

NEA Workshop on  
Developing Safety Cases  
for Various Radioactive  
Waste Disposal Facilities

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# *Overview of the Safety Case for Low-Level Radioactive Waste Disposal Facilities*

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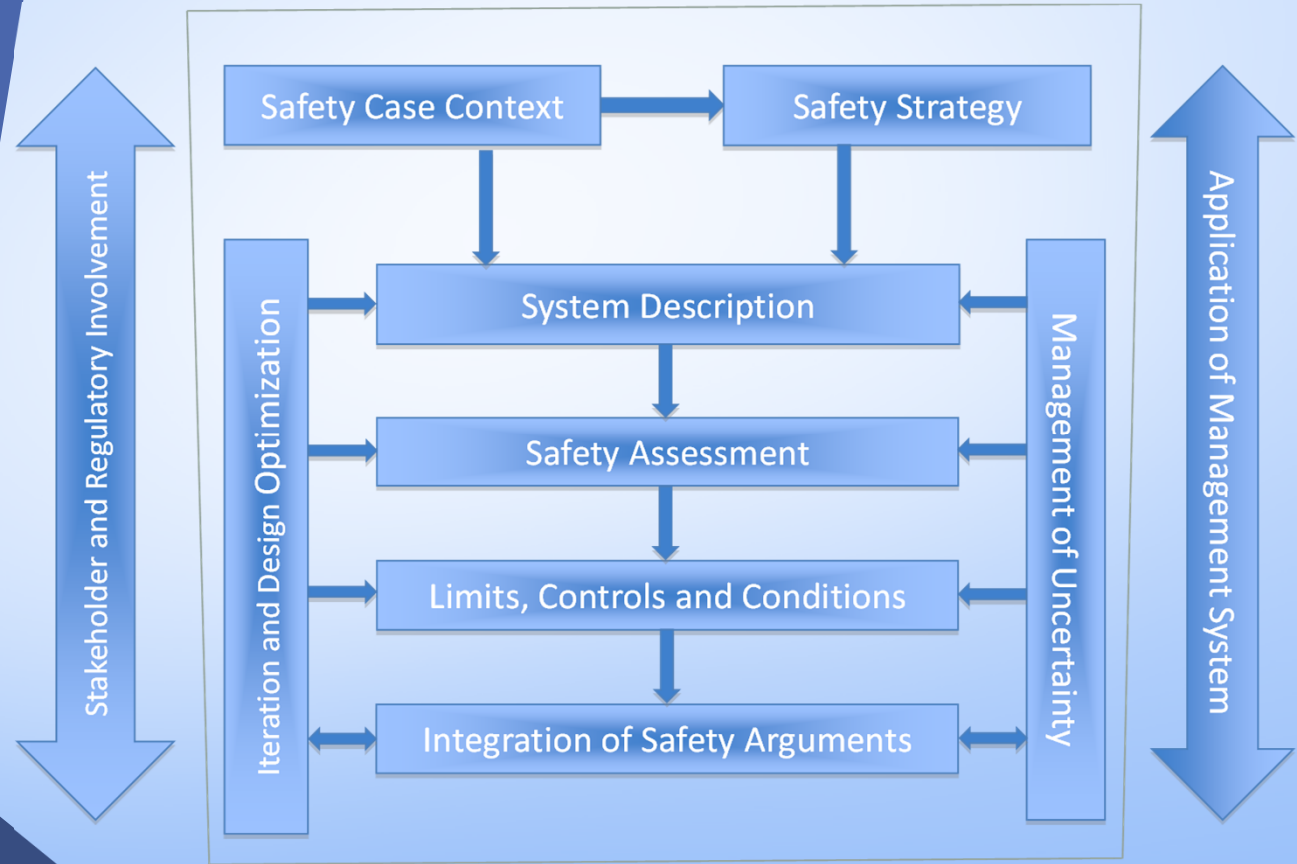
Office of Nuclear Material Safety and Safeguards  
U.S. Nuclear Regulatory Commission



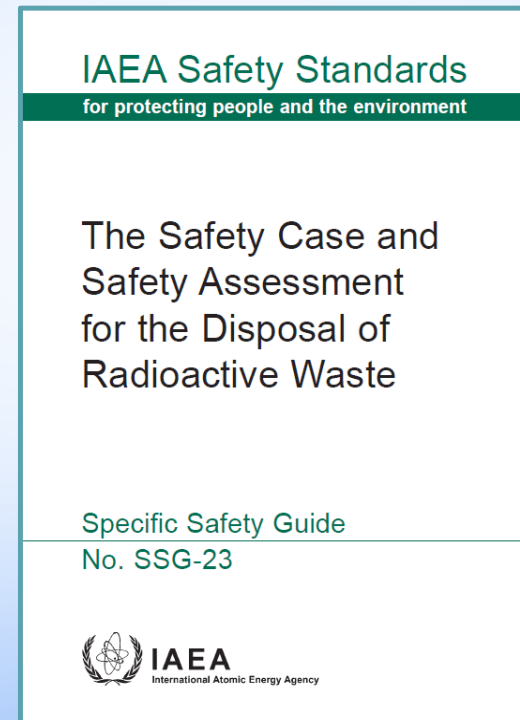
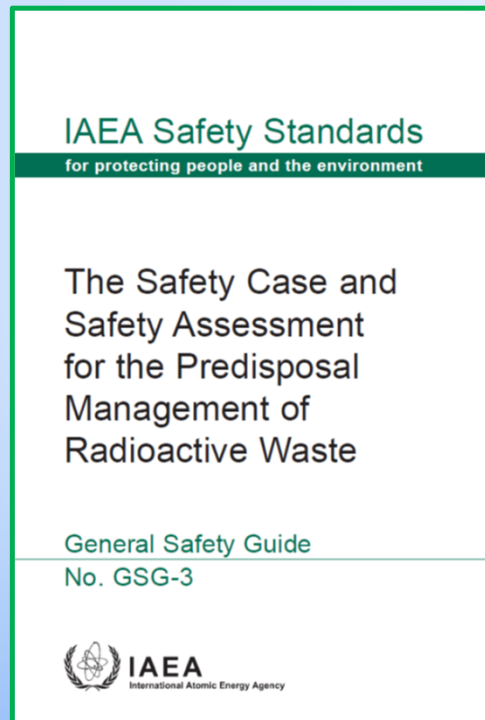
# Low-Level Radioactive Waste Disposal

- International Safety Case Framework
- Regulatory Approach and Framework
- Safety Case Development
- Stakeholder Interactions

# International Framework

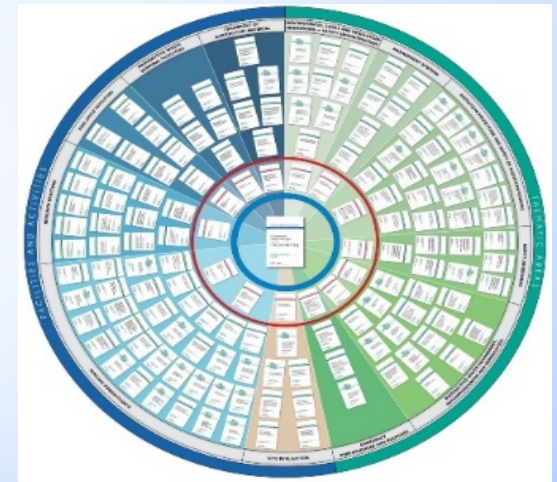


# Relevant Documents



# Relevant Documents

- RS-G-1.9 Categorization of Radioactive Sources
- RS-G-1.10 The Safety of Radiation Generators and Sealed Radioactive Sources
- GSG-1 Classification of Radioactive Waste
- SSG-1 Borehole Disposal Facilities for Radioactive Waste (under revision by DS512)
- SSG-14 Geological Disposal Facilities for Radioactive Waste
- SSG-29 Near Surface Disposal Facilities for Radioactive Waste
- SSG-23 The Safety Case and Safety Assessment for the Disposal of Radioactive Waste
- SSG-31 Monitoring and Surveillance of Radioactive Waste Disposal Facilities
- SSG-44 Establishing the Infrastructure for Radiation Safety
- SSG-45 Predisposal Management of Radioactive Waste from the Use of Radioactive Material in Medicine, Industry, Agriculture, Research and Education
- WS-G-6.1 Storage of Radioactive Waste



# Regulatory Approach and Framework

- Basis for all aspects of safety case provided for licensing process
  - May be updated throughout lifecycle
  - Regulator provides oversight (inspections)
- Framework
  - Regulations & guidance
  - Prospective licensee submits information, regulator documents review and makes licensing decision
- Public interactions throughout licensing process



## Regulatory Review of the Safety Case

- Regulatory body should be involved at all steps of the safety case
- The role and function of the regulatory body is encoded in IAEA documents
- Credibility is important. Must have technical competency, clarity of decision making, generate adequate records, and involve stakeholders
- Goal of the regulatory review is to verify that the facility or activity will not cause unacceptable adverse impacts on human health or safety, or on the environment, both now and in the future

## Regulatory Review of the Safety Case: General Considerations

- Manage the review of the safety case as a project where standard principles of good project management apply
- It may be necessary to establish a dedicated team of personnel to conduct the review
- The regulatory review may be conducted by the regulatory body with or without support from external organizations. Results of the review are the responsibility of the regulatory body
- The regulatory body should establish clear and consistent regulatory requirements, guidance and expectations. The regulatory review process must be independent



# Safety Case Development

- Describe the safety-relevant aspects of the site, the facility, and the managerial and regulatory controls
- Demonstrate the operator will provide for the protection of people and the environment
- Provide assurance to the regulatory body and other interested parties that safety requirements will be met
- Demonstrate that consideration has been given to all steps in the management of the waste, from its generation to its disposal

# Safety Case Content

- **Context** – regulatory requirements, purpose, system characteristics, philosophy, timeframes, endpoints
- **Strategy** – integrated approach, intended safety functions, management strategy
- **System Description** – information and system understanding, basis for safety assessment, characterization data, engineering studies
- **Safety Assessment** – quantification of impacts (scenarios, models, data, calculations, interpretation of results)

## Safety Case Content (continued)

- **Iteration and Design Optimization** – dynamic process with changes expected
- **Management of Uncertainty** – compile, assess, and mitigate uncertainties
- **Limits, Controls, Conditions** – limits on inventory, controls on engineering components, conditions for operation or monitoring
- **Integration of Safety Arguments** – results comply with requirements using multiple lines of reasoning.

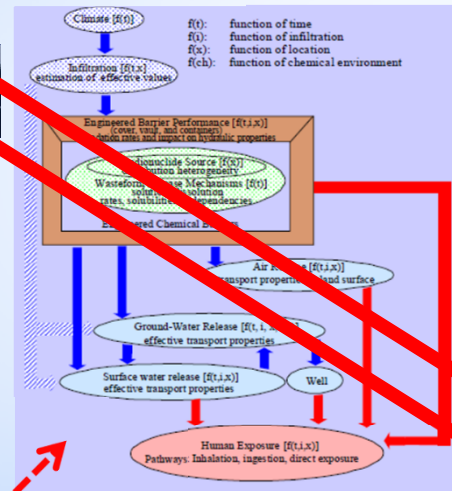
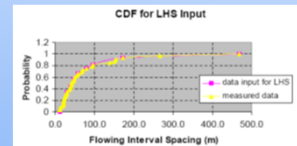
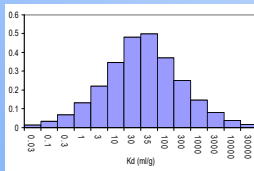
# Example: Safety Assessment – Post-closure



Real  
system

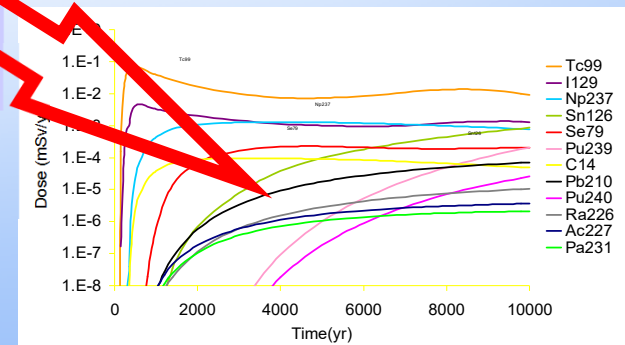


Model  
Support

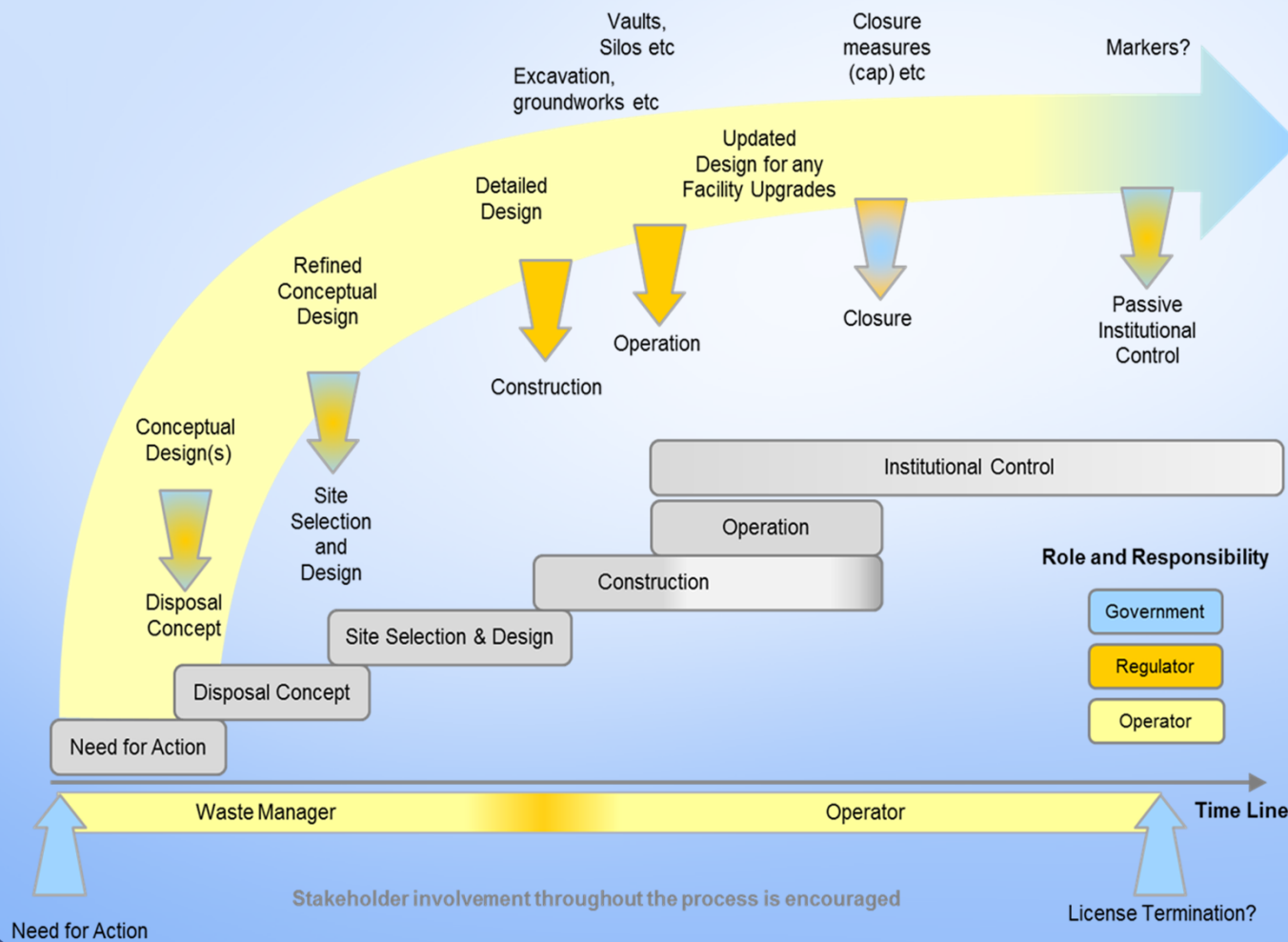


Mathematical model  
(abstraction)

Estimated future  
performance

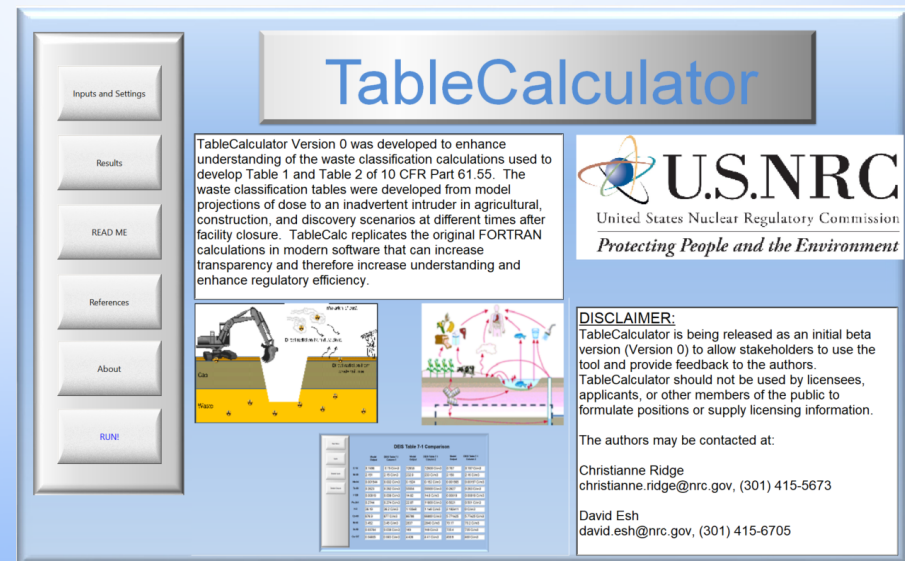


# Example: Iteration and Design



# Continual Learning and Improvement

- Important to learn from experience
  - Must document observations!
  - Must have systems to manage information!
  - Knowledge management is a challenge
- Example: TableCalculator





# **Lessons Learned from Early Experience in the U.S. for Near- Surface Performance Issues**

## **Hydrology Issues**

- Water Retention in Disposal Cells -> 'Bathtubbing'
- Unidentified Fast Flow Groundwater Paths

## **Waste Inventory Concerns**

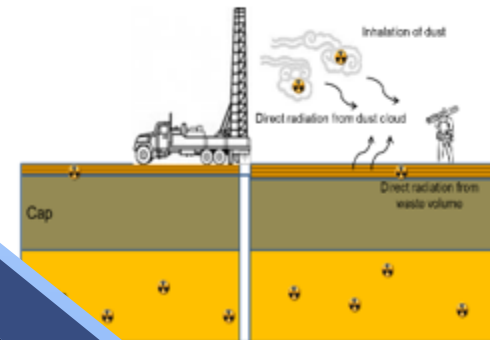
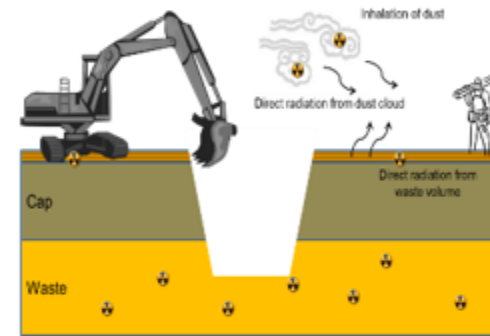
- Appropriate Concentration Limits
- Waste Forms
- Presence of Hazardous Material
- Presence and Treatment of Liquids

See NUREG-1853, "History and Framework of Commercial Low-Level Radioactive Waste Management in the United States", <https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1853/index.html>

# Human Intrusion Scenarios

- Near surface more accessible for potential intrusion
- Loss of knowledge of sites still an issue with near surface disposal
- Larger variety of methods of disturbance

## Disturbance Processes



# Community Outreach and Involvement

- Often of the outreach managed by the licensee/developer/operator
  - May establish citizen advisory panels
  - Work with local organizations
- Regulator's focus
  - Explaining regulations and allowing public comment
  - Identifying hearing opportunities
  - Discussing the decision-making process
  - Announcing review findings and decisions

# Conclusions

- Approaches and considerations for Safety Cases are similar for geologic and near-surface facilities
- Near surface facilities likely have:
  - A greater range of waste streams and waste forms that will be co-disposed
  - Less reliance on specific waste form characteristics for containment
  - Greater concerns of future human actions disturbing the facility barriers or resulting in direct contact with waste
- Knowledge management over the long period of siting, construction, operation, and post-closure a challenge for any waste disposal facility

# Contact

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