U.S. DEPARTMENT OF ENERGY

Environmental Management

Savannah River Site Saltstone Disposal Facility Performance Assessment

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Agenda

- Key Points
- DOE Low-Level Waste Disposal Requirements
- Liquid Waste Integrated System
- New Disposal Cell Design
- 2009 Saltstone Disposal Facility Performance Assessment
- Risk Perspective
- Saltstone Disposal Facility Performance Assessment Maintenance Program
- Conclusions and Path Forward

Key Points

- The Saltstone Disposal Facility (SDF) PA has undergone an extensive development and review process consistent with DOE Manual 435.1-1
  - The PA revision initiated in 2007
- NRC's review confirmed that DOE will meet its DOE Manual 435.1-1 performance objective for the member of the public during the DOE 1,000-year compliance period
  - Identified the peak dose could occur within 10,000 years following closure of SDF
  - Seeking reduction in uncertainty of the projections 8,000 to 15,000 years into the distant future
  - Acknowledged that distant future risk is low – peak annual doses are <100 mrem

Requirements Documents

- DOE manages its Low-Level Waste Disposal Facilities per its Atomic Energy Act authority
- SCDHEC regulates the SDF operations under a Solid Waste Landfill permit and conducts routine monitoring
- DOE Order 435.1, *Radioactive Waste Management*, and its associated Manual documents requirements for these operations
  - The requirements share many similarities with NRC guidance documents and build on the 10 CFR 61, Subpart C performance objectives
- Salt waste disposal at SDF is consistent with the NDAA Section 3116 Waste Determination approved by the Secretary of Energy in January 2006

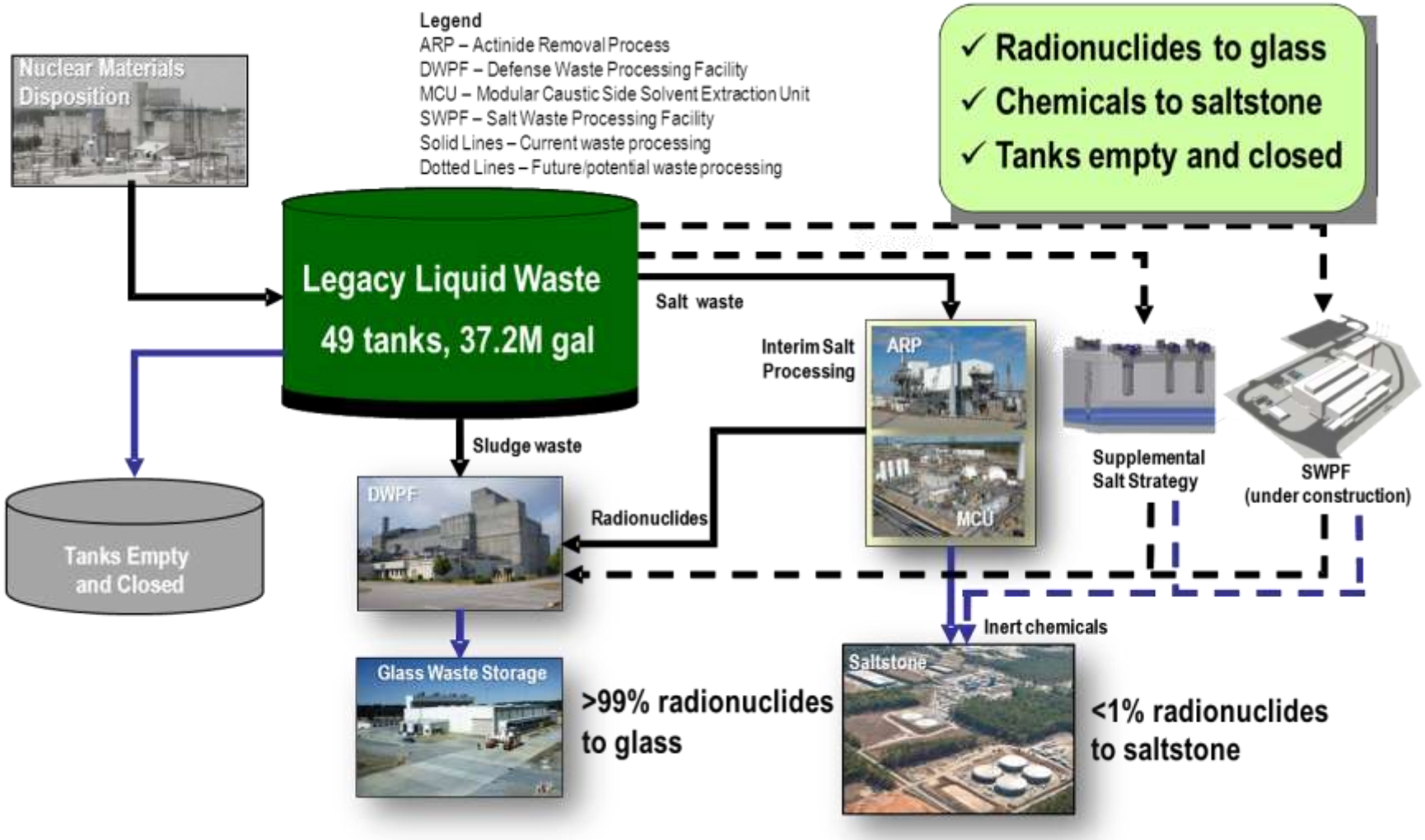
DOE Manual 435.1-1

- Chapter IV describes requirements for handling and disposing of Low Level Waste
- The DOE performance objective for a member of the public and the 10 CFR 61, Subpart C performance objective are the same – 25 mrem annual peak dose
- The point of compliance for assessing is generally a 100-meter buffer zone from the disposal facility
- The period of compliance for demonstrating that performance measures are met is 1,000 years

DOE Decision Making Process

- Due to the large uncertainties in projecting doses 100's to 1,000's of years into the future, DOE considers a myriad of cases and scenarios in reaching a determination of "reasonable assurance" that a performance objective will be met
  - A single deterministic compliance case or "Base Case" is just one of the cases used in reaching this determination
  - A large series of uncertainty and sensitivity cases are also produced and considered in the decision-making process
- DOE further considers the risks to current workers and members of the public from delaying activities
- DOE also recognizes that, if new information is discovered, design changes or remedial actions can be taken to ensure performance objectives are met

Integrated System

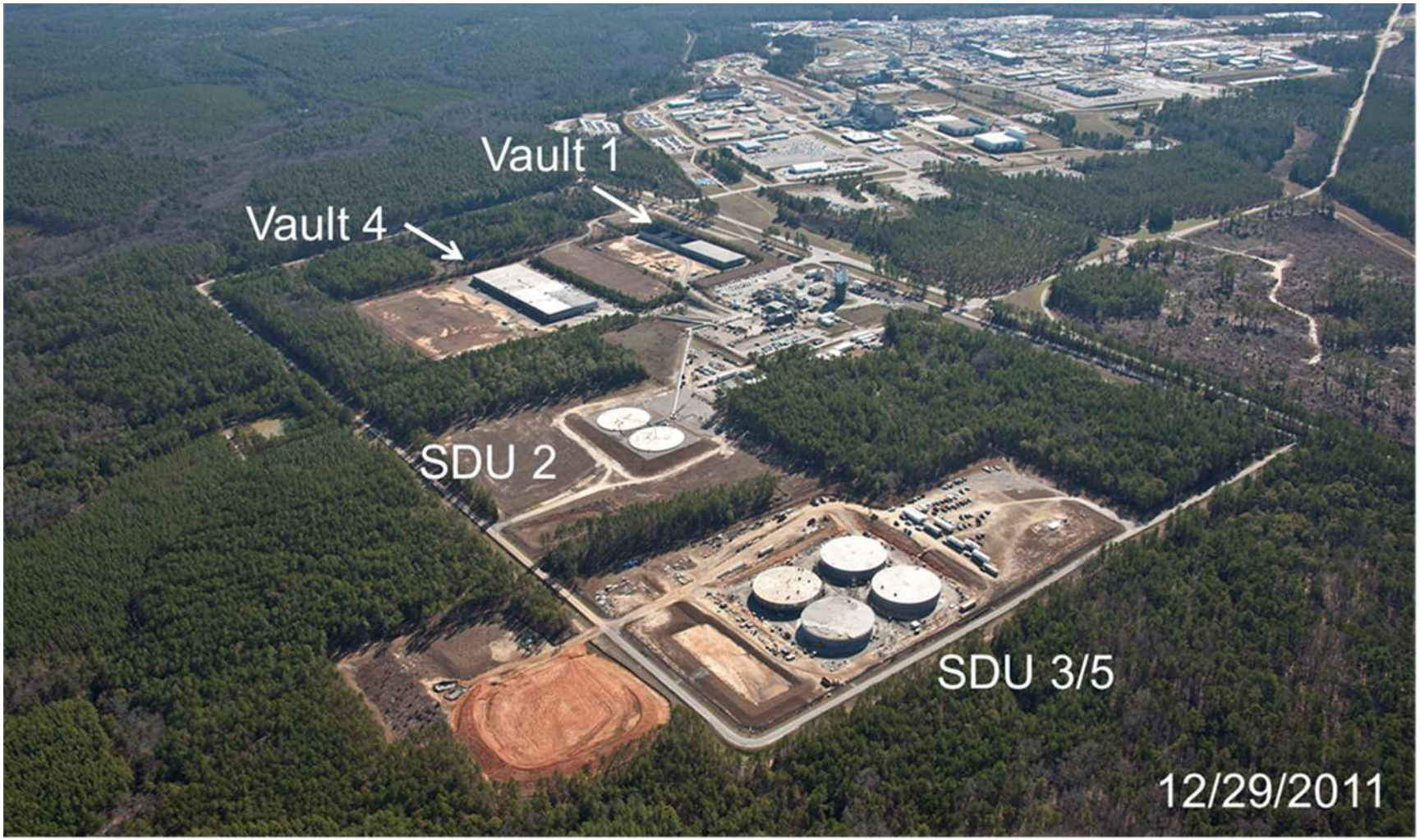


Consensus Goals and Values

DOE, South Carolina Department of Health and Environmental Control, South Carolina Governor's Nuclear Advisory Board and the US Environmental Protection Agency developed these goals and values for the SRS liquid waste program:

1. Reduce risk by removing waste from tanks and closing tanks
2. Give priority to removal of actinides
3. Maximize radioactivity to the Federal Repository
4. Remove as much cesium as possible
5. Keep salt processing schedule in alignment with sludge
6. Limit on-site disposal to ALARA
7. Ensure public involvement

Saltstone Disposal Facility



Robust Disposal Unit Design

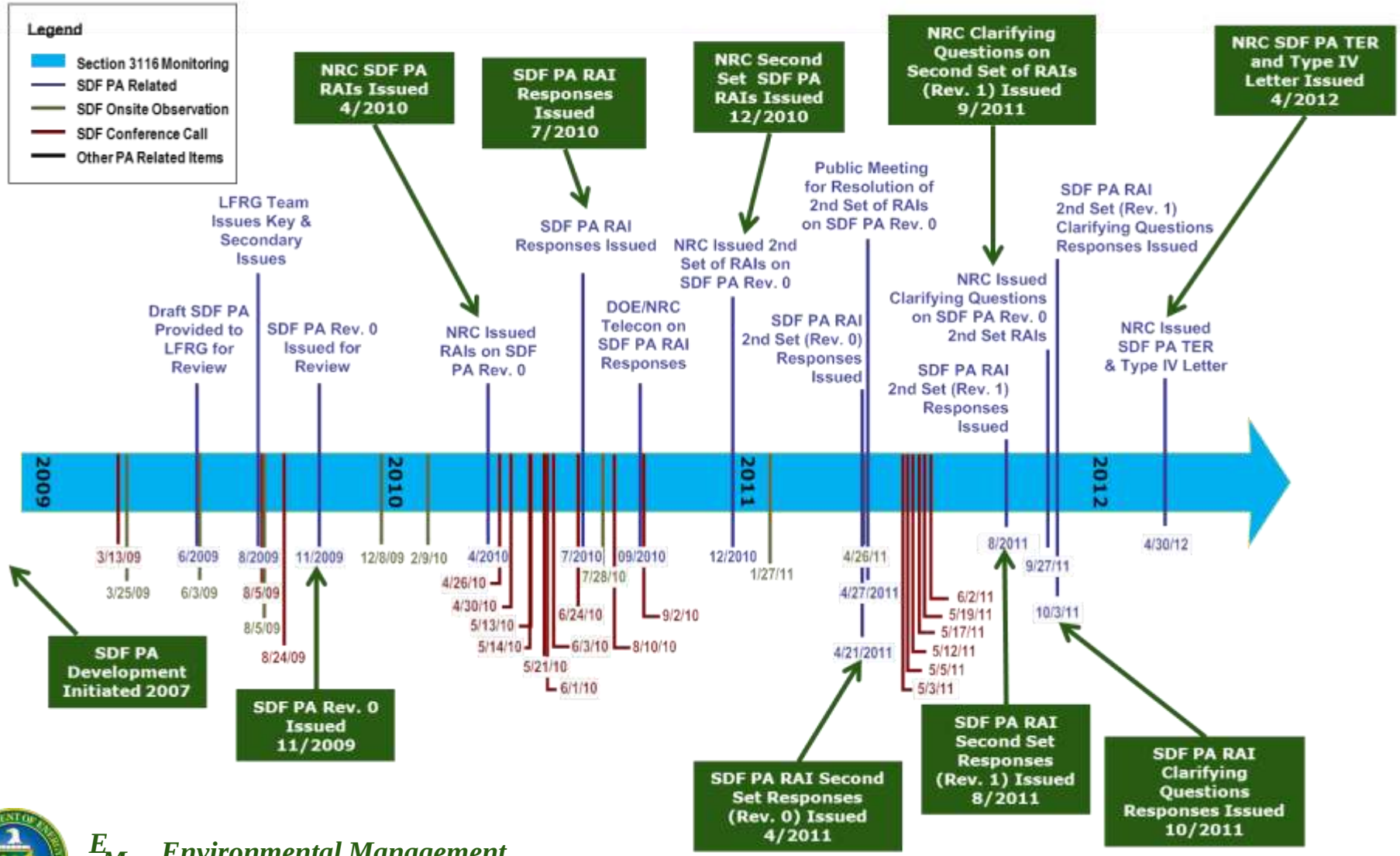
New Disposal Unit Design Features:

- Cylindrical 150’ diameter, 24’ high
- 2.9 million gallon grout capacity
- High quality Class III sulfate resistant concrete
- Minimum 8” walls, 12” floor, 8” roof
- Interior epoxy coating
- Interior drain water collection system
- Significant design improvement over the existing rectangular disposal units
- Hydrotesting of disposal cells

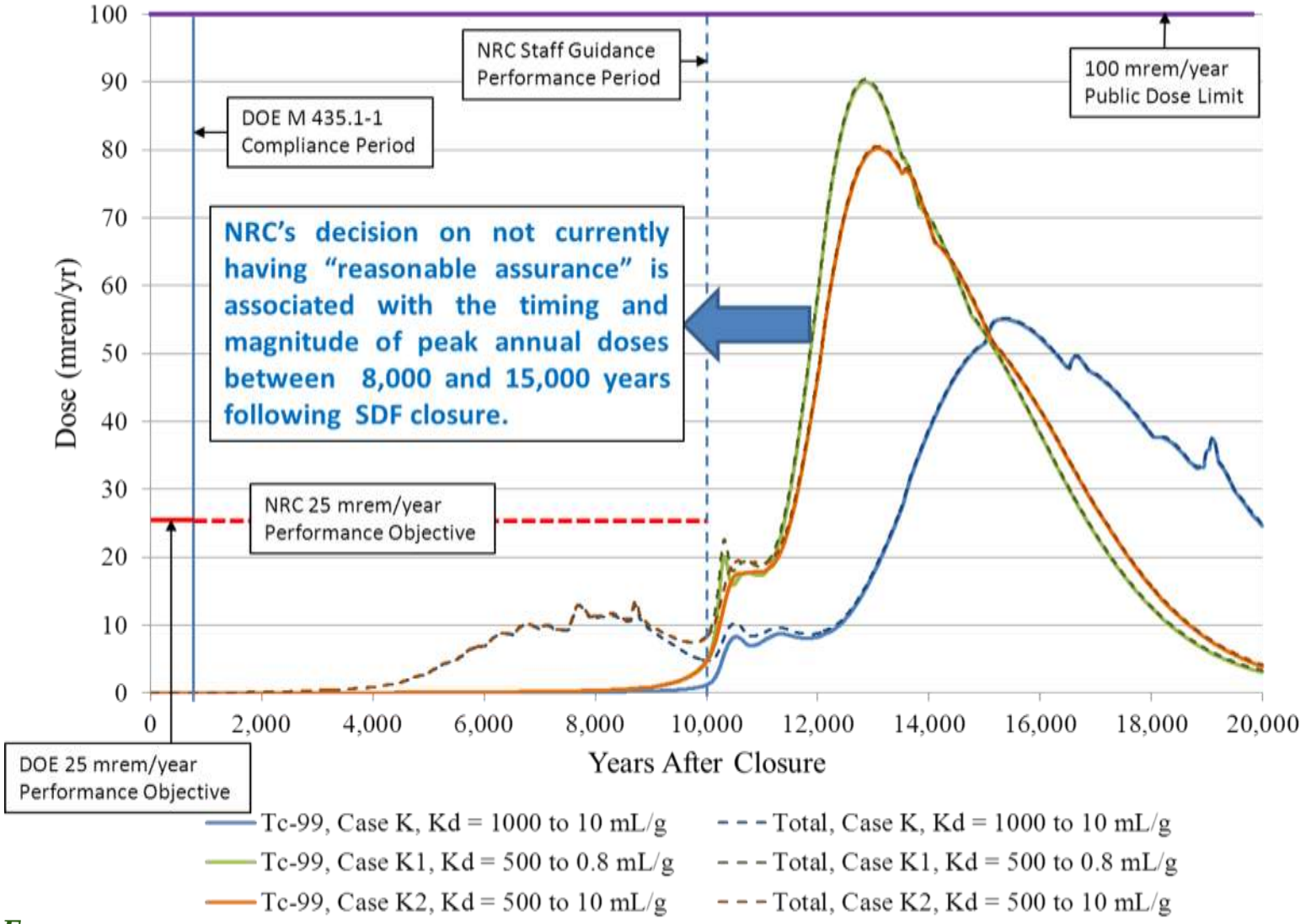
2009 SDF PA Development

- Development of the “new” PA began in earnest in 2007
  - Built upon Scoping Meetings held on F-Tank Farm PA with SCDHEC, NRC and EPA
- Used extensive new material testing data and enhanced computer modeling – both deterministic and probabilistic
- Provided to DOE Low-Level Waste Disposal Facility Federal Review Group (LFRG) in 6/2009
- LFRG recommended release for public review in 10/2009 following implementation of their key recommendations
- Formally issued to SCDHEC and NRC on 11/23/2009

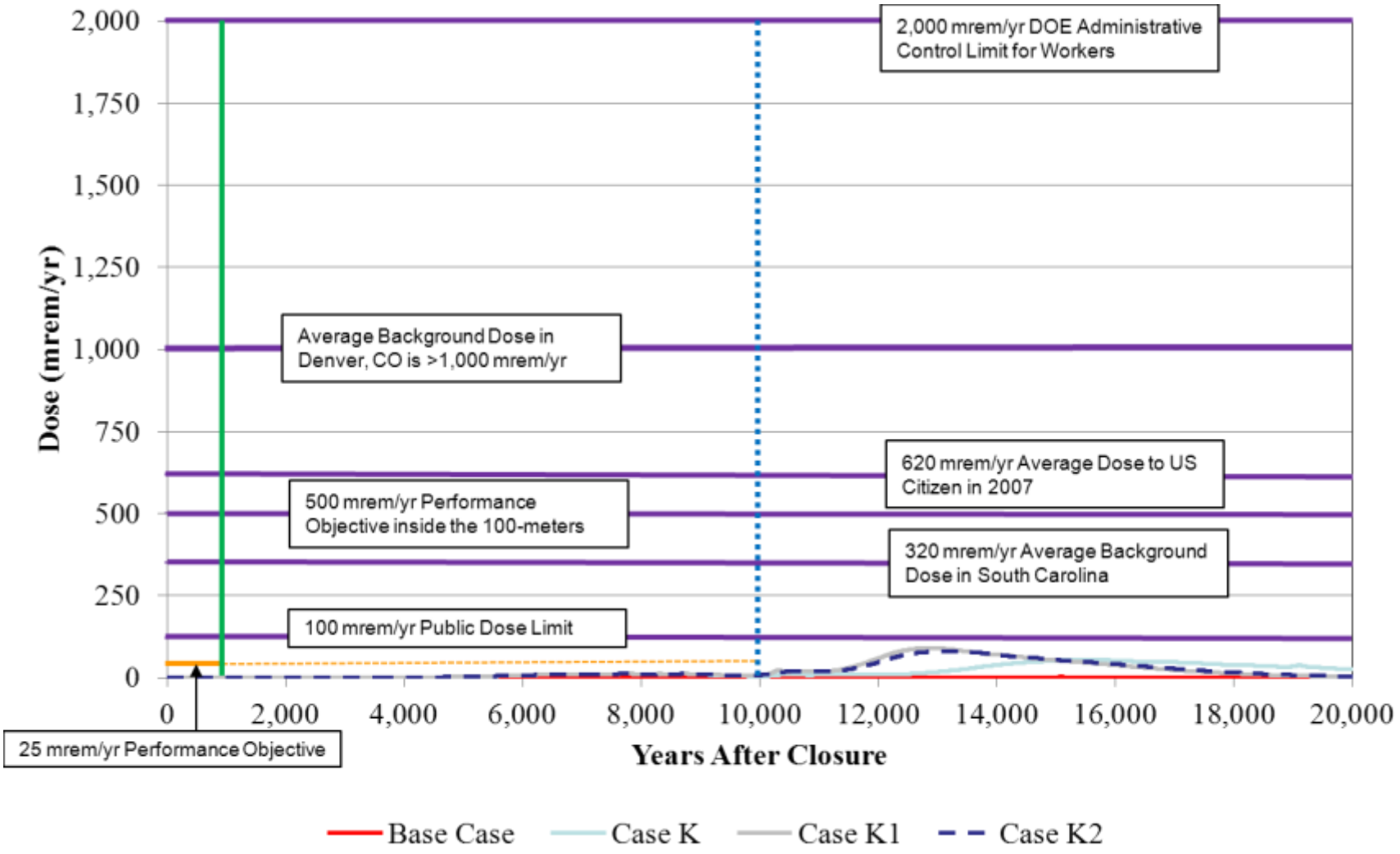
SDF PA Review Process



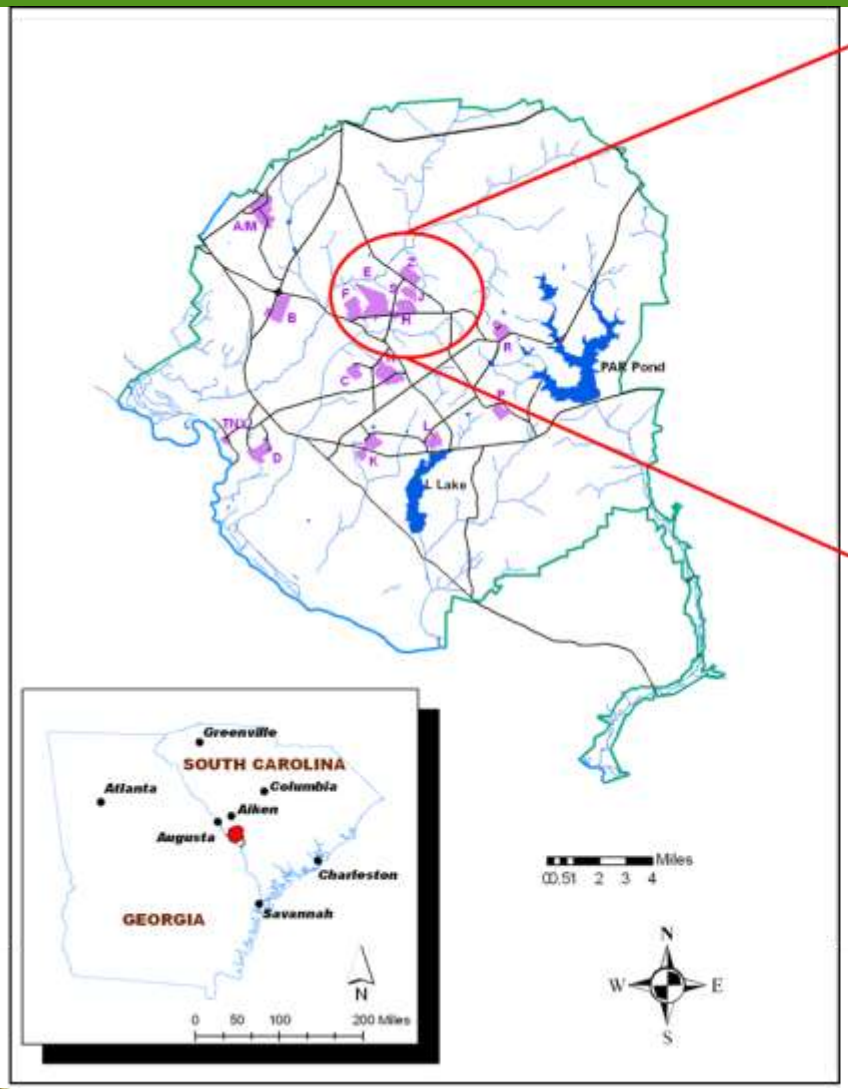
NRC TER on the SDF PA

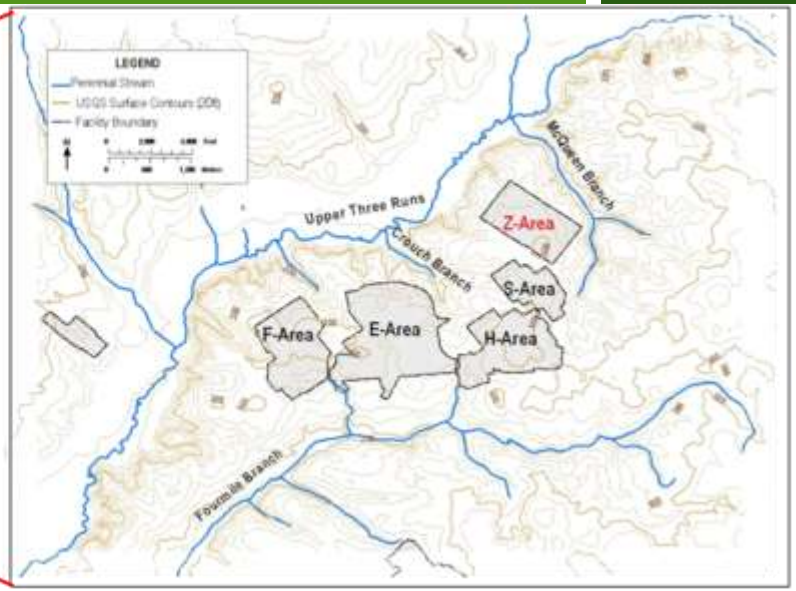


Putting Issue Into Perspective



Location of the SDF





- The SDF is located in Z-Area within the "General Separations Area."
- SDF sits approximately six miles from the closest SRS site boundary and approximately ten miles from the Savannah River.
- The reported peak annual doses are at 100 meters from SDF.

DOE PA Maintenance Process

- All DOE PAs are required to have maintenance plans which address uncertainties or gaps in existing data and include
  - Conduct of research,
  - Field studies, and
  - Environmental monitoring
- Reviews of PA maintenance plans are conducted annually to determine if changes are required

SDF PA Maintenance Program

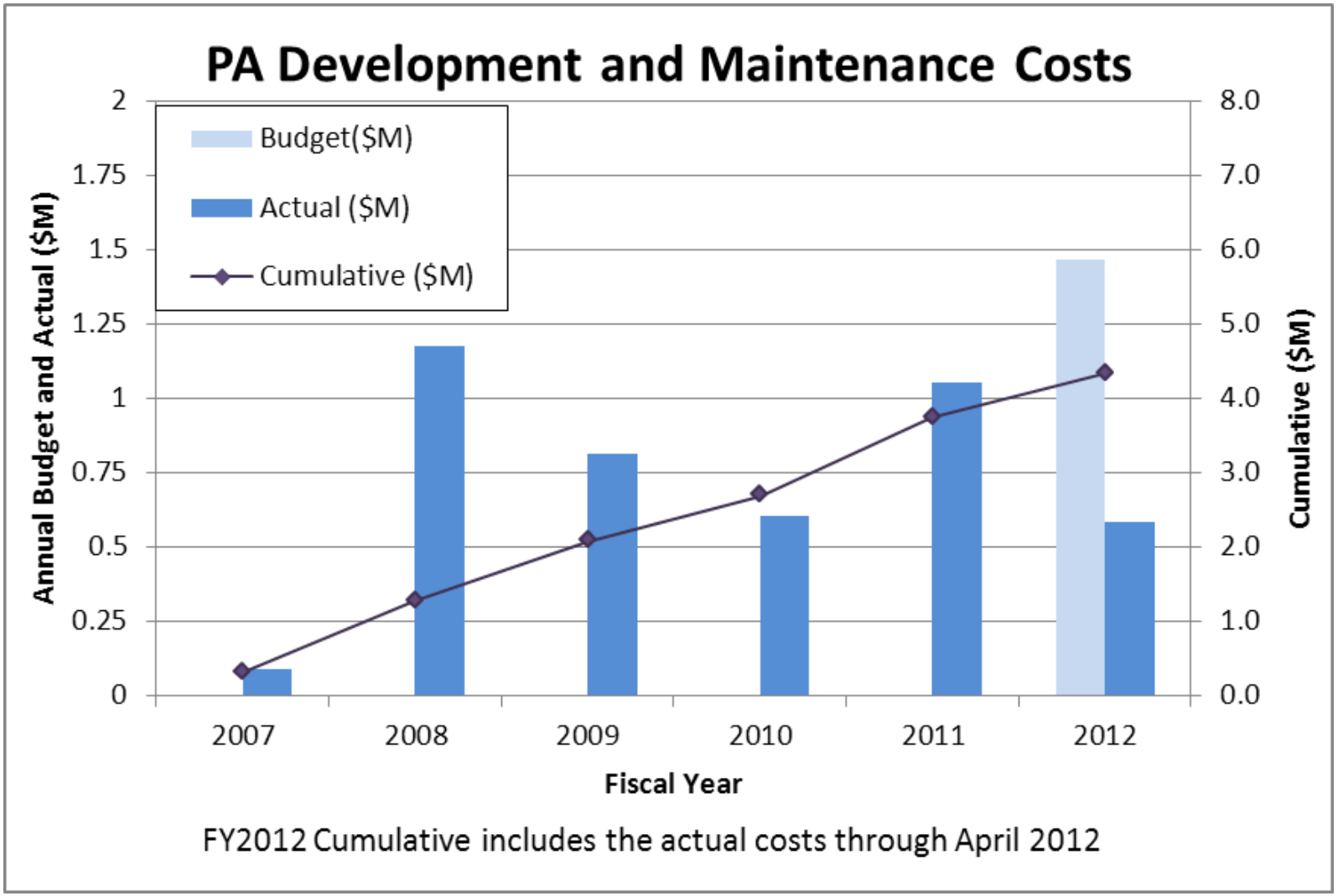
- The SRS Liquid Waste PA Maintenance Plan is updated each fiscal year
  - The plan includes activities for F-Tank Farm PA, H-Tank Farm PA, and the SDF PA
  - Coordinated with PA Maintenance Programs for the E-Area PA and the SRS Composite Analysis
- Items identified in the 2009 SDF PA revision, and specifically in Section 8.2, were incorporated in the plan
- The Liquid Waste Contractor has incorporated the maintenance plan results to date and adjusted research items to continue to reduce model parameter uncertainty

SDF PA Maintenance Program

The 2012 Plan consists, in part, of the following activities:

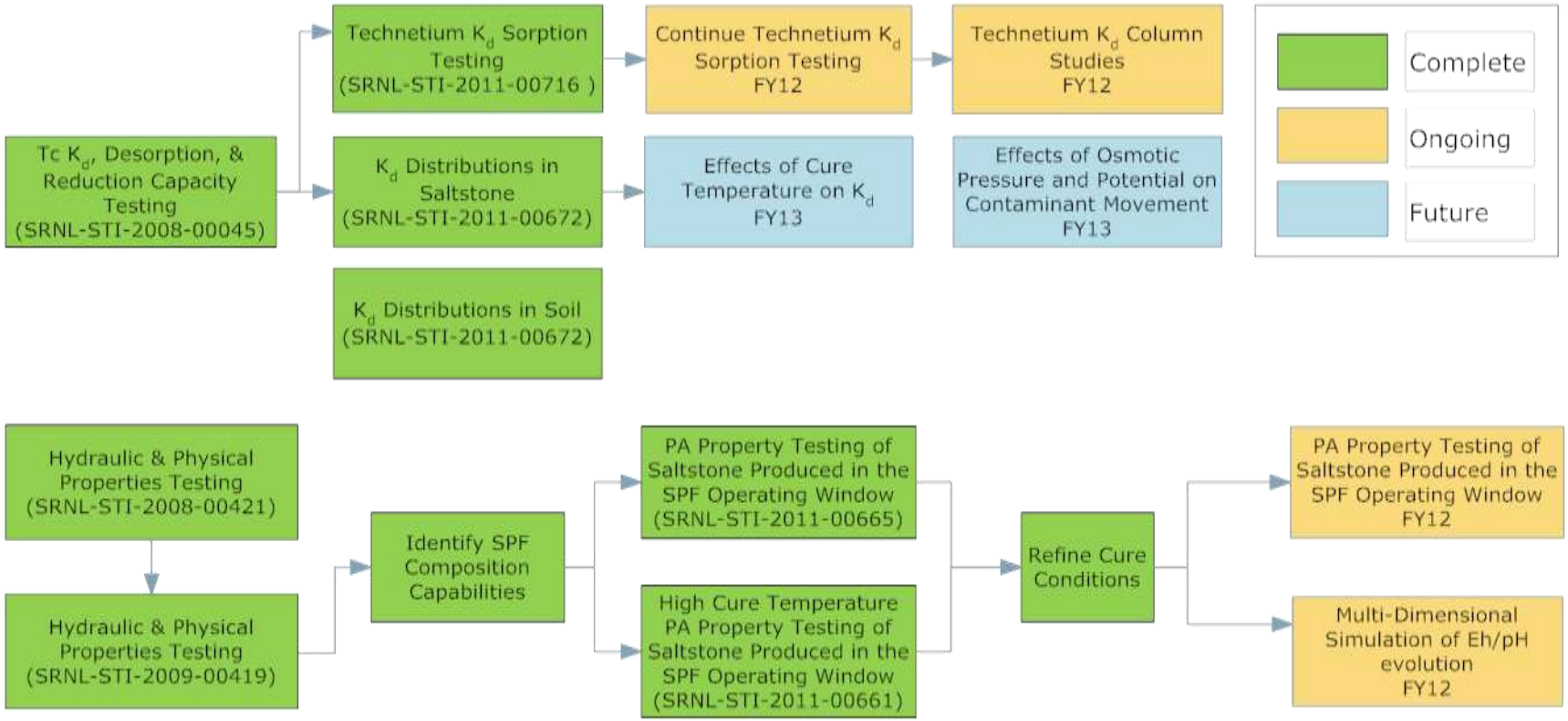
- Technetium K_d sorption testing and column testing
- Property testing of saltstone produced under varying conditions
- Verification of Disposal Cell hydraulic & physical properties
- Degradation of saltstone and similar cementitious materials
- Oxidation rate analytical method development
- Long-term radiological lysimeter program

SDF PA Maintenance Funding



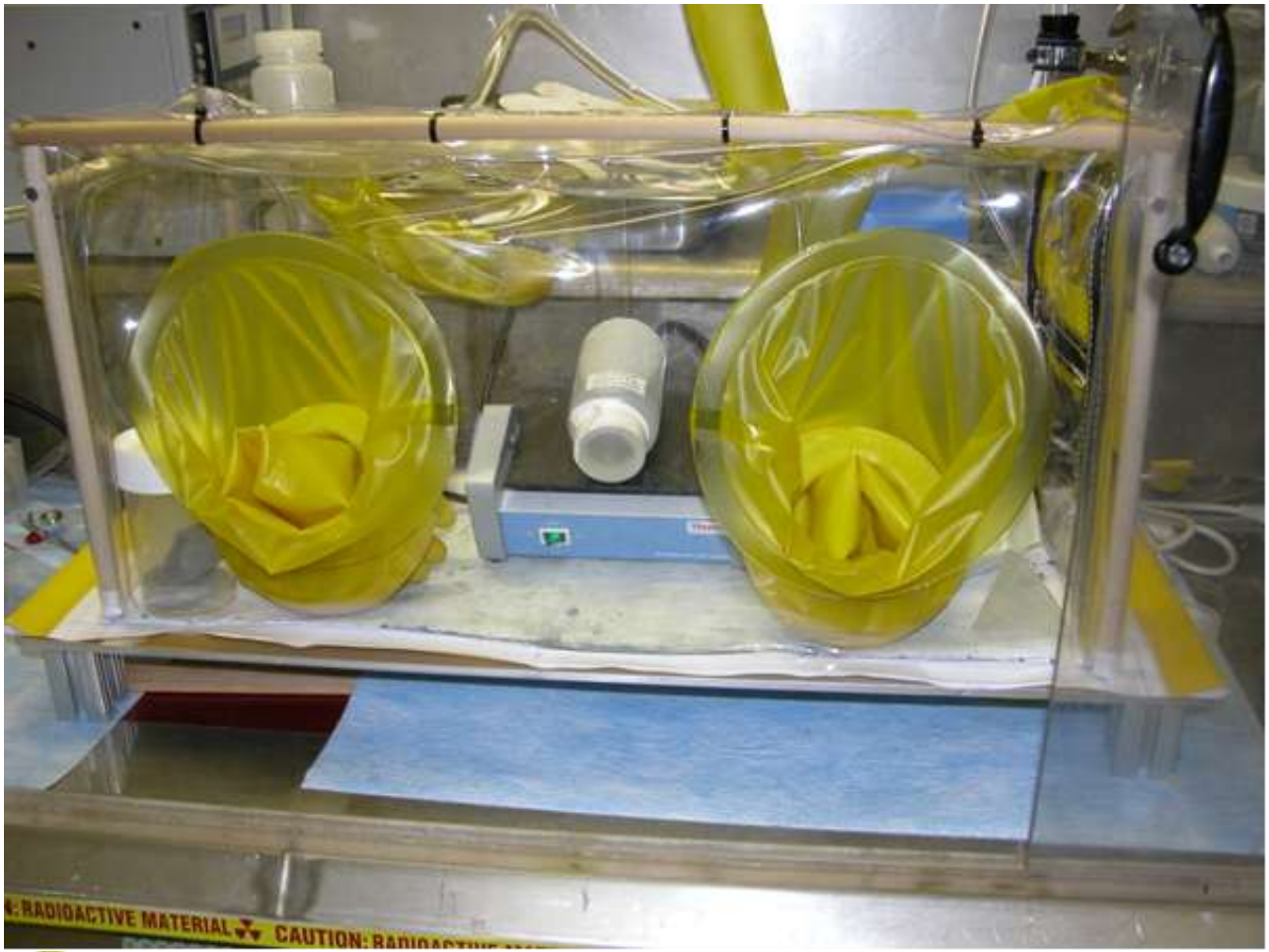
Future funding is subject to change based on risk prioritization

SDF PA Maintenance – Tc Retention & Variability



1st Tc K_d Tests in Glovebag

SRNL testing with Vault 4 saltstone sample



Saltstone sample

2nd Generation Glovebag

Collaborative work with SRNL and Clemson

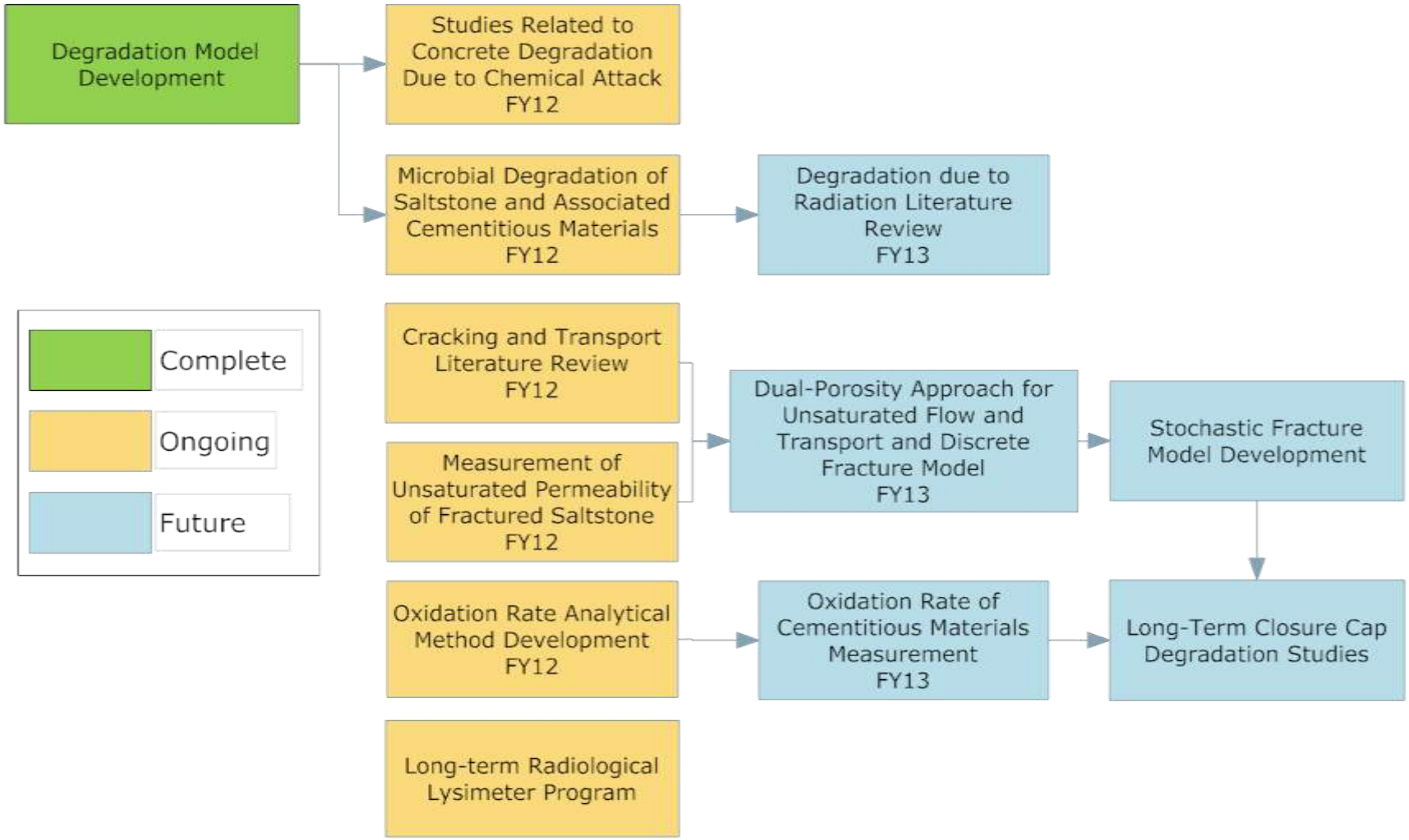
PNNL Column Glovebox

SDF PA Maintenance Operating Envelope

- Efforts continue to further understand saltstone production variability to better define an operating envelope

- Efforts this year are focused on the parameters of importance and will be tested under conditions (e.g., temperature and humidity) to mimic the disposal cells

SDF PA Maintenance Model Development



Other Material Properties

- Studies underway to evaluate various material degradation properties such as unsaturated hydraulic conductivity
- Using available information from sources such as the Cementitious Barriers Partnership (CBP), Advanced Simulation Capability for Environmental Management (ASCEM), SIMCO and Purdue
- SDF PA PORFLOW modeler also a key technical lead for CBP and ASCEM

Oxidation Rate Testing

- Interested in assessing the rate of oxidation in actual disposal conditions
- FY12 testing is focused on methods development and testing first field sample
- Have completed method testing at Stanford beam

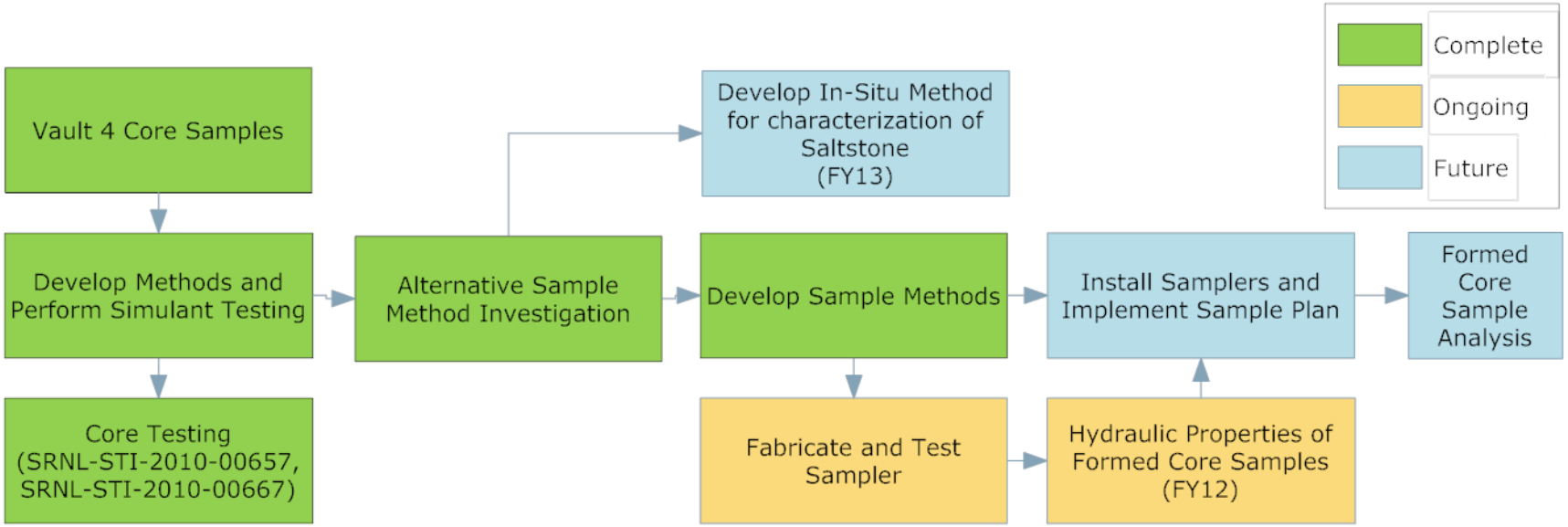
Long-Term Lysimeter

- Ten-year study of various elements/ radionuclides in several media of interest to the Liquid Waste performance assessments
- Test site in the SRS environment (not laboratory)
- First hot samples placed in unit in April

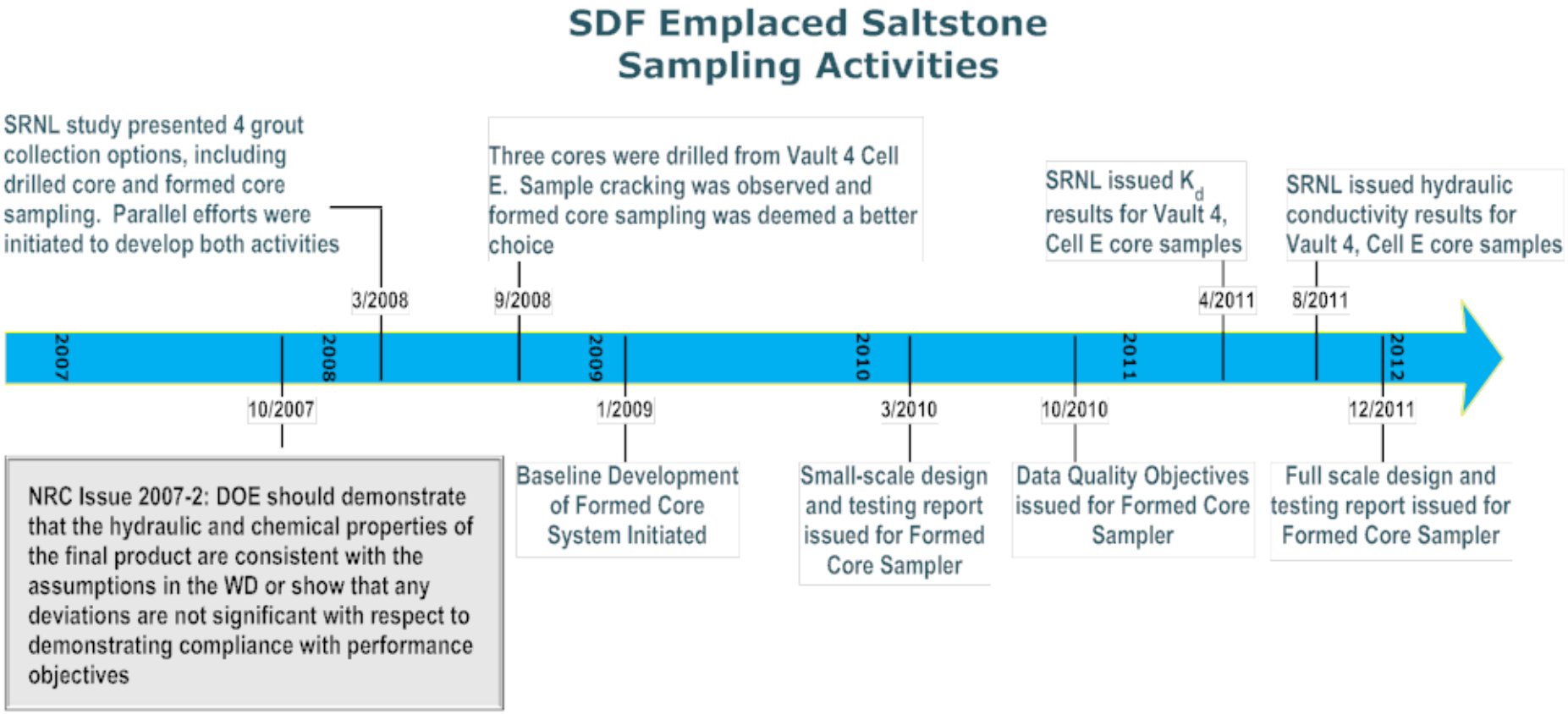
Long-Term Lysimeter

Emplaced Properties

- Focus has been on means to obtain a representative emplaced saltstone sample
- SRNL developed method and conducting testing

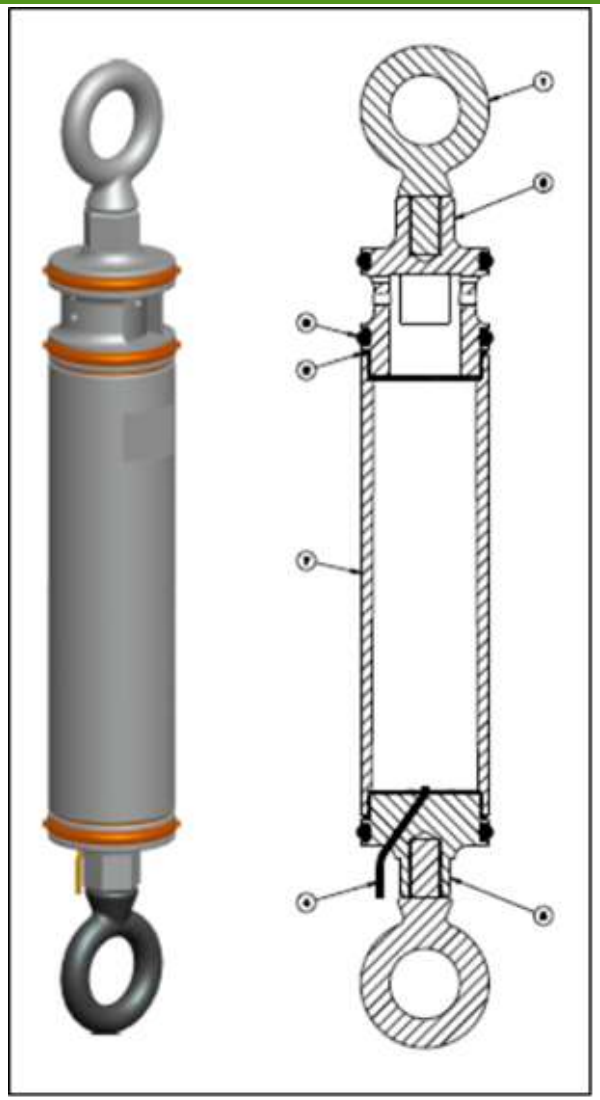


Timeline of Activities



Sampling from Vault 4

Formed Core Sampler Concept



Formed Core Demonstration

SRS R&D Path Alignment

NRC Recommendation (TER pg 86)	PA Maintenance Plan Section	Task Title	Description
Leaching of radionuclides from as-emplaced saltstone	2.3.3.6	Long-Term Radiological Lysimeter Program	Long term (10 years) studies to evaluate degradation impacts on Kd values in saltstone formulations
Leaching of radionuclides from as-emplaced saltstone, reduction of Tc in saltstone	2.3.3.5	Oxidation Analytical Method Development Rate	Evaluate the rate of oxidation front movement through saltstone and cementitious materials. Determines how fast saltstone is oxidized and Tc-99 is available for release
Potential veraibility of as-emplaced saltstone properties, effect of curing temperature on as-emplaced saltstone	2.3.1.4	Saltstone Property Testing - Operating Window	Continues 2011 R&D to evaluate Saltstone Production Facility operating constraints for impact on saltstone waste form properties
Hydraulic conductivity of as-emplaced saltstone, applicability of laboratory measurements to field-scale as-emplaced saltstone	2.3.4.2	Formed Core Samples PA Properties	Continues 2011 R&D by evaluating samples generated in the formed core mock-up performed for impacts on the sample itself
Expected current and future Eh and pH conditions in the saltstone	2.3.1.6	Multi-D. Simulation of pH/Eh Evolution in CM	Expands the current one dimensional Eh/pH model into two dimensions to capture more gradual changes in Eh and pH
Expected fracturing in saltstone with time	2.3.3.4	Microbial Degradation of Saltstone and Cementitious Material	Initial literature review of existing studies of microbal degradation of cementitious materials. Forms the basis for future laboratory testing of microbal degradation
Expected fracturing in saltstone with time	2.3.3.4	Measure Unsaturated Permeability of Fractured Saltstone	Initial attempt to develop modeling techniques that address fracture formation and contaminant release from saltstone
Leaching of radionuclides from as-emplaced saltstone, reduction of Tc in saltstone	2.3.1.5	Independent Confirmation of Tc-99 using column method	Develop independent confirmation of Tc-99 Kd values using saltstone simulant material packed in test columns. Attempts to simulate pore water infiltration through saltstone and determine Kd values of Tc-99. DOE managed activity with PNNL.

Conclusions

- DOE has a strong, comprehensive program built on the principle of continuous improvement and reduction of uncertainty
  - The new robust disposal cell design is an example
- Disposal of treated salt solution reduces risk from the overall Liquid Waste program
- NRC's comprehensive review validates that the current and planned future disposal activities at SDF are safe
- DOE looks forward to working closely with the NRC staff to further reduce uncertainty in dose projections associated with the SDF
- If new information is discovered, design changes or remedial actions can be taken

Path Forward

- DOE will be sharing new information generated since August 2011
- DOE will respond to NRC's 4/30/2012 Letter and TER; response will be developed prior to disposal of treated salt waste into the new disposal units
- DOE will hold a public meeting in coordination with the next NRC salt waste disposal monitoring visit to share the response