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SRS Composite Analysis
A Risk Based Management Tool

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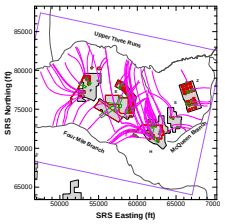
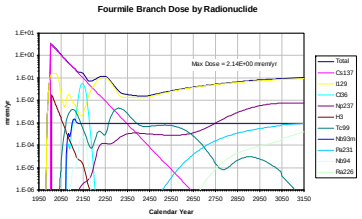
November 17, 2010





Presentation to EM Waste Processing Technical Exchange

SRNL-MS-2010-00247

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Overview

- SRS Overview
- SRS CA: What is it?
- SRS End States and Inventories
- SRS CA Model
- SRS CA Results
- SRS CA Maintenance
- SRS CA – A Risk Based Management Tool

SRS Quick Facts

- 310 square miles
- 5% of area developed
- 16 operating areas
- 95% of area undeveloped
- Five major watersheds
- Land Use: Perpetual Federal Control
- Public exposure location: Stream mouths and Savannah River
- Four major radiological contractors

SRS Historic Operations

SRS Operations began in the 1950s for the production of tritium, Pu-239, and other special nuclear materials (e.g. Pu-238) and included the following major operations:

- **Heavy Water Extraction Plant (D-Area)**
- **Nuclear Fuel and Target Fabrication Facility (M-Area)**
- **Five Production Reactors (C, K, L, P, and R-Areas)**
- **Two Chemical Separation Plants (F and H-Areas)**
- **Tritium Processing Facilities (H-Area)**
- **Waste Management Facilities (E, F, H, S, and Z-Areas)**
- **Savannah River National Laboratory (A and T-Areas)**

Ongoing SRS Missions

Major changes in SRS Operations began in 1988 when the last heavy water reactor was shut down. Ongoing SRS Missions include:

- **Savannah River National Laboratory (A-Area)**
- **Tritium Extraction Facility (H-Area)**
- **Enriched Uranium and Plutonium Disposition Program (H-Canyon complex)**
- **Nuclear Materials and Spent Fuel Management (KAC and LAC)**
- **Waste Management Facilities (E, J, S, and Z-Areas)**
- **Tank Closure (F and H-Areas)**
- **Deactivation & Decommissioning and Environmental Restoration**
- **Mixed Oxide Fuel Fabrication Facility (F-Area)**

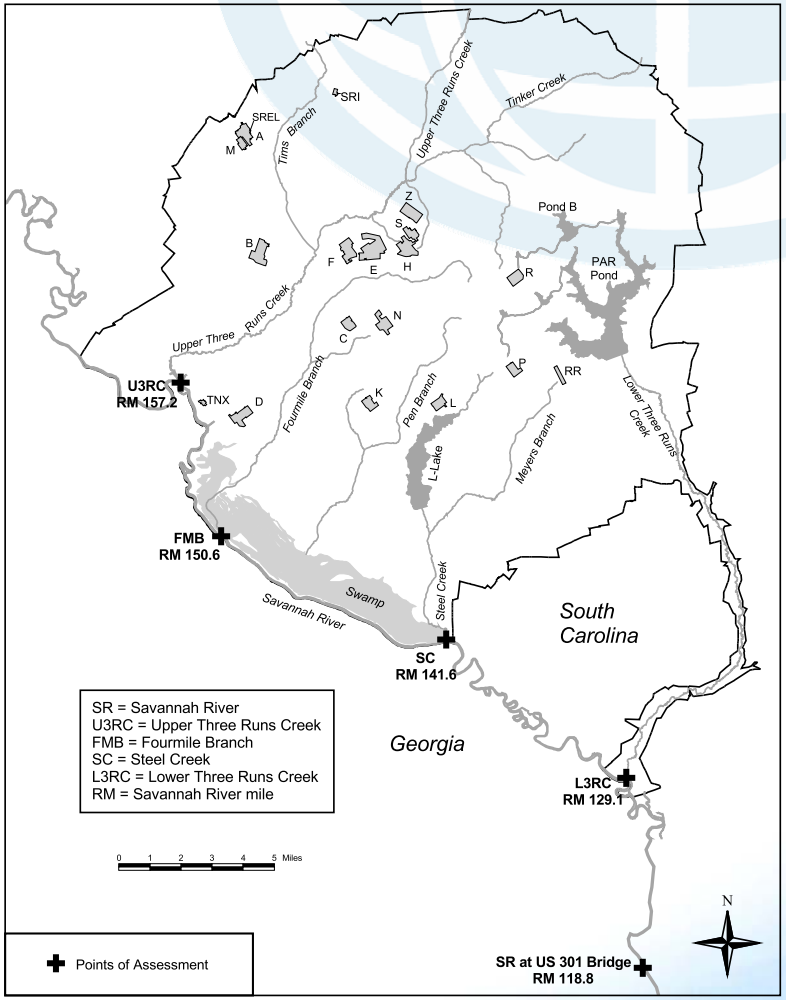
SRS Composite Analysis (CA): What is it?

- **It is required by DOE Order 435.1, Radioactive Waste Management as part of the Radioactive Waste Management Basis for SRS low-level waste disposal facilities (i.e. ELLWF and SDF) and closure of the SRS Tank Farms (F and H).**
- **It is a prospective analysis that addresses the question:**

  Will the configuration of the projected SRS end state radionuclide inventory be protective of the public?
- **It is a management tool intended to provide a reasonable expectation that future corrective or remedial actions will not be required to ensure radiological protection of the public.**

SRS Composite Analysis (CA): What is it? (continued)

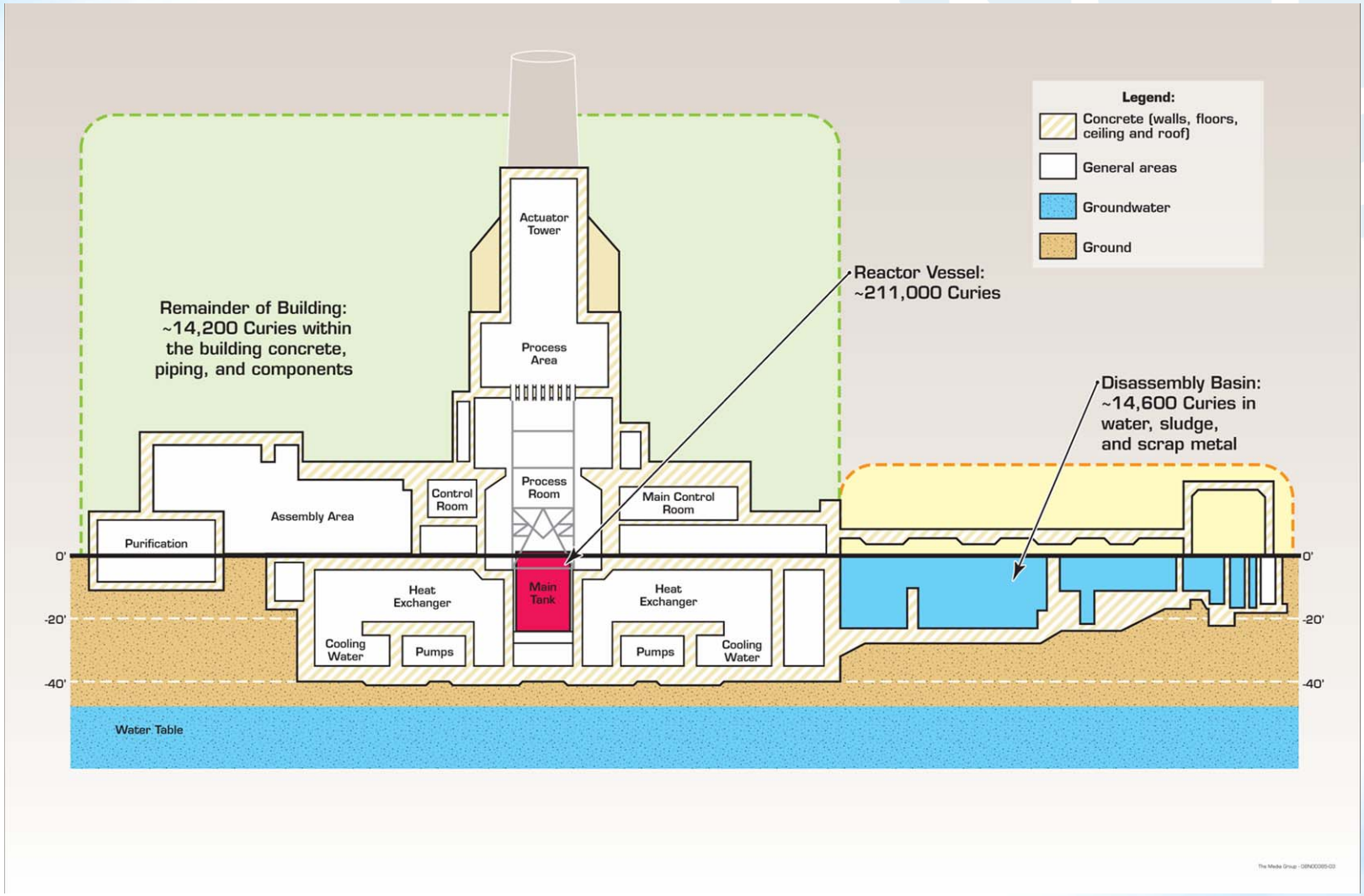
- **Projected dose to member of the public at SRS site boundary: stream mouths and Savannah River**
- **1,000 year assessment period**
- **Performance measures:**
  - **30 mrem/year administrative dose constraint**
  - **100 mrem/year primary dose limit**



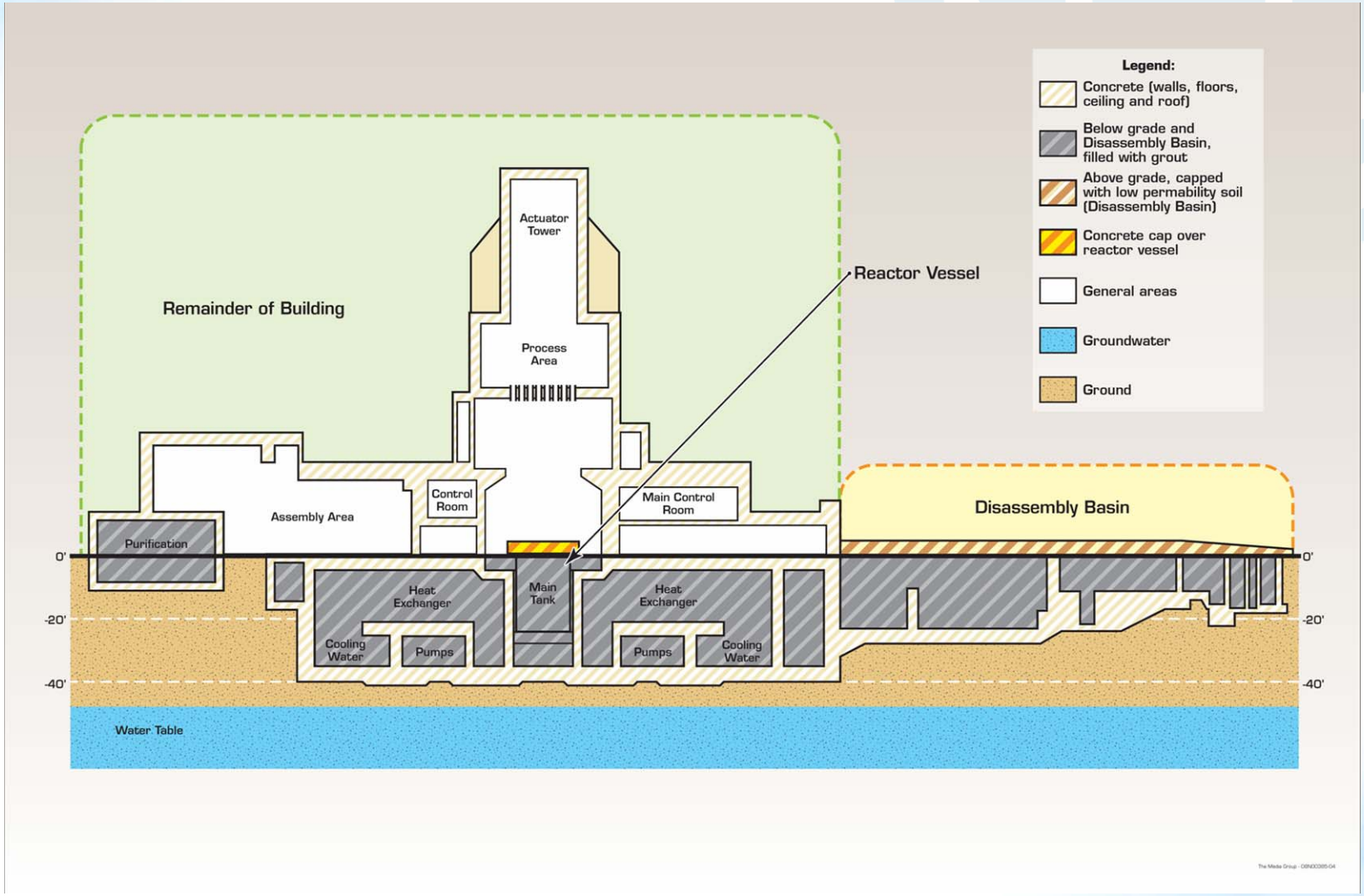
End State Example: T-Area Past

End State Example: T-Area Today

End State Example: P-Reactor



End State Example: P-Reactor In-Situ Disposal



SRS CA End State Inventory

Projected End State Inventory:

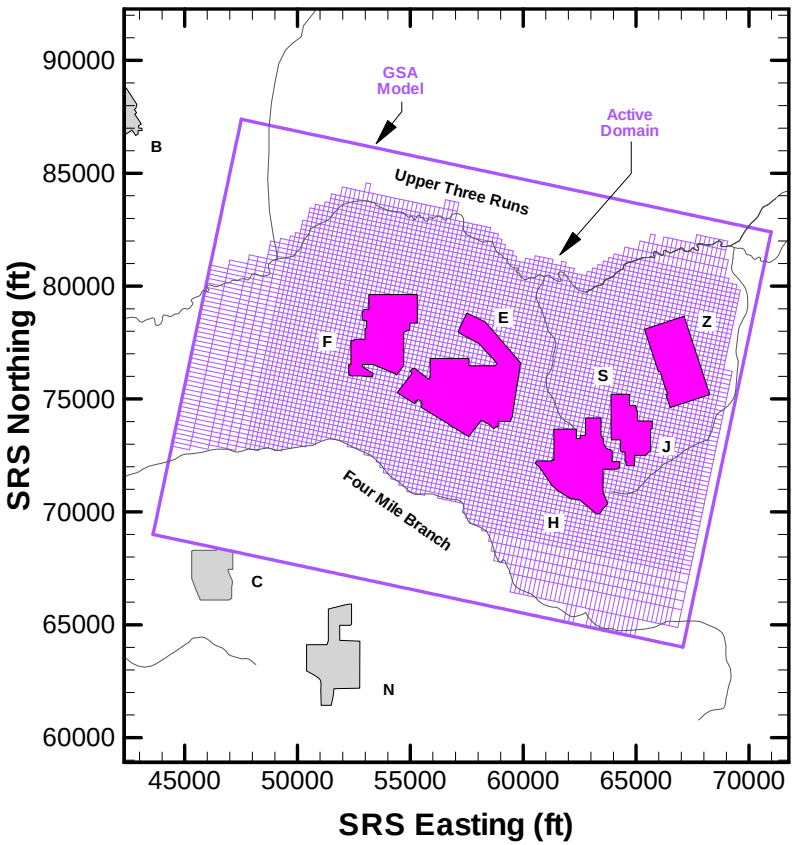
- **PA Facilities (Tanks and LLW Facilities): Inventories developed for PAs**
- **RCRA/CERCLA sites including waste sites, groundwater plumes, and D&D facilities: RCRA/CERCLA regulatory documents (e.g. RI/FS, BRA, RODs)**
- **Operating Facilities:**
  - **Safety Analysis Reports (e.g. H-Canyon)**
  - **NEPA Documentation (e.g. MOX)**

SRS CA Modeling Approach

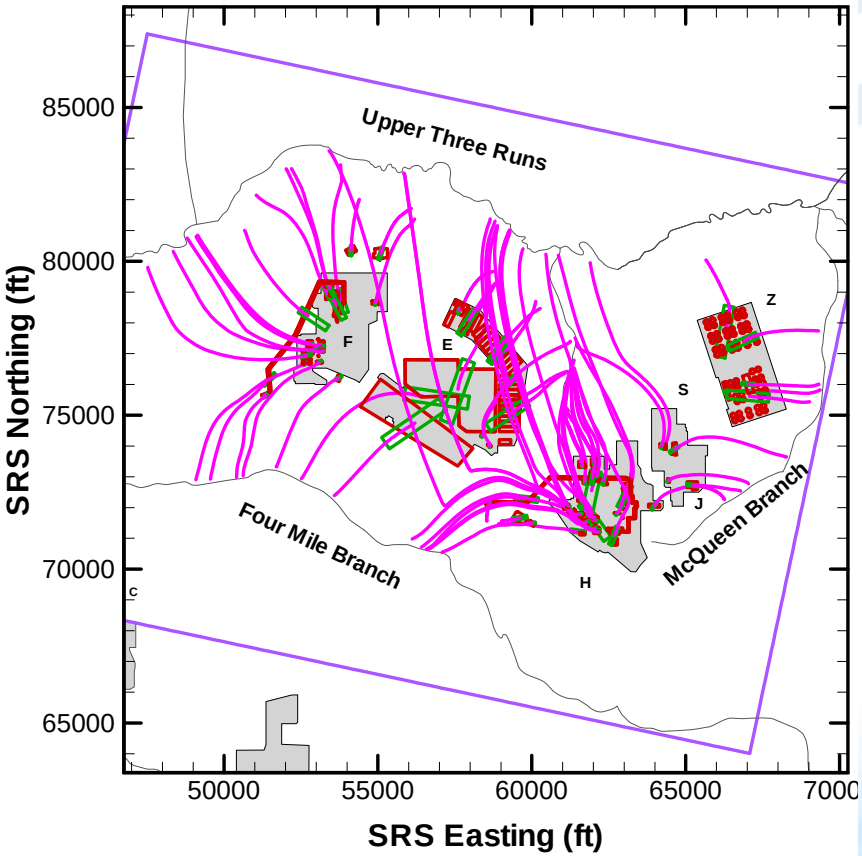
- **1-D abstraction from 3-D groundwater flow models**
- **Graded approach**
- **Hybrid modeling approach using GoldSim™ for both transport and dose modeling (152 sources):**
  - Reasonably-conservative best estimate deterministic base case:
    - Generic Release Model
    - Source Release Modeling
  - Deterministic sensitivity cases and probabilistic (uncertainty) modeling to aid in the interpretation of the deterministic base case results

1-D Abstraction from 3-D Groundwater Flow Model

3-D GSA Groundwater Flow Model



1-D Abstraction



1-D Abstraction from 3-D Groundwater Flow Model Example

Example: Old Radioactive Waste Burial Ground (ORWBG):

a) **Streamtrace plot (~1000)**

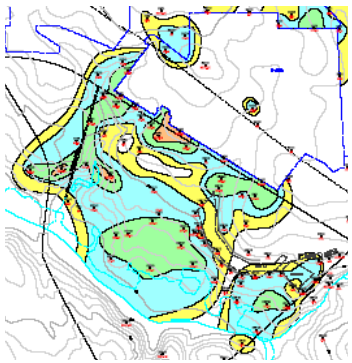
b) **Inventory distribution (area projection)**

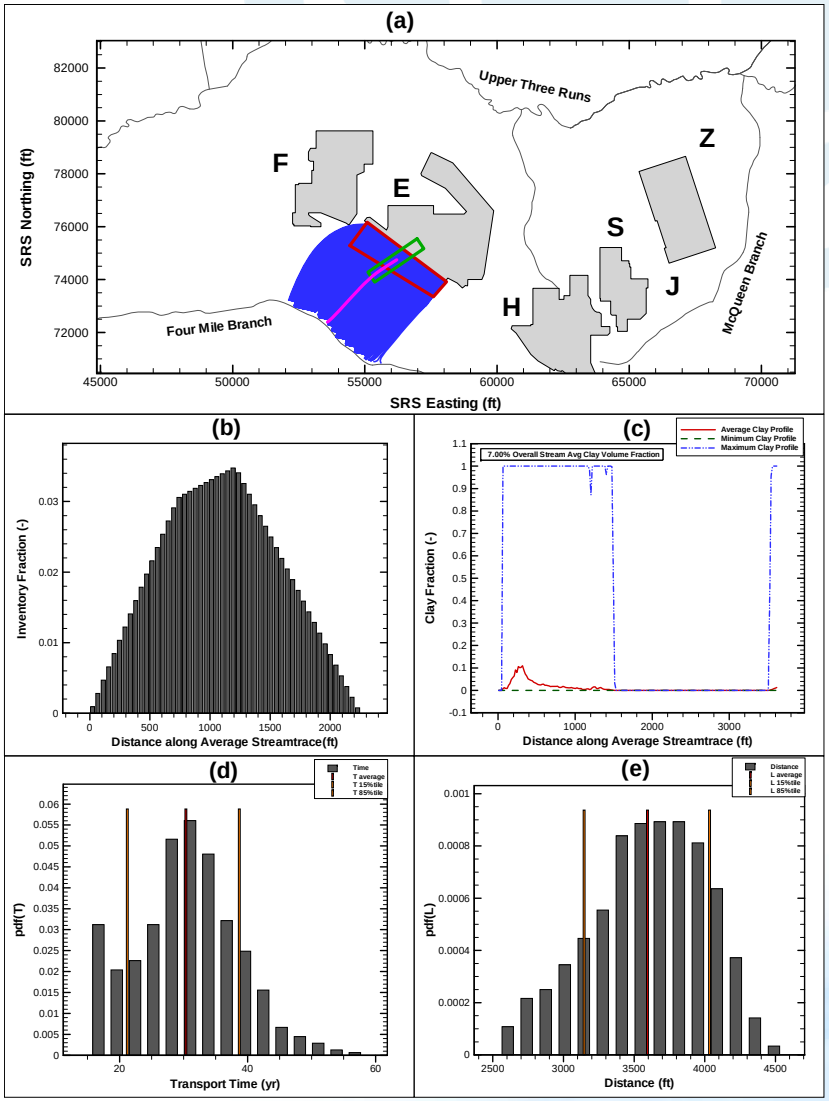
c) **Clay in flow path (~27 ft)**

d) **Transport time (~30 years)**

e) **Distance (~3600 ft)**

ORWBG Tritium Plume





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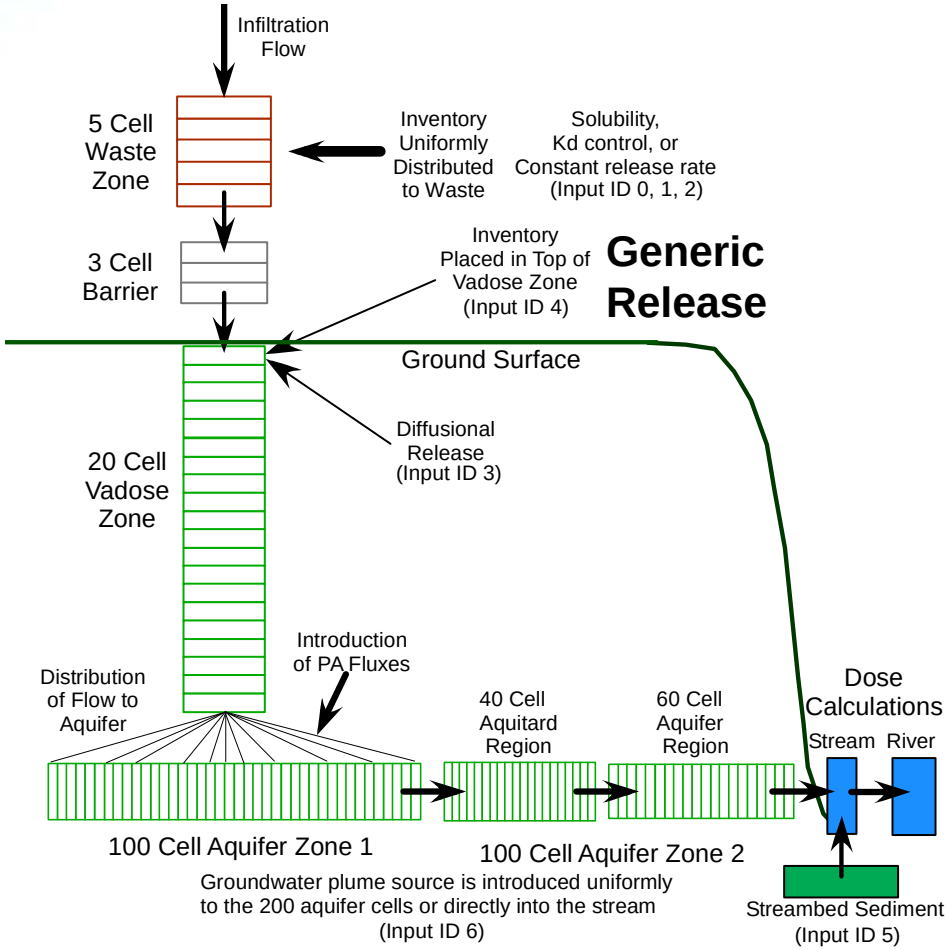
SRS CA Model: Transport Module

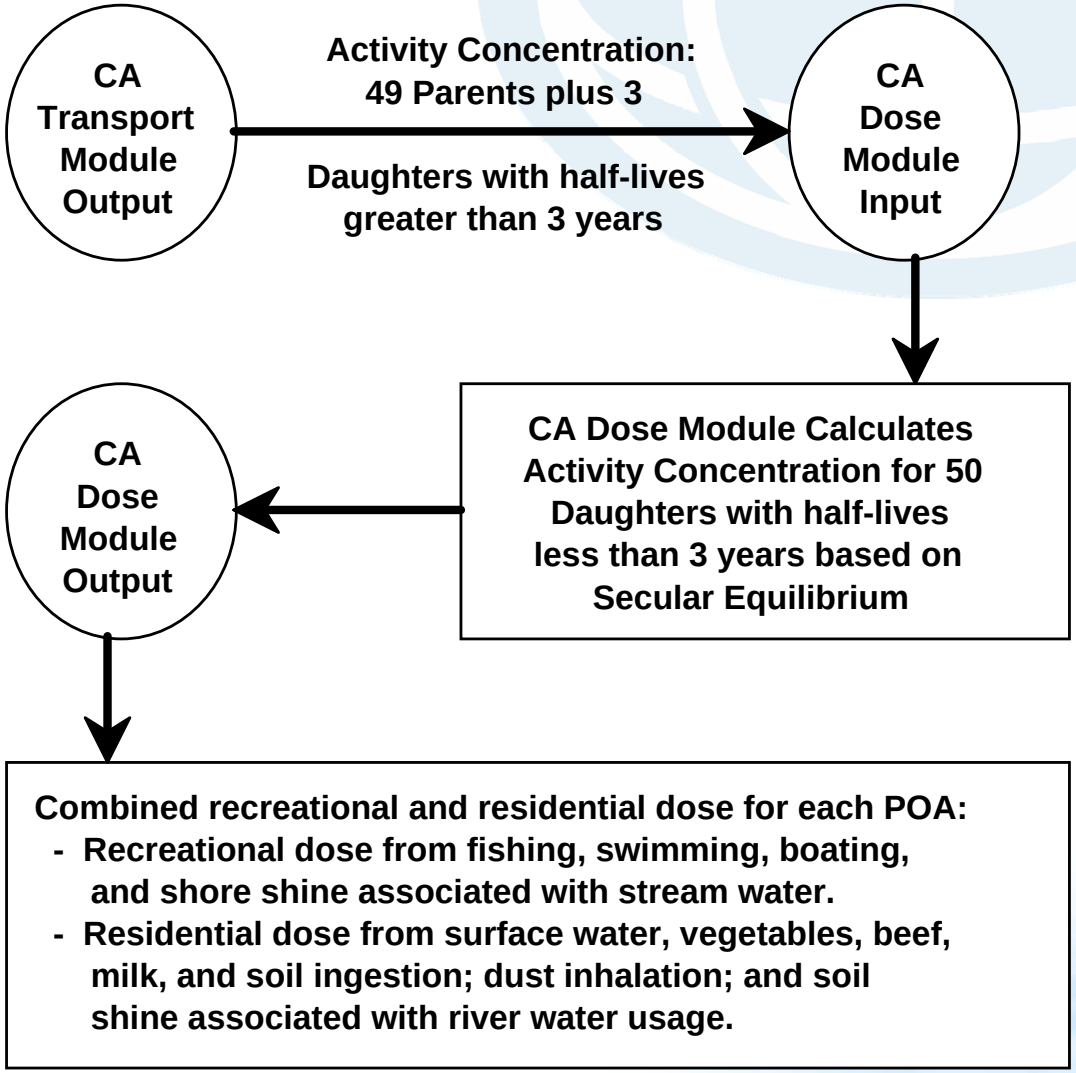
Schematic Representation of CA GoldSim™ Transport Module



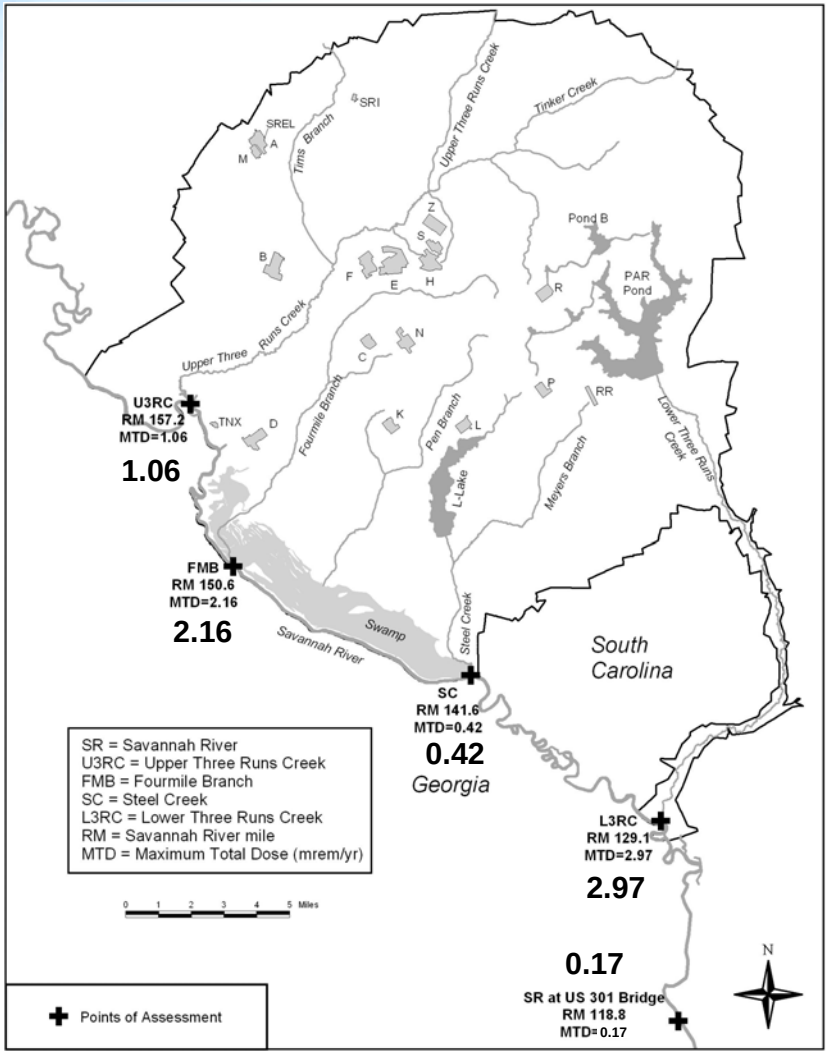
- **Generic Release (108 sources):**
  - Inventory on top of vadose zone
- **Source Release (44 sources):**
  - Source with generic release >0.1 mrem/yr
  - More accurately account for radionuclide release mechanism

SRS CA Model: Dose Module

GoldSim™ Dose Module calculates a combined recreational and residential dose for each POA.



SRS CA Results Summary



- **Source Interaction:**
  - **81 Sources at U3RC**
  - **118 Sources at FMB (add 37)**
  - **141 Sources at SC (add 23)**
  - **152 Sources at L3RC (add 11)**
  - **152 Sources at Savannah River (Highway 301 Bridge)**
- **Maximum 3 mrem/year at L3RC**
- **Traced to individual sources, radionuclides, and pathways**

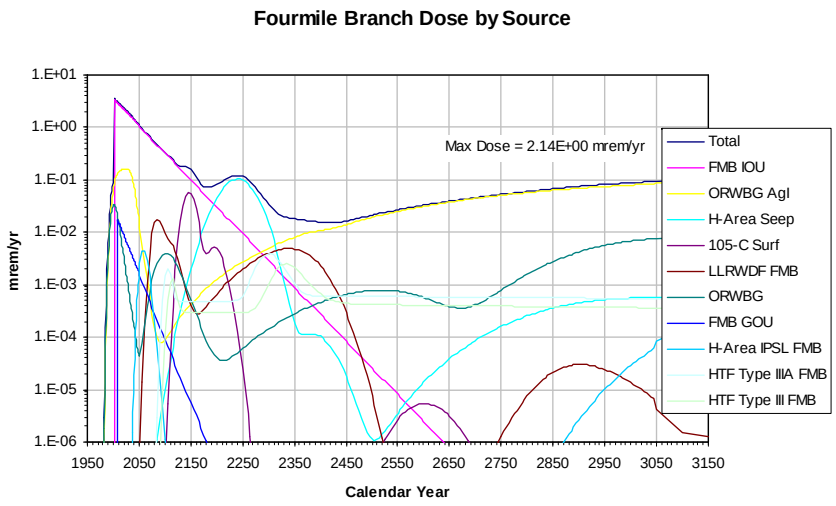
SRS CA Results Summary (continued)

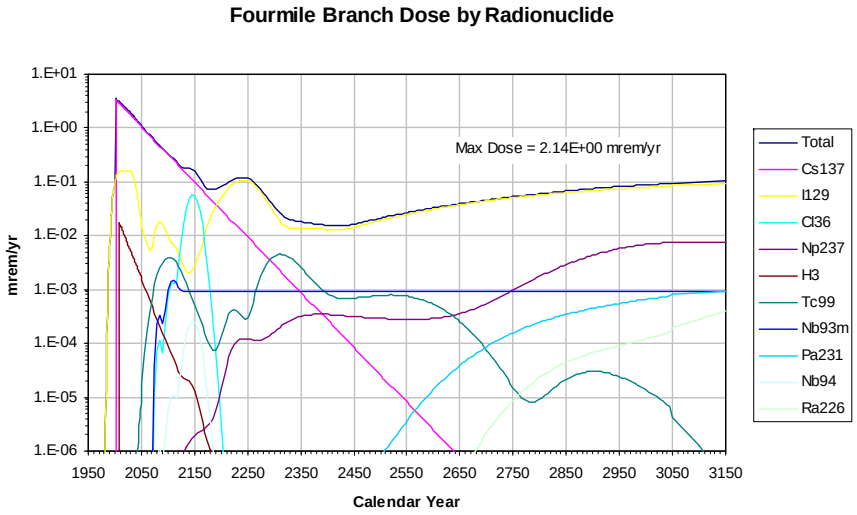
Maximum Cumulative* Dose at each POA

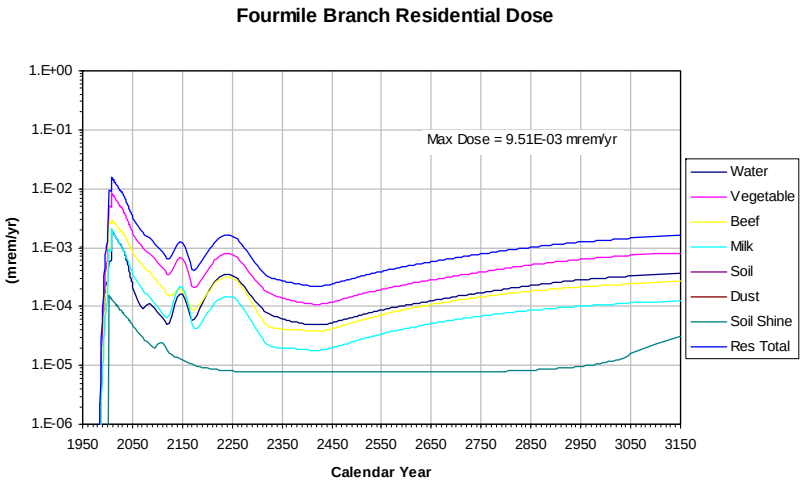
Point of Assessment	1000-Year Maximum Cumulative Dose mrem/yr	Next 9000-Year Maximum Cumulative Dose mrem/yr	Major Contributing Source	Major Contributing Radionuclide	Major Exposure Scenario/Pathway
Upper Three Runs	1.06	0.40	H-Canyon	Np237	Recreational / Fish Ingestion
Fourmile Branch	2.16	0.14	FMB IOU	Cs137	Recreational / Fish Ingestion
Steel Creek/Pen Branch	0.42	0.05	SC IOU	Cs137	Recreational / Fish Ingestion
Lower Three Runs	2.97	0.05	LTR IOU	Cs137	Recreational / Fish Ingestion
Savannah River	0.17	0.05	LTR IOU	Cs137	Residential / Vegetable Ingestion

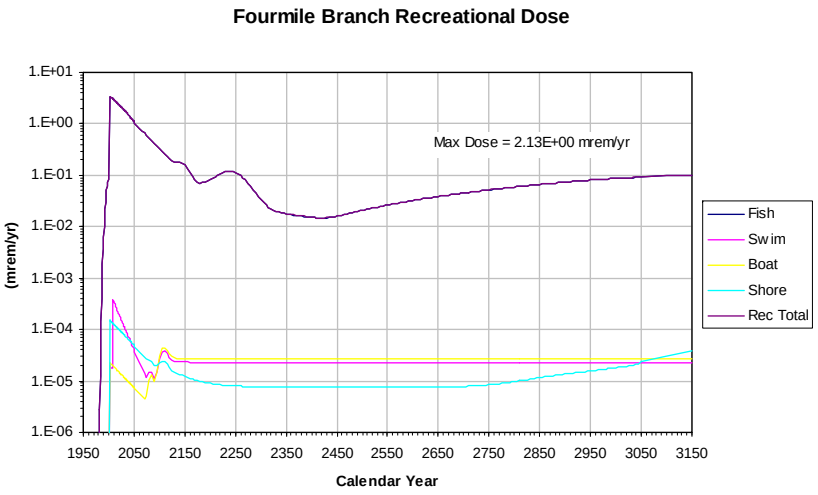
* Cumulative dose includes contribution from upstream sources

SRS CA Results Summary (continued)





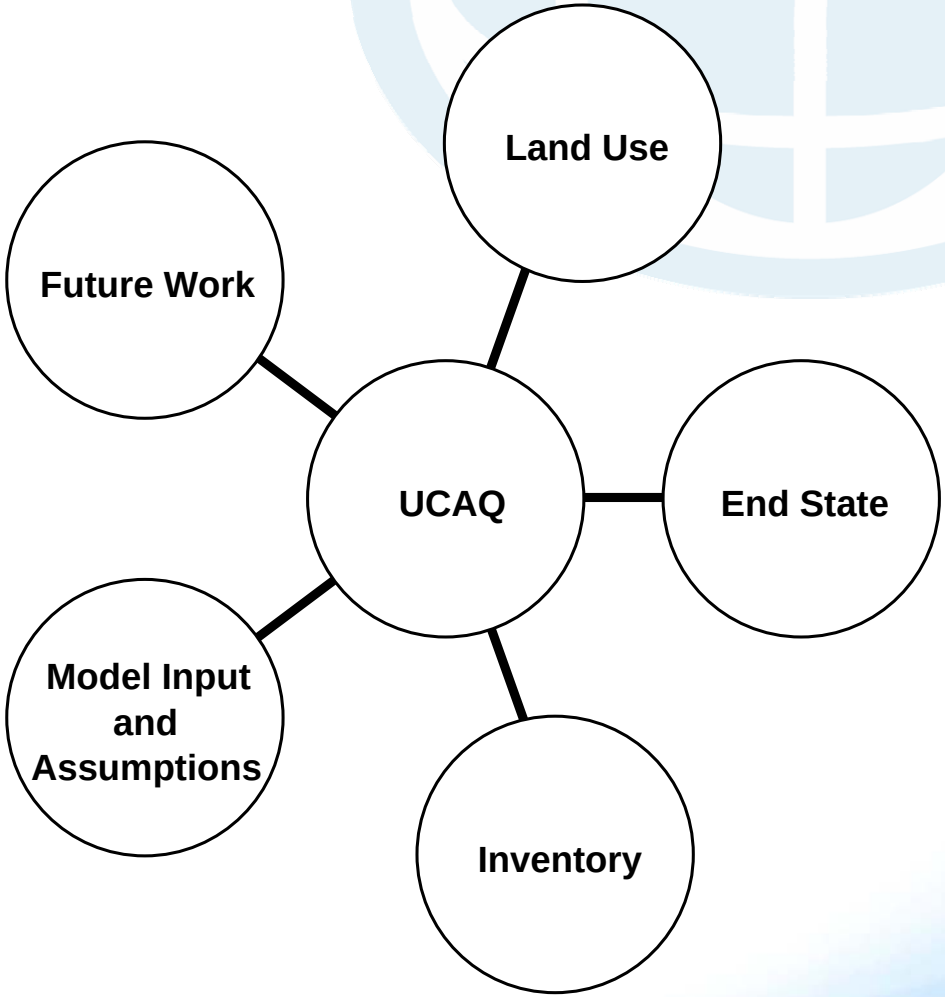




SRS CA Maintenance

The SRS CA will be maintained as required by DOE Order 435.1:

- **Key input and assumptions will be protected**
- **Changes will be evaluated for their impact on CA conclusions**



UCAQ = Unreviewed Composite Analysis Question

SRS CA – A Risk Based Management Tool

- **Risk based management tool:**
  - Provides the aggregate radiological impact resulting from all end state facilities/waste sites
  - Allows identification of the relative importance of individual facilities/waste sites, radionuclides, and exposure pathways to the radiological protection of the public
  - Provides a screening tool which can be used to indicate when more detailed analyses are warranted
  - Provides a means to evaluate facility/waste site remedial actions relative to radiological protection of the public
- **Could be expanded relatively easily to also evaluate average groundwater radionuclide concentrations for a comparison to the EPA maximum contaminant levels (MCLs)**

Q&A / Contact

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