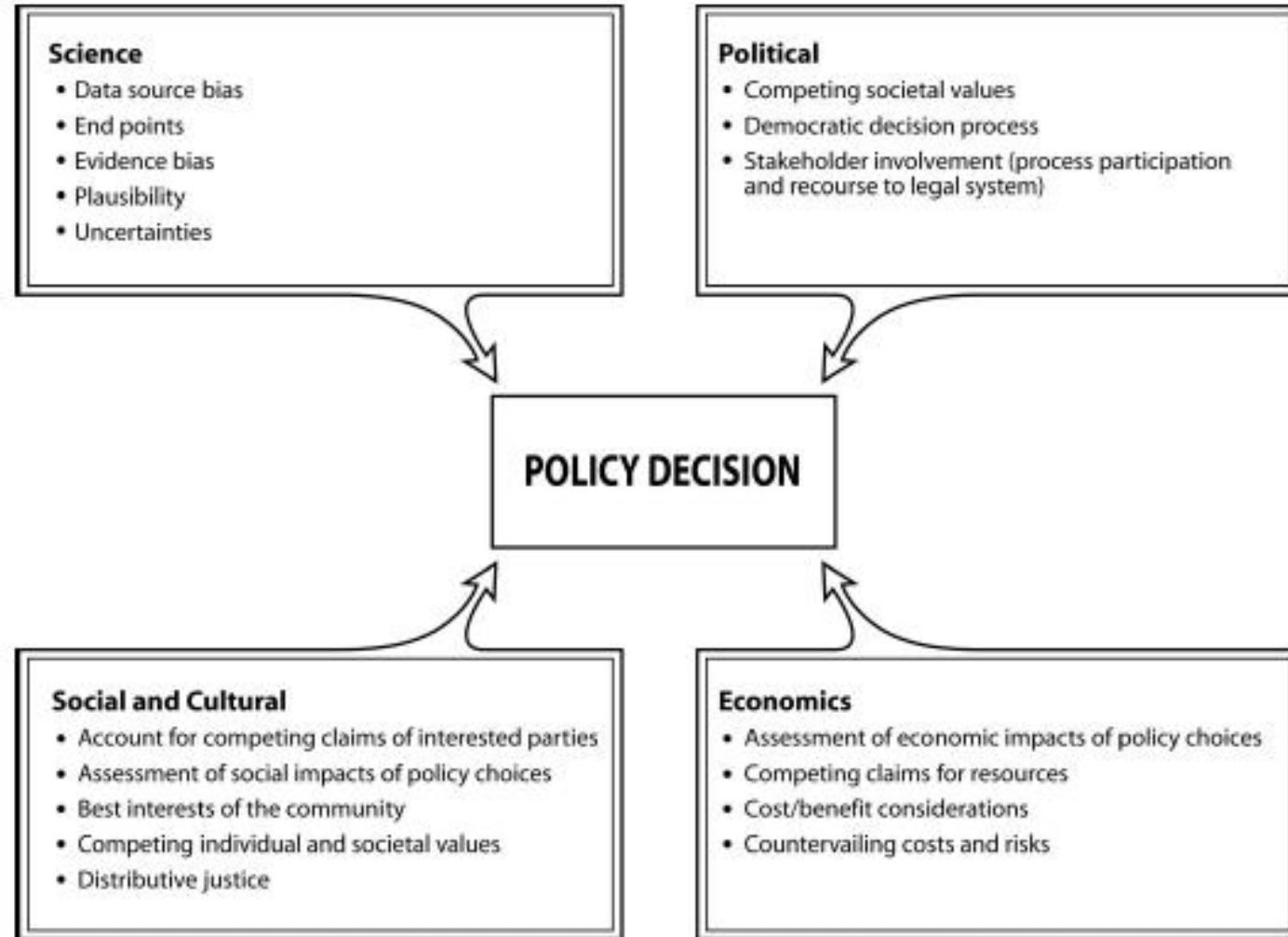
Source: Lazo 2015/NEA

Science forms the basis for recommendations

- UNSCEAR
- ICRP
- IAEA
- NAS
- NCRP
- ISCORS
- Federal Agencies
- Tribes
- CRCPD
- States



Policy is Not Based on Science Alone



US Constitution: Amendment X

- The powers not delegated to the United States by the Constitution, nor prohibited by it to the states, are reserved to the states respectively, or to the people.
- NORM (and machine-generated radiation) is not specifically reserved to the Federal Government
- However, authority to regulate carcinogens is granted to EPA under a variety of statutes.
 - Radioactivity is a known human carcinogen, and as such is regulated under specific instances.



Hierarchy

- Congress makes federal laws
- Federal law overrides State law
- Federal authority under some statutes delegated to States for implementation
 - State has police powers to protect health and safety
 - State laws that interfere with or are contrary to Federal law are invalid
- BUT: State law can go beyond Federal law if not contrary.
- States can step in and regulate TENORM



Some examples of regulated NORM

- Safe Drinking Water Act
 - Maximum Contaminant Levels for drinking water (40 CFR Part 141). Uranium, radium (combined), gross alpha/beta
- Clean Water Act (40 CFR Part 440, Subpart C)
 - Surface runoff standards for uranium and radium at mines and mills
 - NORM not traditionally addressed in discharge permits.
 - Current example: leachate from landfills that accept NORM
- Clean Air Act
 - National Emissions Standards for Hazardous Air Pollutants (40 CFR Part 61):
 - Underground uranium mines
 - Phosphogypsum stacks
 - Elemental phosphorous production
 - No NESHAP for oil and gas or coal combustion (1987 analysis/decision)



New Guidance for U.S. NCRP Report 180 (December 31, 2018)

- Adopts the ICRP ethical principles
- Five categories of ionizing radiation exposure are: occupational, public, medical, emergency worker, and nonhuman biota.
- NCRP continues to recommend a negligible individual dose of 0.01 mSv (1 mrem) annual effective dose per source or practice as a guide for evaluating when efforts to reduce further the dose to an individual may not be warranted.
- Commercial airline crews, as well as pilots of cargo and corporate aircraft are occupationally exposed.

NCRP REPORT No. 180

MANAGEMENT OF EXPOSURE TO
IONIZING RADIATION: RADIATION
PROTECTION GUIDANCE FOR THE
UNITED STATES (2018)



National Council on Radiation Protection and Measurements



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NCRP Report 180 - NORM/TENORM

- [NORM-generating] industrial processes should be examined for the possible presence of radioactive material, and an assessment made of concentrations and exposures. [Assessment, Inventory]
- If necessary, actions should be taken to manage and properly dispose of waste streams that contain radioactive material, to prevent exposure and possible environmental damage.
- The numeric protection criterion to manage dose to an individual for occupational exposure applies.
- NCRP recommends that the contribution of radon should be included in an individual's annual occupational effective dose if the activity concentration in air in the workplace (after the application of radon mitigation measures) remains above 300 Bq m^3 (8 pCi/L).
- NCRP recommends that the annual effective dose to a member of the public from the continuous or reasonably anticipated presence of a source should not exceed 1 mSv (100 mrem).



NCRP Report 180 - NORM/TENORM

- NCRP recommends that the:
 - **effective dose for a member of the public should not exceed 20 mSv (2 rem) in the first year following identification of an exposure situation that was not previously subject to control.**
 - annual effective dose for a member of the public for later years should be further reduced based on evaluation of the current circumstances and application of optimization of protection.
 - radon levels in dwellings and workplaces should be assessed and mitigation measures be taken and continued, as appropriate, applying optimization of protection to reduce the activity concentration in air of radon in dwellings and workplaces to $<300 \text{ Bq m}^3$ (8 pCi/L.)



NCRP Report 180

It's Linear (for Radiation Protection Purposes)

“Recognizing the great variability of biological processes, and the considerable uncertainty in estimates of stochastic effects at low absorbed doses and low absorbed-dose rates, **the recommendations continue to apply a simplifying and prudent assumption of approximate linearity of the dose and effect relationship** for stochastic effects (particularly cancer) for purposes of implementing the system of radiation protection.”



U.S. EPA Definition - TENORM

- TENORM: technologically enhanced NORM – NORM materials that have been concentrated **or exposed to the accessible environment** as a result of human activities such as manufacturing, mineral extraction, or water processing.
- “Technologically enhanced” means that the radiological, physical, and chemical properties of the radioactive material have been altered by having been processed, or beneficiated, **or disturbed in a way that increases the potential for human and/or environmental exposures**
 - Source: EPA 2008



Uranium Recovery Regulated Separate from NORM in the U.S.

- IAEA considers uranium recovery as part of identified NORM industries
- The US regulates uranium recovery as a planned exposure
- Uranium Recovery residuals are captured by the Atomic Energy Act (AEA) since 1978 to ensure proper management
 - AEA only addresses source (ore), byproduct (U/Th mill tailings) or special nuclear material (enriched).
 - Disposal options limited by regulation
 - Does not capture X-Rays or NORM or TENORM
- DOE regulates their TENORM under Order 458.1



Pedigree Matters

- Uranium, thorium, radium, lead and polonium (among others) **can be** regulated under the AEA and **not be** regulated under the Act, **depending on pedigree.**
- Example. From the same ore:
 - Uranium mill tailings – AEA
 - Vanadium or radium tailings – Non-AEA
- Authority for non-AEA materials [NORM] primarily falls to the states
 - Often regulated as solid waste for purposes of disposal



Various Approaches...

- AEA requirements are strict with respect to control and exposure to radioactive materials
 - Licensing/Inspection - Planned Situation
 - Requirements for possession of radioactive material
 - Adequate training, resources, and need for material
 - Liability
- Not the same with NORM...
 - Unintended – Existing Situation
 - Established industries can be treated as planned exposure
 - Relatively limited oversight,
 - Some residuals are low activity, but high-volume
 - Some residuals are significantly concentrated
 - Various state regulations, but not comprehensive or consistent
 - Can still be significant liability...



States Acting on Disposal Options

- Disposal of NORM in solid waste or hazardous waste facilities is being permitted by states
 - Current proposed regulations (MT, ND) is for 1.85 Bq/g (50 pCi/g) combined radium
 - Discharge of leachate is of concern
- Downhole disposal of oil and gas liquids primary means of disposal
 - Reuse and recycling of drilling fluids
 - Proposals to treat and discharge produced water being considered for the western US
- Produced water from unconventional wells no longer allowed to go to wastewater treatment plants under the Clean Water Act
- EPA recent promulgated solid waste regulations for management and disposal of coal combustion residuals.
 - States are setting up the programs
 - Regulations are under review



Continued Participation

- Collaborative efforts to update and expand guidance are useful.
 - NRC is examining NORM from fracking.
 - CRCPD is updating its regulatory “model” for NORM, taking account of current technical information.
 - The ICRP is developing a report on how the ICRP-103 framework can be applied in the context of NORM.
 - IAEA has a number of useful technical guidance documents (often industry-specific) and encourages information sharing through meetings and conferences.



Strategy

- More research is needed to understand the scope and risks of TENORM.
 - In the U.S. especially, the increase in unconventional oil and gas production-generates significant interest and motivation. The challenge is to ensure that radiation is appropriately addressed in studies.
- Such efforts need to account for national contexts, as always. In the U.S.,
 - States will likely continue to take the lead in any regulation.
 - National regulatory action is possible on specific TENORM-related topics (e.g., coal ash).
 - Greater coordination and broader guidance on TENORM can encourage consistency and good practices.

