USDOE Regulatory Approach – Low Level Waste Classification

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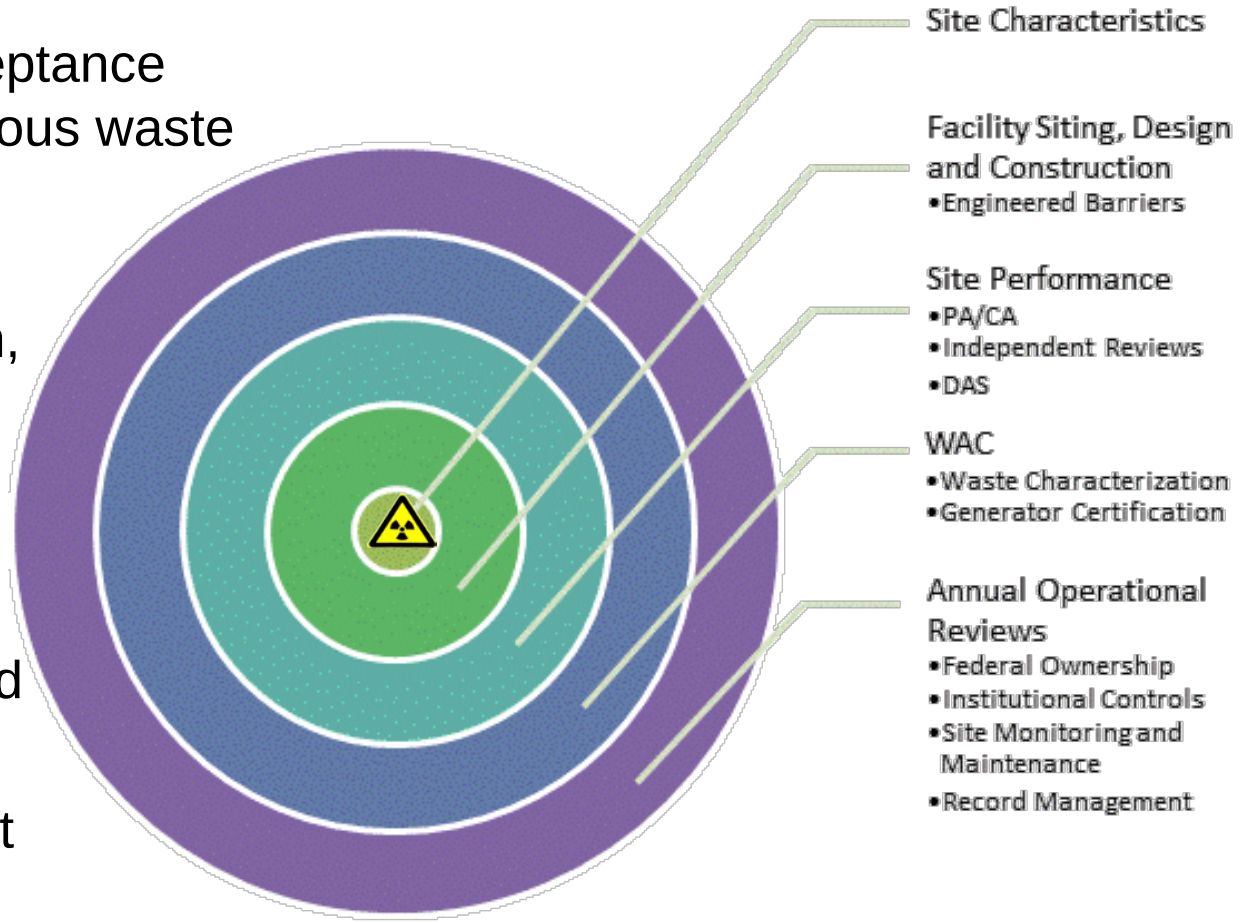
USDOE LLW Regulatory System

- USDOE has used a risk-informed, performance-based regulatory approach for more than 25 years.
- Regulations are prescribed through two primary directives: DOE Order 435.1 (Radioactive Waste Management) and DOE Order 458.1 (Radiation Protection of the Public and Environment)
- Radioactive waste is classified as High-Level Waste, Transuranic Waste, and Low-Level Waste. LLW is any waste that is not HLW or TRU. Does not include Uranium or Thorium mill tailings.
- Waste disposal is implemented from an integrated protection system perspective using defense-in-depth principles
- Each potential disposal facility is evaluated as a total system considering natural and engineered barriers to identify the types and volumes of waste that can be disposed (Waste Acceptance Criteria (WAC))

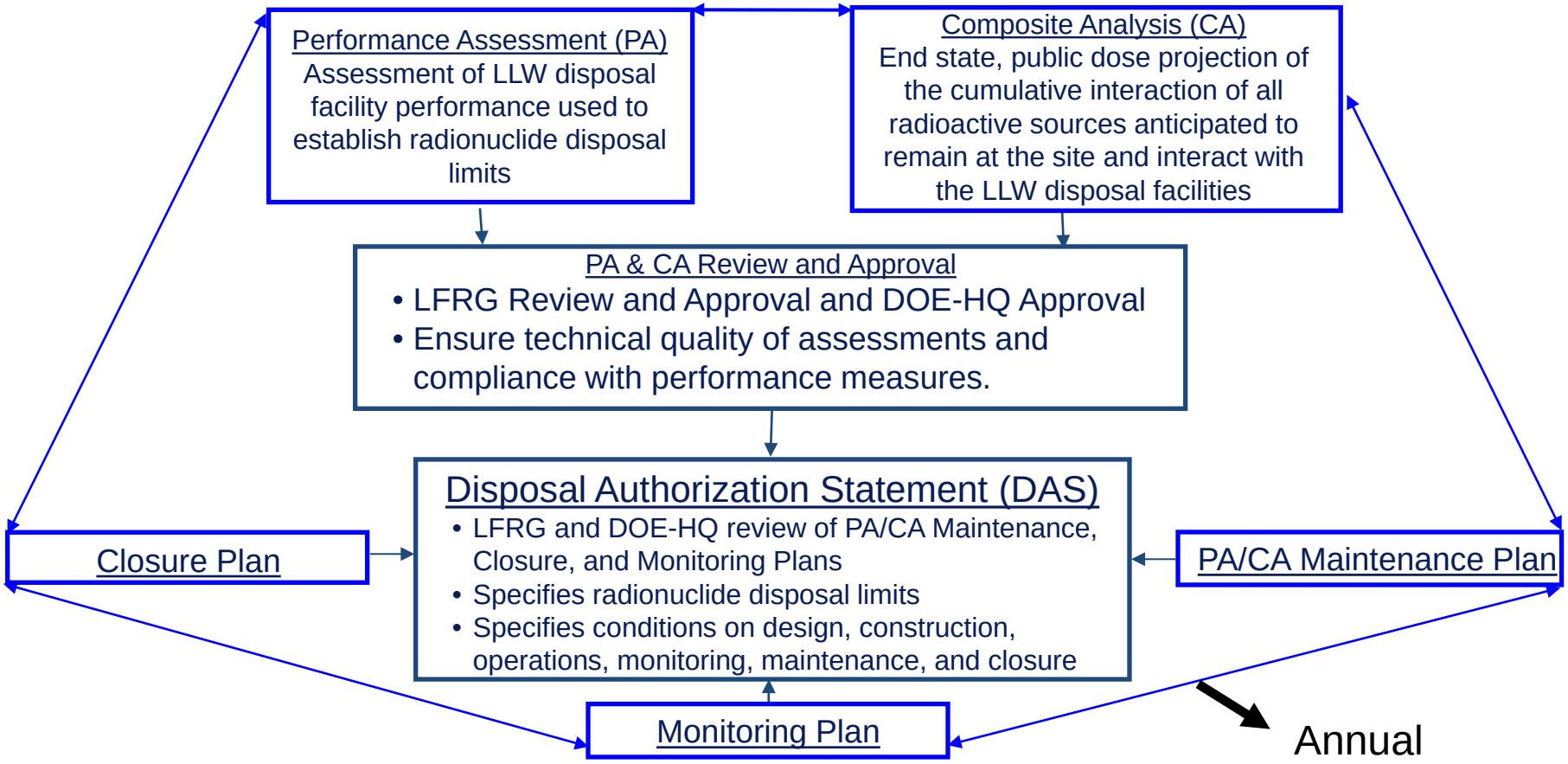
Defense-in-Depth

- Multiple layers of protection
- Site-specific waste acceptance criteria (WAC) and rigorous waste generator certification
- WAC can also be specific to facility design, container and waste forms
- Federal ownership and necessary buffer zones until site can be released
- Commitment to continuous improvement with PA reviews and maintenance, including monitoring



Documentation Required for a LLW Disposal Facility

An Integrated & Iterative Regulatory Framework



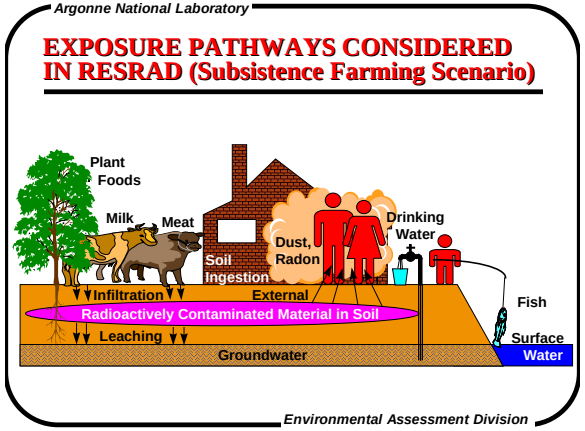
All together this forms the Facility Radioactive Waste Management Basis

Performance Assessment (PA)

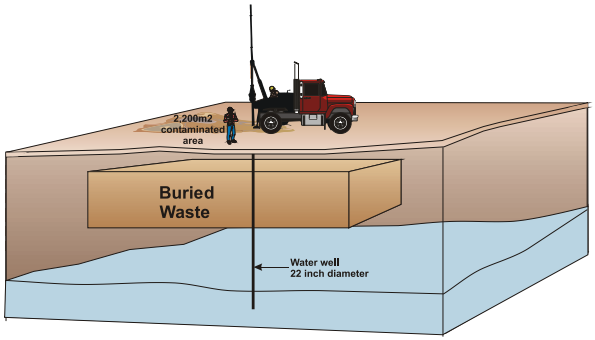
- WAC for DOE disposal facilities have been developed using site-specific, risk-informed and performance-based PAs for more than 25 years
- Technical approaches and WAC have continued to evolve through requirements for on-going PA Maintenance
- Through these experiences, each site has been able to develop and maintain multi-disciplinary technical teams necessary to develop the model support (laboratory, field, engineering, etc) and conduct the modeling necessary for a site-specific PA

Basis for WAC

- Facility-specific WAC are established in the context of an integrated protection system considering multiple limiting factors:
  - Prohibited wastes (e.g., strictly LLW facilities cannot dispose of mixed waste, some facilities are approved for mixed waste with State/EPA oversight)
  - Operational safety analysis (e.g., worker exposure considerations)
  - All pathways dose (groundwater, air, etc.), migration through the environment and eventual exposure (typically result in thresholds on the total inventory)
  - Inadvertent intrusion is assumed to occur (member of public unknowingly disrupts the waste) (typically results in radionuclide specific concentration limits)
  - Design and operational considerations modify WAC for specific wastes or containers (e.g., depth of disposal precludes some scenarios, enhanced barriers (concrete, metal) can delay intrusion)



All Pathways

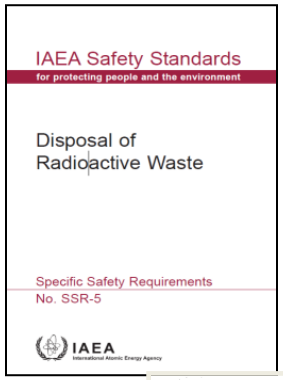


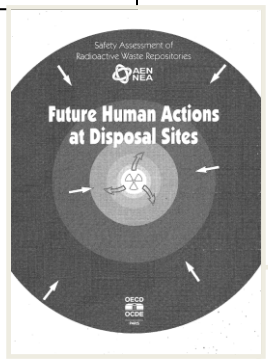
Intruder Drilling

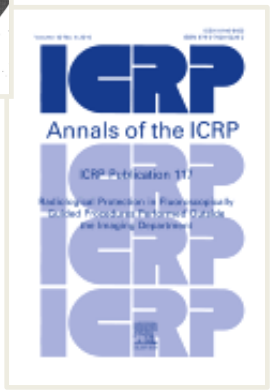
Inadvertent Intrusion

IAEA, ICRP and OECD/NEA

- Consider inadvertent intruder, not advertent intruder
- Striving to reduce potential for and/or consequences of intrusion
- Intrusion considered in the context of intervention and optimization, not as a dose constraint or objective
- Limited stylized scenarios (drilling, basement), current habits
- Optimize waste acceptance, design, etc.







Technical Reviews and Collaboration

- Over the 25+ years, USDOE has also developed a formal technical review process (conducted by the Low Level Waste Disposal Facilities Federal Review Group (LFRG)) that must be completed prior to authorization for waste disposal
- Numerous reviews have been conducted, which has provided a large team of experienced reviewers from which individual review teams are selected
- USDOE also has formed and supports the Risk & PA Community of Practice to facilitate sharing of experiences and lessons learned from modeling activities across the Complex
  - Foster continuous improvement in the quality, credibility, consistency, and efficiency of DOE's PA and risk-based decision-making

Back up slides

Low-Level Waste Disposal Facility Federal Review Group

LFRG comprises representatives from each site office with a disposal site and specific HQ organizations

Roles and Responsibilities

- Develop and conduct formal review processes
- Review compliance documentation submitted by sites in support of disposal authorization statements
- Track and report preparation of compliance documentation
- Provide LFRG recommendations to senior managers
- Prepare disposal authorization statements for disposal facilities
- Monitor maintenance activities
- Conduct other reviews and assessments as directed by senior management (e.g., waste determinations and transuranic waste disposal performance assessments)

Defense-in-Depth

Compliance decisions are made in the context of multiple layers of safety factors, for example:

- 0.25 mSv/yr (25 mrem/yr) is 25 times less than the average annual dose received in the United States (6.3 mSv/yr, NCRP) and a factor of 4 less than the dose limit of 1 mSv/yr
- Assumed that all memory of the facility will be lost (DOE commitments, land use agreements, etc. will be ineffective at some time)
- Future residents will not test well water or be able to recognize that contamination is present underground
- General intent for conservative bias in PA approach (e.g., “highly exposed individuals”, barriers or processes are not credited in calculations in lieu of defending their performance)

Current Performance Objectives

Low-level waste disposal facilities shall be sited, designed, operated, maintained, and closed so that a reasonable expectation exists that the following performance objectives:

All Pathways

- Dose to representative members of the public shall not exceed 25 mrem (0.25 mSv) in a year total effective dose equivalent from all exposure pathways, excluding the dose from radon and its progeny in air.

Note: Separate treatment of radon is consistent with 40 CFR Part 190.10, 40 CFR Part 61 (subpart H), 40 CFR Part 61.192 (subpart Q), and 10 CFR Part 40 (Appendix A, criterion 6))

Performance Objectives (cont.)

Air

- Dose to representative members of the public via the air pathway shall not exceed 10 mrem (0.10 mSv) in a year total effective dose equivalent, excluding the dose from radon and its progeny. (Consistent with NESHAPS dose limits)

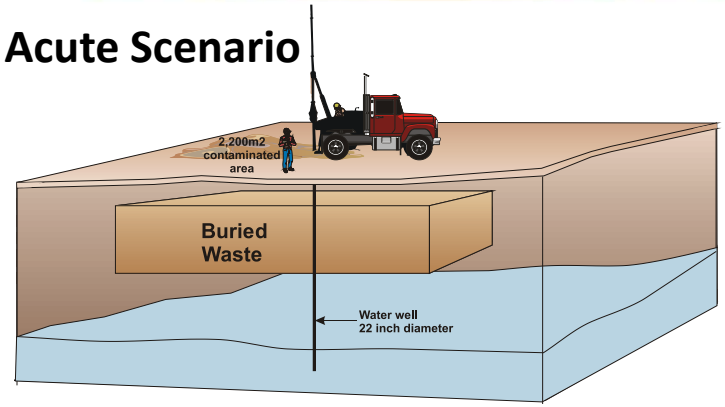
Radon in Air

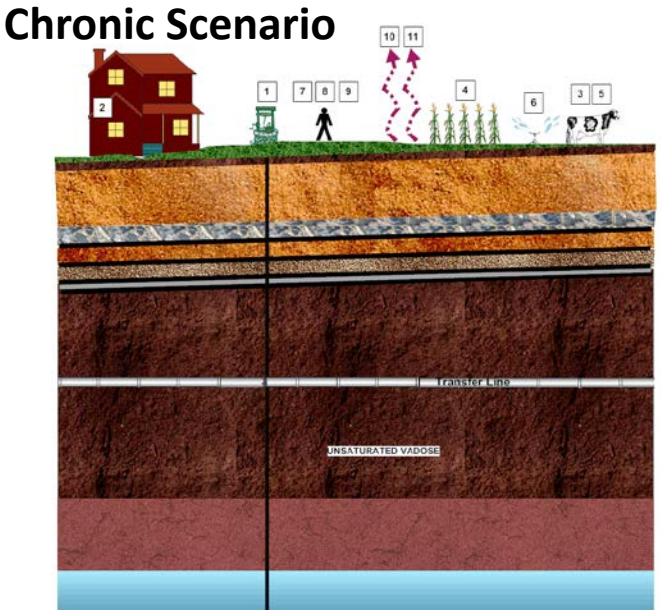
- Release of radon shall be less than an average flux of 20 $pCi/m^2/s$ (0.74 $Bq/m^2/s$) at the surface of the disposal facility. Alternatively, a limit of 0.5 pCi/l (0.0185 Bq/l) of air may be applied at the boundary of the facility. (Consistent other promulgated rules, see previous slide)

ALARA – maintain releases as low as reasonably achievable

Inadvertent Intrusion (DOE)

- Assess the potential consequences in the case of a temporary loss of institutional controls (hypothetical)
- Typically assumed to occur immediately following loss of institutional controls (e.g., complete loss of memory of site, land use/deed restrictions not effective)
- Active institutional control assumed to only last for 100 years, in spite of DOE requirements to maintain controls
- Stylized scenarios (basement, drilling) similar to Part 61 typically used





Inadvertent Intrusion (DOE Cont.)

- Results are addressed in the context of establishing waste acceptance criteria and improving facility design, but not considered a performance objective - consistent with
  - EPA feedback on 10 CFR Part 61 rulemaking that intrusion should not be a performance objective
  - International recommendations that intrusion is considered from the perspective of optimization rather than as a performance objective

Two criteria are considered

- Acute (e.g., basement excavation, well drilling) exposures are compared with 500 mrem consistent with basis for Part 61
- Chronic (e.g., residential) exposures are compared with 100 mrem/yr which is more restrictive than basis for Part 61, but does not include doses from groundwater use

Demonstrating Compliance with Performance Objectives

Performance Assessment will:

- Assess for compliance with dose limit for 1000 year period after closure and to risk inform decisions and evaluate model performance for periods >1000 years
- Average living habits for members of the critical group (more highly exposed individuals)
- Point of compliance is 100 meters from disposal facility boundary unless other point is justified
- Evaluate reasonably foreseeable natural processes that may disrupt disposal system
- Evaluate sensitivity and uncertainty
- Apply ALARA process to determine if releases are as low as reasonably achievable

History of Time of Compliance

Support Decision making process:

- Internal Consistency
  - Property control and release requirements
  - 435.1 working groups
- External Consistency
  - EPA, NRC requirements
  - OMB risk assessment recommendations (E.O.12866, Circular A-94 and A-4, and memo M-12-06)
  - NAS recommendations (NAS, 1990; NAS 1995)

Not a science but science policy & public administration issue (resource allocation and intergenerational equity and support good decisions):

- Contracted National Academy of Public Administration to review intergenerational issues

NAS Recommendations

- NAS 1990: *"[A] scientifically sound objective of geological modeling is learning over time, how to achieve the long-term isolation of radioactive waste. That is a profoundly different objective from predicting the detailed structure and behavior of a site…it is the latter use to which models have been put. The Board believes that this is scientifically unsound."*

NAS Recommendations

NAS 1995:

- *"[W]e believe that there is no scientific basis for limiting the time period of the individual-risk standard to 10,000 years or any other value."*

- *"[W]e note that although the selection of a time period of applicability has scientific elements, it also has policy aspects that we have not addressed." "Another … issue is intergenerational equity."*

- Recommended peak dose or a million years

NAPA Study

***Deciding for the Future: Balancing Risks, Costs, and Benefits Fairly Across Generations*, June 1997**

- Exhaustive literature survey
- Stakeholder workshop
- Expert panel

NAPA Study Recommendations

- **Trustee Principle** - Every generation has obligations as trustee to protect the interests of future generations.
- **Sustainability Principle** - No generation should deprive future generations of the opportunity for a quality of life comparable to its own.
- **Chain of Obligation Principle** - Each generation's primary obligation is to provide for the needs of the living and succeeding generations. Near-term concrete hazards have priority over long-term hypothetical hazards. (rolling present)
- **Precautionary Principle** - Actions that pose a realistic threat of irreversible harm or catastrophic consequences should not be pursued unless there is some compelling countervailing need to benefit either current or future generations.