Savannah River Site (SRS)
Special Exposure Cohort (SEC)
Update on Priority Issues

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SRS Priority Issues

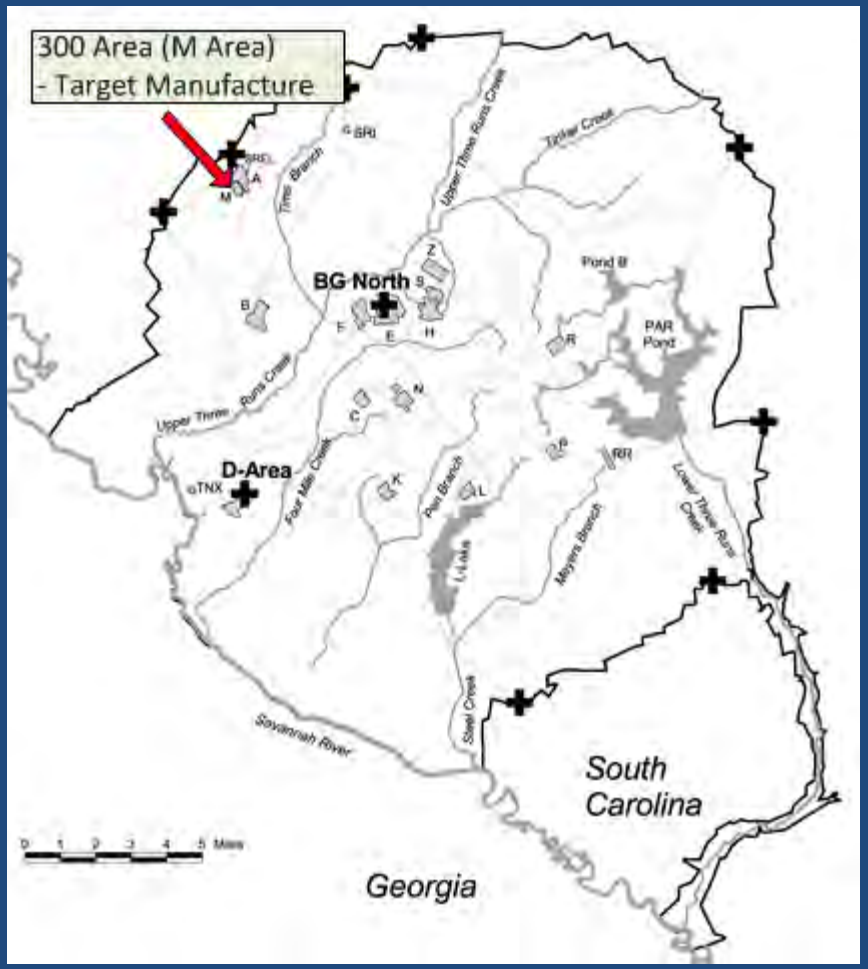
- Issue 1: Thorium 1953 – 1965: metal
- Issue 2: Thorium 1965 – 1971: oxide
- Exotic Radionuclides
  - Issue 4: Trivalent (Am, Cm, Cf)
  - Issue 5: Neptunium
  - Issue 6: Mixed Fission Products
  - Issue 7: Cobalt-60
  - Issue 11: Other exotics (Po, Tm, Tl)

SRS Isotope Production

- Three step process:
  1. Target manufacture
     - 300 Area or M area
  2. Target irradiation
     - 100 Area – reactors
  3. Target chemical separation
     - 200 Area – canyons

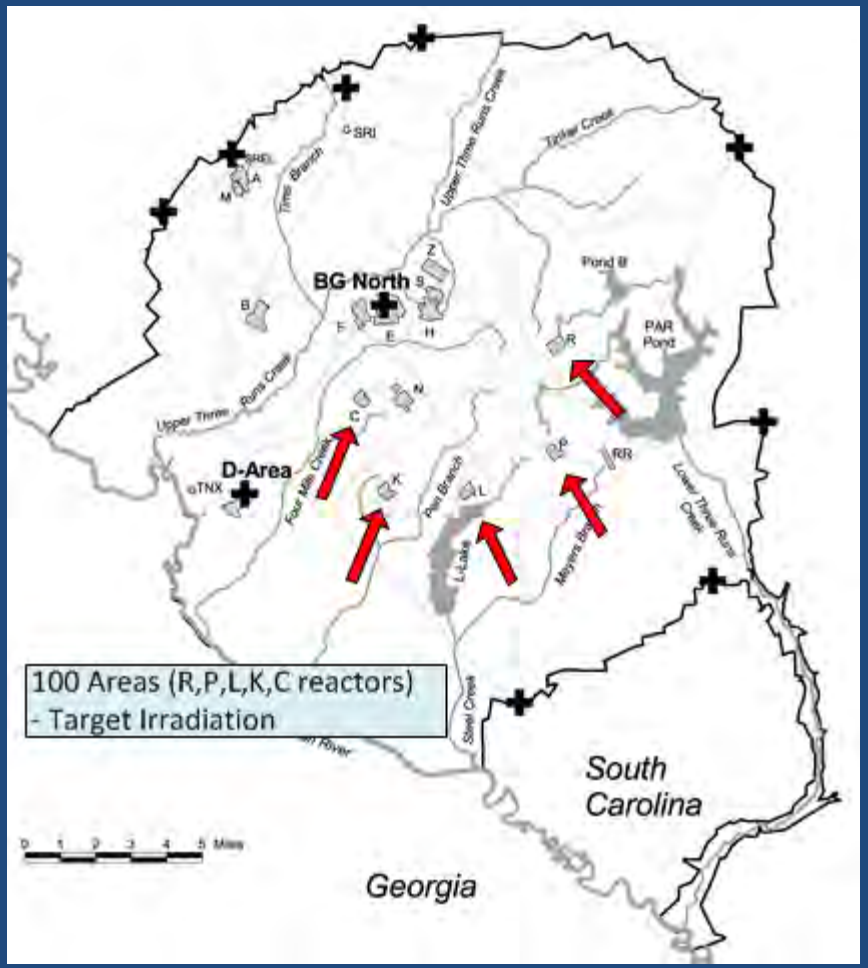
Target Manufacture

- Material
  - Th metal pre 1965
  - Th oxide post 1965
- Material Canning
  - Onsite pre 1955
  - Offsite 55-64 - Sylvania
  - Onsite post 1964
- Target Inspection
  - Pressure tests
  - Radiography
  - Smears



Target Irradiation

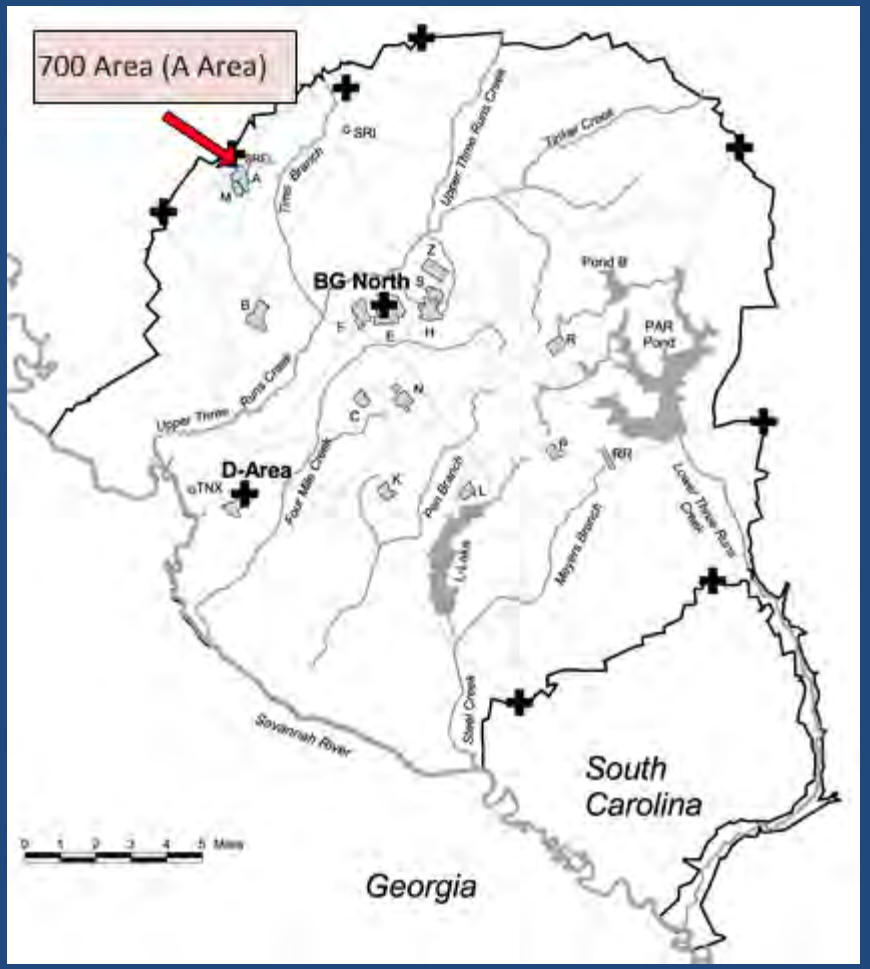
- Assembly
  - Encapsulated thorium slugs loaded into assemblies
- Reactor
  - Encapsulated thorium slugs irradiated for specified period
- Disassembly
  - Encapsulated thorium slugs unloaded and allowed to cool in pool



Target Chemical Separation

(pre 1964)

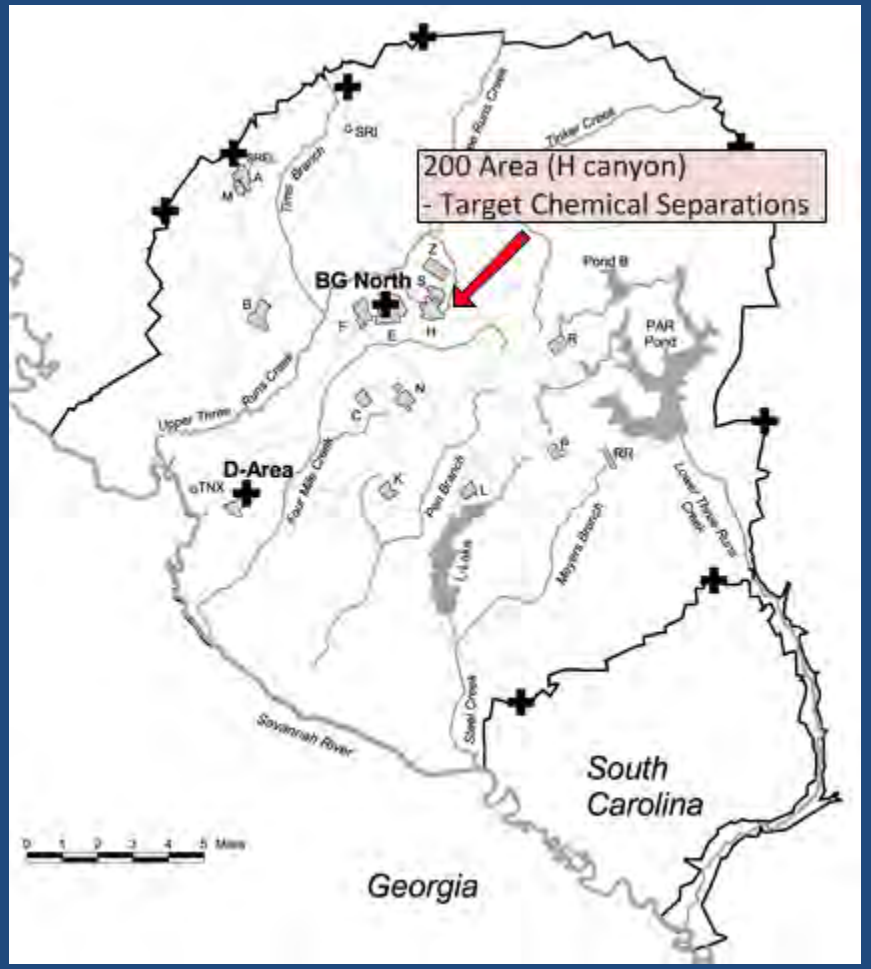
- **Offsite – Oak Ridge**
  - Pre 1964: the encapsulated thorium slugs that had been irradiated were sent to ORNL
- **Onsite – 700 area**
  - Some samples sent for lab analysis



Target Chemical Separation

(post 1964)

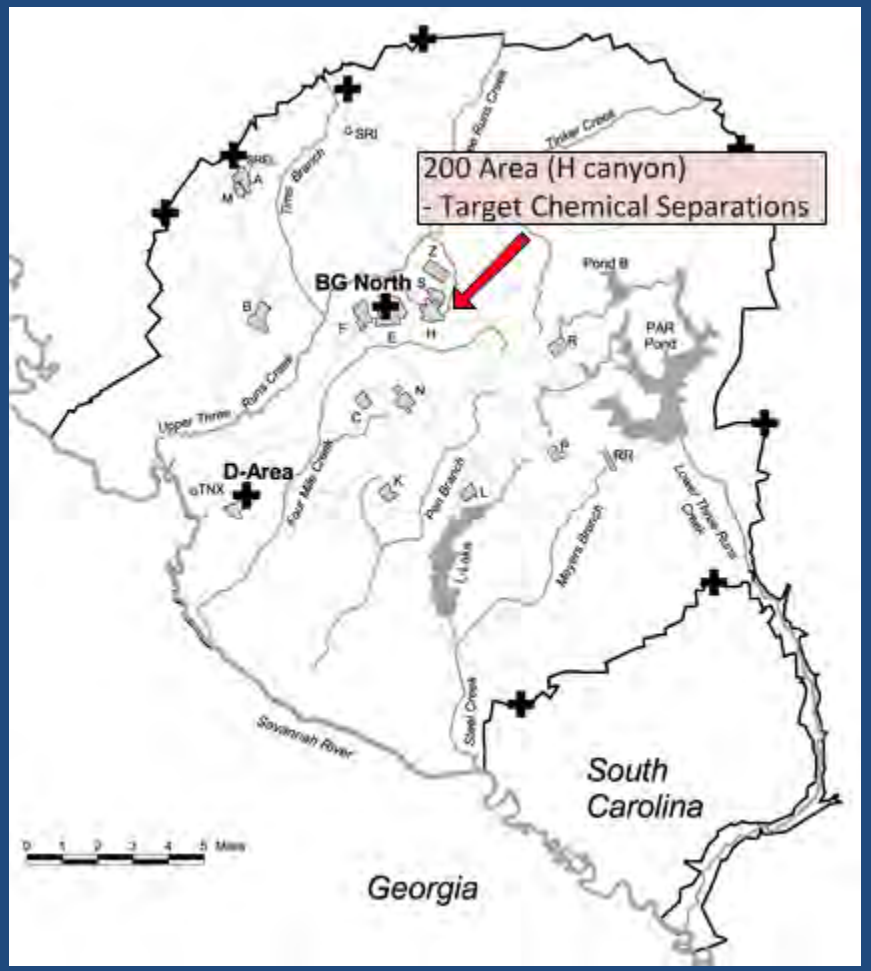
- **Onsite – 200 H Canyon**
  - First campaign (1964): Th treated as a waste product and slurry with mixed fission products sent to tank farms.
  - Later campaigns: Th recovered as $ThNO_3$ and sent to Fernald



Target Chemical Separation—cont.

(post 1964)

- H Canyon
  - Separate U-233 from thorium and mixed fission products
  - U-233 ,which was the product, was sent to the B-Line
  - Mixed Fission Products (MFP) sent to waste tanks (tank farms)
  - Th recovered as $ThNO_3$ and sent to Fernald



SEC Evaluation – Th Addendum

- Of the three steps in the U-233 production campaigns, NIOSH originally felt the exposures in the 300M Area were of greatest concern
  - 300M Area – unencapsulated material
  - 100 Areas – encapsulated material
  - 200 Area
    - Material not present until 1964
    - After 1964, wet process and $ThNO_3$ sent to Fernald for processing back to metal

Thorium Metal Dose Reconstruction Methodology for 300M Area

- Thorium canning AlSi dipping method
- Other components of canning process
  - Lathing
  - Dipping
  - Welding
  - Inspection

Interior of canning building illustrating dip canning process, (SRS Archives 1956, SRDB 27540)

Thorium Metal Dose Reconstruction Methodology for 300M Area—cont.

- Thorium canning process similar to uranium canning process
- After 1956, thorium was canned at Sylvania and finished/inspected in the 300M area
- Uranium bioassay available
- Since U-Th canning processes were similar
  - Used uranium bioassay to determine the ***mass*** intake of uranium
  - Assumed equal ***mass*** intake of thorium and calculated dose

Thorium Slug Production

Year	Number of Uranium Targets	Number of Thorium Targets	Thorium Fraction
1953	200,000	321	0.0016
1954	500,000	1,726	0.0036
1955	1,200,000	26,618	0.0222
1956	2,700,000	0	0
1957	751,000	5,200	0.0069
1958	840,000	0	0
1959	1,600,000	0	0
1960	1,106,500	0	0
1961	725,100	417	0.0006
1962	955,000	14,000	0.0147
1963	404,825	16,500	0.0408
1964	286,900	9,600	0.0335

Thorium Oxide Dose Reconstruction Methodology for 300M Area

- Powder form of thorium required vibration and compaction
- Different than metal process thus uranium bioassay was not useful
- Due to powder form, glovebox was used to can the thorium

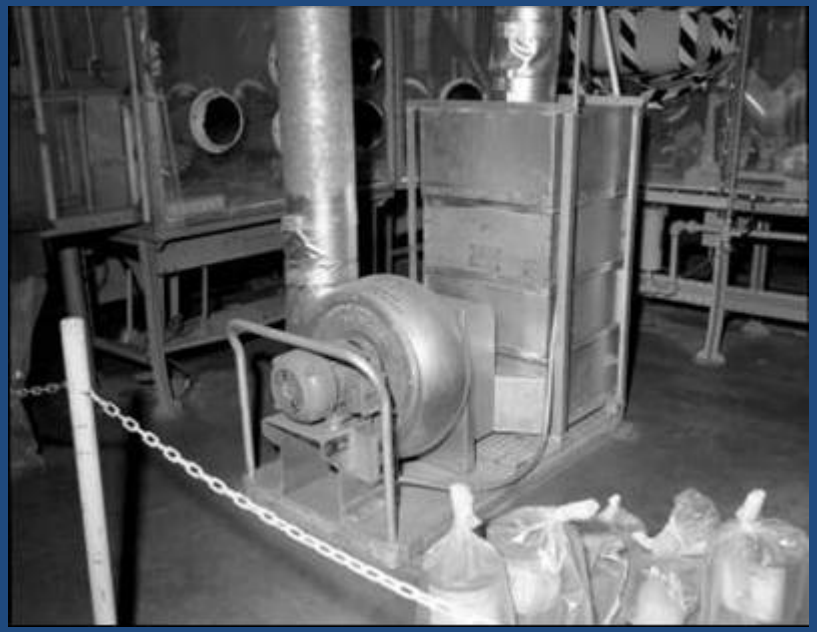
Thorium Oxide Dose Reconstruction Methodology for 300M Area—cont.

Worker at thorium glovebox containment (SRS Archives)

Thorium oxide glovebox containment structure (SRS Archives)

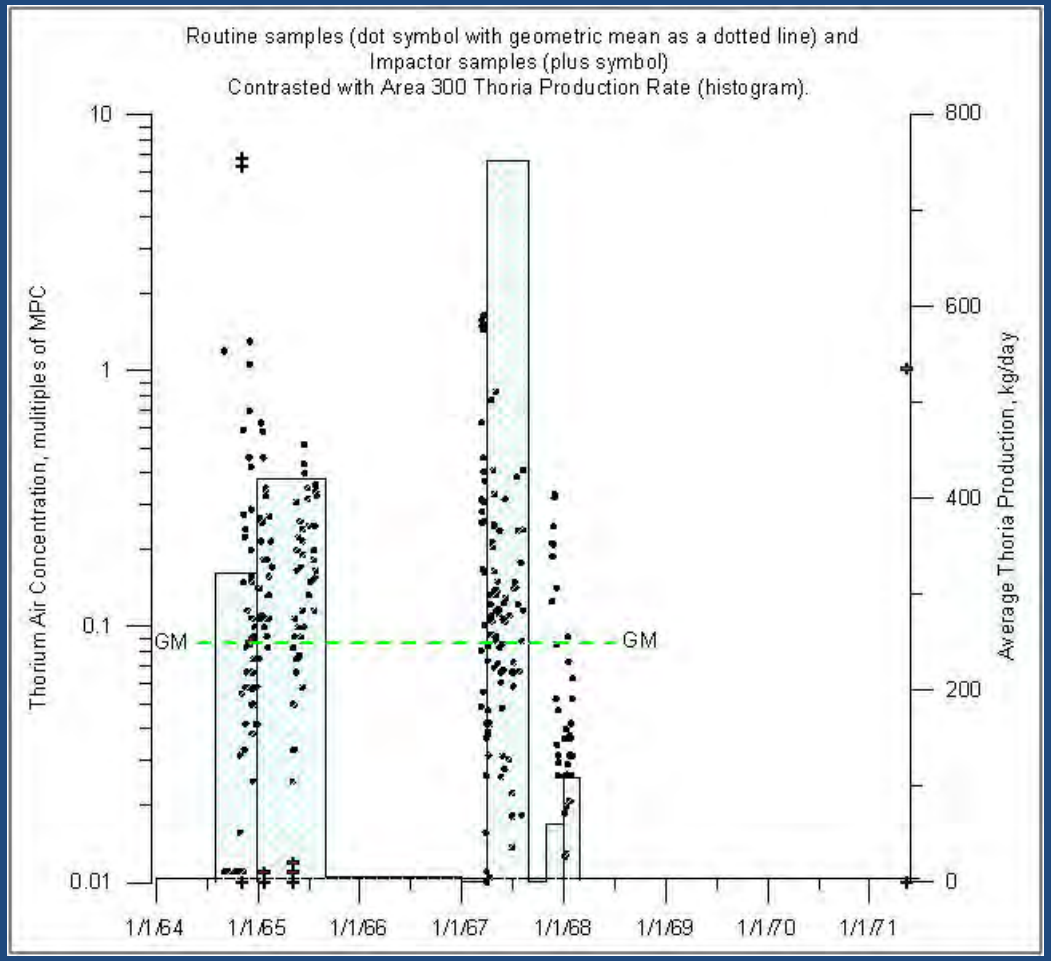
Thorium Oxide Dose Reconstruction Methodology for 300M Area—cont.

Thorium oxide containment ventilation system



HEPA filtration of thorium oxide containment

Thorium Oxide Dose Reconstruction Methodology for 300M Area—cont.



Thorium Oxide Dose Reconstruction Methodology for 300M Area—cont.

- Obtained air sample data in the room of thorium oxide manufacturing line (glovebox)
- Confirmed through interviews with Radiological Control Technician that the air samples outside glovebox was breathing zone equivalent
- Based on air samples we calculated intakes and doses

Thorium Work in Other SRS Areas

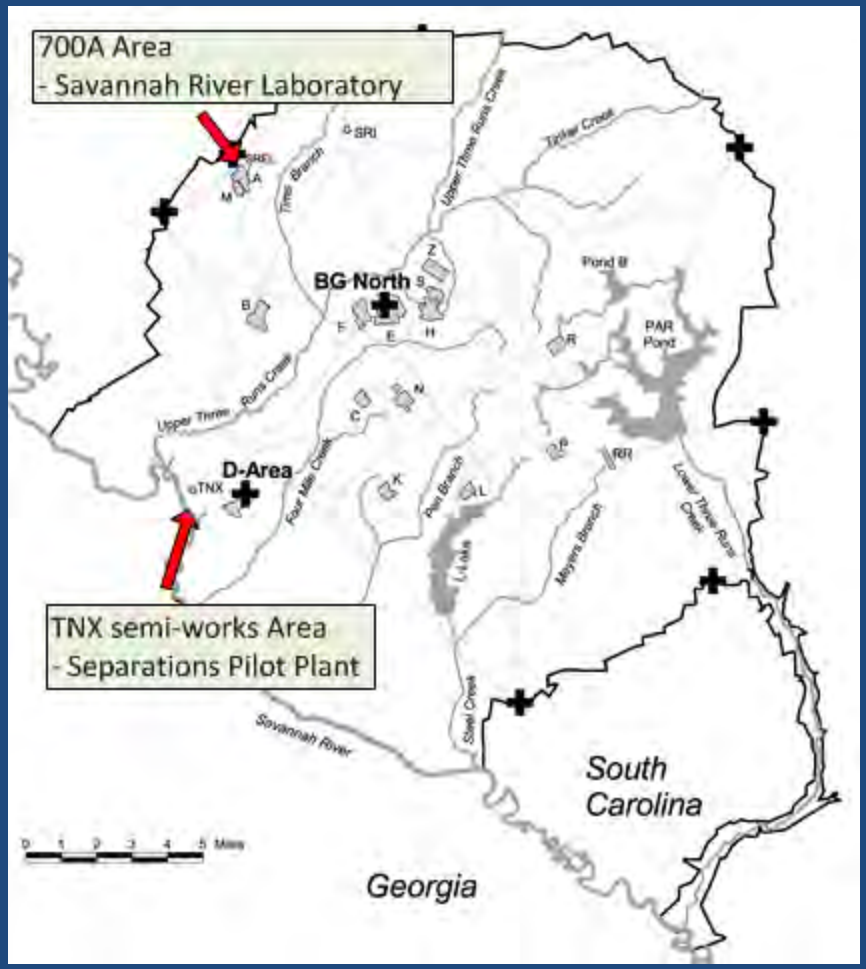
- 300M Area – predominant exposure potential
- Interviews with workers knowledgeable of the thorium operations indicated that Research and Development work was minor using only bench top type quantities
- SC&A finding (January 2011)
  - NIOSH did not address thorium exposures in other areas

Thorium Work in Other SRS Areas—cont.

- Data review at SRS in March 2011
  - Material Accountability Ledgers (inventories)
- Found significant quantities of unencapsulated thorium in the following areas
  - 700A Area
  - TNX Area

Thorium Research and Development (R&D)

- Apparently three steps to new processes:
  1. Lab work (700)
  2. Semi-works or pilot plant scaled up from Lab but below production
  3. Full scale production



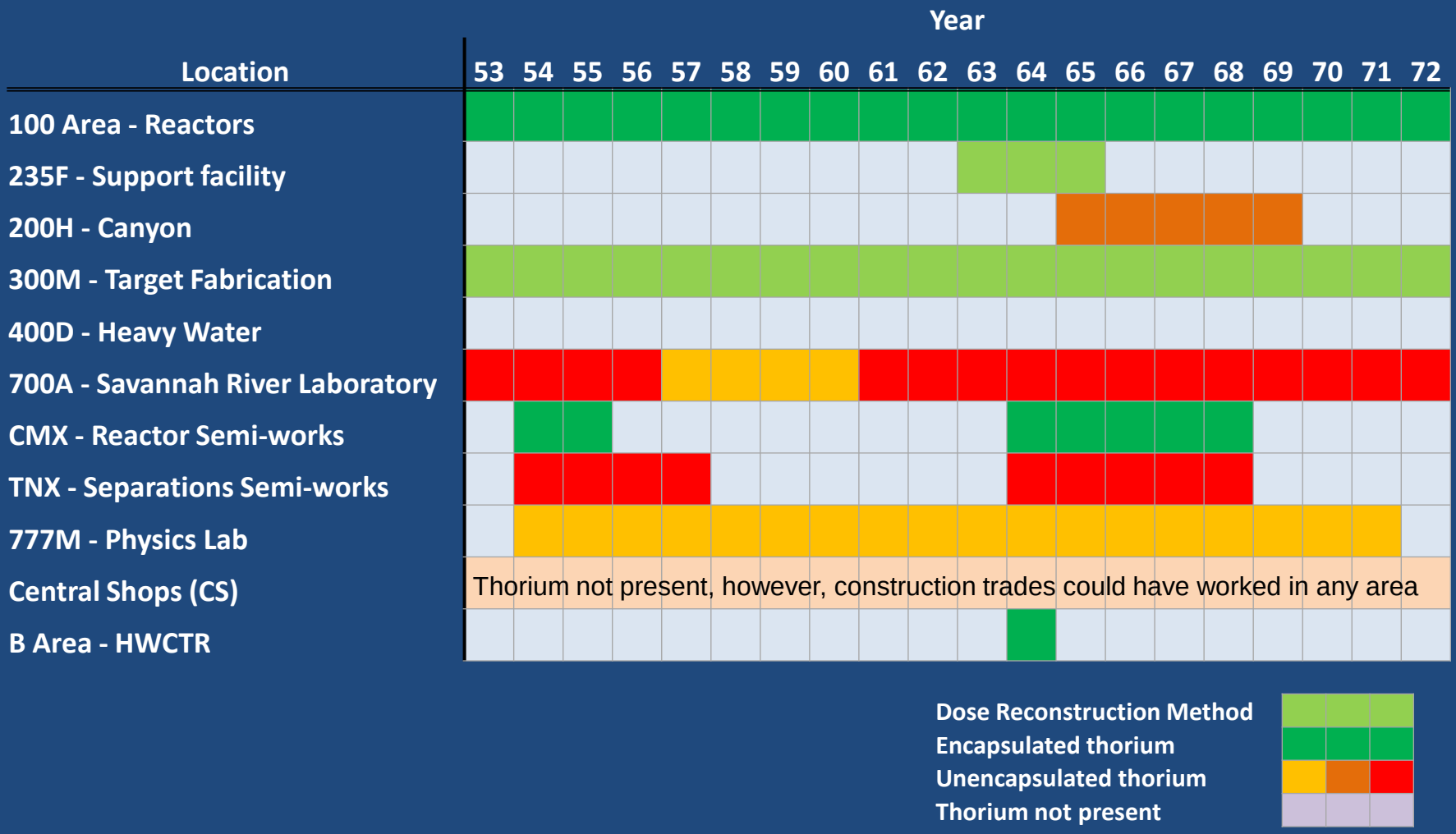
Thorium R&D in 700A Area

- 700A Area – Savannah River Laboratory
  - Memos discussing bench top thorium work in B-wing room 131 appears often
  - Some Hanford irradiated thorium work in High Level Caves
  - Metallurgical R&D Laboratory
    - Known to have capability to manufacture full scale fuel and target assemblies
    - Current belief that most thorium work in 700A area was conducted in this Lab

Thorium R&D in TNX Area

- TNX Area – Separations Semi-works
  - Ledgers indicate intermittent work
    - 1954-1956, and 1964-1968 timeframes
  - 1964 -1968: work involves dissolving un-irradiated (normal) thorium slugs to test designs of separations process for the canyons
  - Thorium separations building built in 1956 (677-G)
    - Building was never put into operation
    - Project was cancelled in 1956

Thorium Dose Reconstruction



Thorium Timeline

- Anticipate revised evaluation report addendum or 83.14 for the Advisory Board's consideration during August meeting
- NIOSH has conducted additional interviews with individuals knowledgeable about thorium research
- Early to mid-June, data review to follow last thread on thorium at SRS

Thorium R&D Radiological Records

- 700A Area – Savannah River Laboratory
  - Identified a box of records labeled as follows

A Pu results Pu control Thorium Log 54-58

A	A Area
Pu results	Plutonium bioassay results for A area
Pu control	Plutonium spikes and blanks for the A Area results
Thorium Log	A thorium bioassay logbook or air samples???
54-58	The data in the box covers 1954 through 1958

Exotic Radionuclides

- Recall: Construction Trades-based SEC Evaluation
- Generally there is less bioassay for construction trades workers compared to operations workers
- Concern has been raised as to whether co-worker models are applicable to construction trades workers due to difference in the nature of the work
  - Potential for higher intensity
  - Less frequent exposure

Exotic Radionuclides—cont.

- Use co-worker models to estimate dose to unmonitored workers
- Analysis Process (co-worker models)
  - Develop All Monitored Workers (AMW) model
  - Develop Construction Trades Worker (CTW) model
  - Hypothesis test to compare the two models
    - Tritium comparison completed in December 2010

Exotic Radionuclides—cont.

- Bioassay samples for Co-worker models for exotic radionuclides
  - Am, Cm, Cf
    - 13,189 urinalysis samples (1964 – 1980)
  - Neptunium
    - 3,012 urinalysis samples (1961-1980)
    - + NOCTS Whole Body Counts
  - Mixed Fission Products
    - 49,061 urinalysis samples (1955-1980)
    - + NOCTS Whole Body Counts

Exotic Radionuclides Concerns

- Insufficient data when only using NOCTS
  - Resulted in the coding of all of the Am, Cm, Cf data
  - All neptunium urinalysis data has been coded along with whole body count data from NOCTS to supplement
  - Mixed Fission Product (MFP) evaluation underway
- Coding work history information
  - Initially used self report from NOCTS
  - Currently using SRS work history cards

Issue #11 Timeline (Other Exotics)

- March 2011: Extracted exotic information from Savannah River Laboratory (SRL) monthly reports
- Selected excerpts from SRL monthly reports
  - Currently undergoing classification review

Questions