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# Hanford Single-Shell Tank Integrity Program

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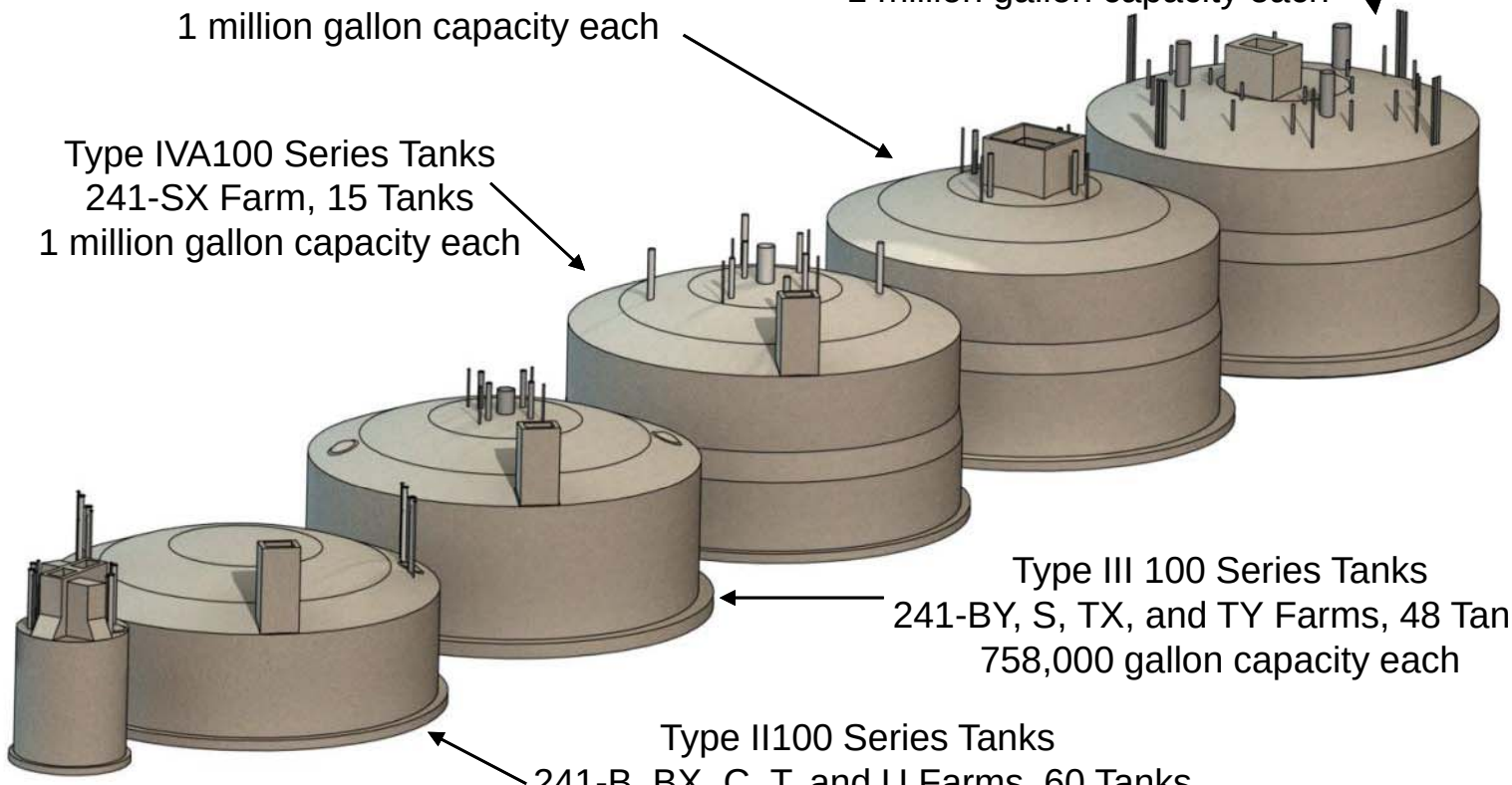
# Introduction

- The Hanford site's principle historic mission was plutonium production for the manufacture of nuclear weapons.
- Between 1944 and 1988, the site operated nine graphite-moderated, light-water, production reactors to irradiate fuel and produce plutonium.
- Four large chemical separations plants were run to extract plutonium from the fuel, and a variety of laboratories, support facilities, and related infrastructure to support production.
- The Hanford Site processed approximately 100,000 metric tons of uranium and generated several hundred thousand metric tons of waste.

# Introduction

- Hanford production activities at the site between 1943 and 1991 resulted in a broad range of contaminated materials and facilities that are now being managed and remediated.
- The major waste to be dealt with is the approximately 53 million gallons of high-level waste, stored underground in the 149 Single-Shell Tanks (SSTs) and the 28 Double-Shell Tanks (DSTs).
- Today we will discuss maintaining and monitoring the 149 SSTs presently containing about 30 million gallons of waste.

# Single Shell Tank Size Comparison



Type IVC100 Series
Tanks 241-AX Farm, Four Tanks
1 million gallon capacity each

Type IVB100 Series
Tanks 241-A Farm, Six Tanks
1 million gallon capacity each

Type IVA100 Series Tanks
241-SX Farm, 15 Tanks
1 million gallon capacity each

Type III 100 Series Tanks
241-BY, S, TX, and TY Farms, 48 Tanks
758,000 gallon capacity each

Type II100 Series Tanks
241-B, BX, C, T, and U Farms, 60 Tanks
530,000 gallon capacity each

Type I 200 Series Tanks
241-B, C, T, and U Farms, 16 Tanks
55,000 gallon capacity each

**12 Single Shell Tank Farms with 149 SSTs were Constructed between 1943 and 1964**

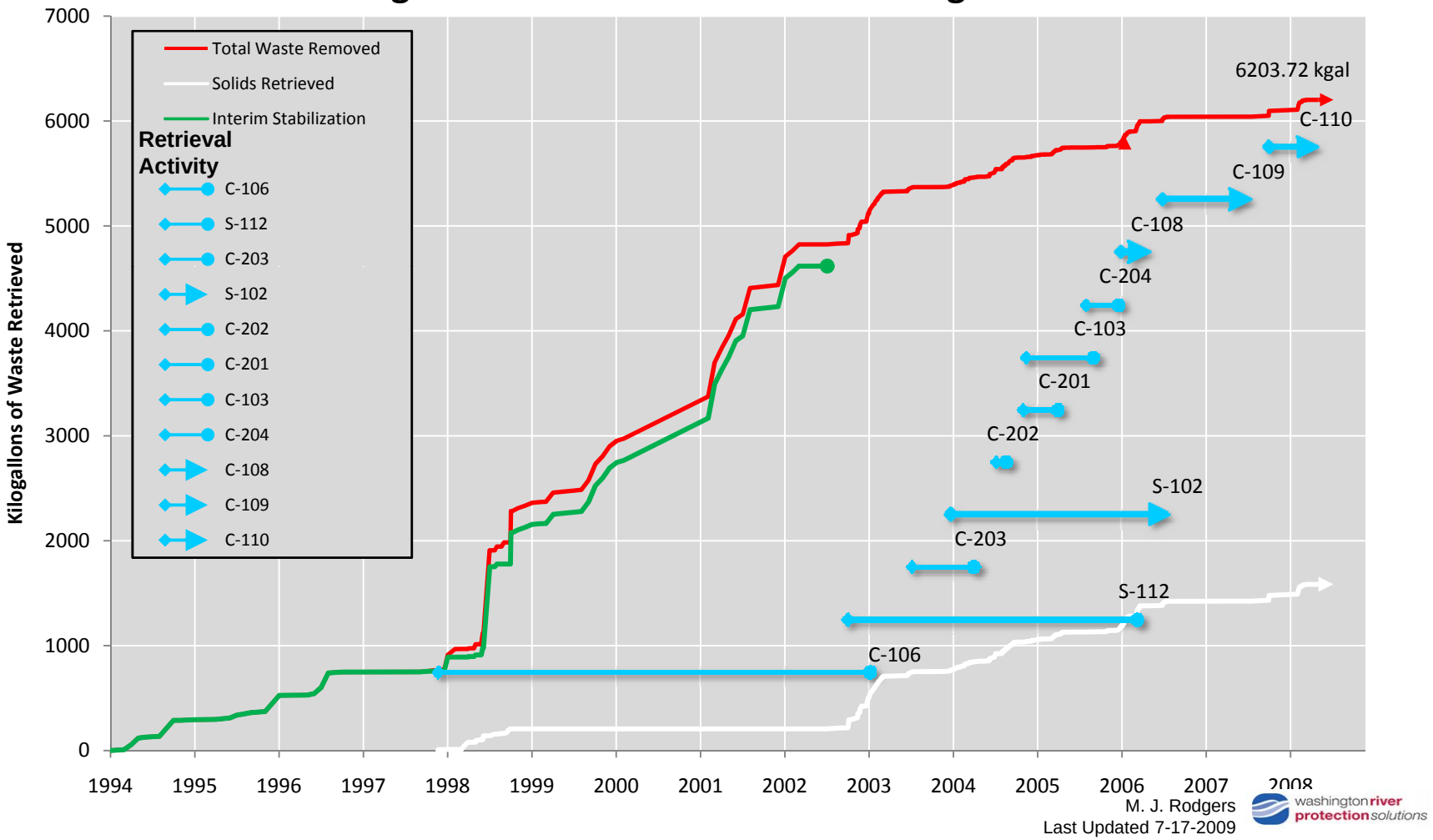
# 241-BX Tank Preparation August 1947

# Single-Shell Tank Condition

- SSTs were built between 1944 and 1964 in twelve tank farms.
- DOE stopped discharges to the SSTs in 1980 to comply with the Congressional mandate that prohibited waste additions to the SST after 1/1/1981.
- Hanford completed interim stabilization of the SSTs in 2004 by removing the SST supernate to less than 5,000 gallons and drainable interstitial liquid less than 50,000 gallons from the SSTs.
- Following stabilization Hanford interim isolated the SSTs by blanking off and sealing access points to the tanks.

# SST Retrieval History

## Single Shell Tank Waste Removal Progress




M. J. Rodgers
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# Double-Shell Tanks for Active Operations

- Waste removed from SSTs has been pumped to DSTs, using temporary Hose-In-Hose transfer lines to the direct buried DST lines.
- The 28 DSTs were built between 1968 and 1986.
- Until recently the primary focus of Hanford integrity activities has been on the development of a robust program for the DSTs, that included:
  - In service inspection
    - Visual of the primary and annulus space of the DSTs
    - Ultrasonic testing of the primary tank and secondary liner by access through annulus risers.
  - Chemistry control for:
    - The prevention of general uniform corrosion, localized corrosion and stress corrosion cracking
    - Optimization of the controls to reduce chemical additions.

# Hose-In-Hose Transfer System

# SST Integrity

- Recognizing the potential remaining duration of the Hanford remediation activities, before all SSTs are closed, recent initiatives are focused on an enhanced SST Integrity program.
- We will review the current activities presently done to ensure SSTs Structural Integrity and SST Leak Integrity
- Following that we will review the potential enhancements to the SST Integrity Program
  - Structural Integrity
  - Leak Integrity

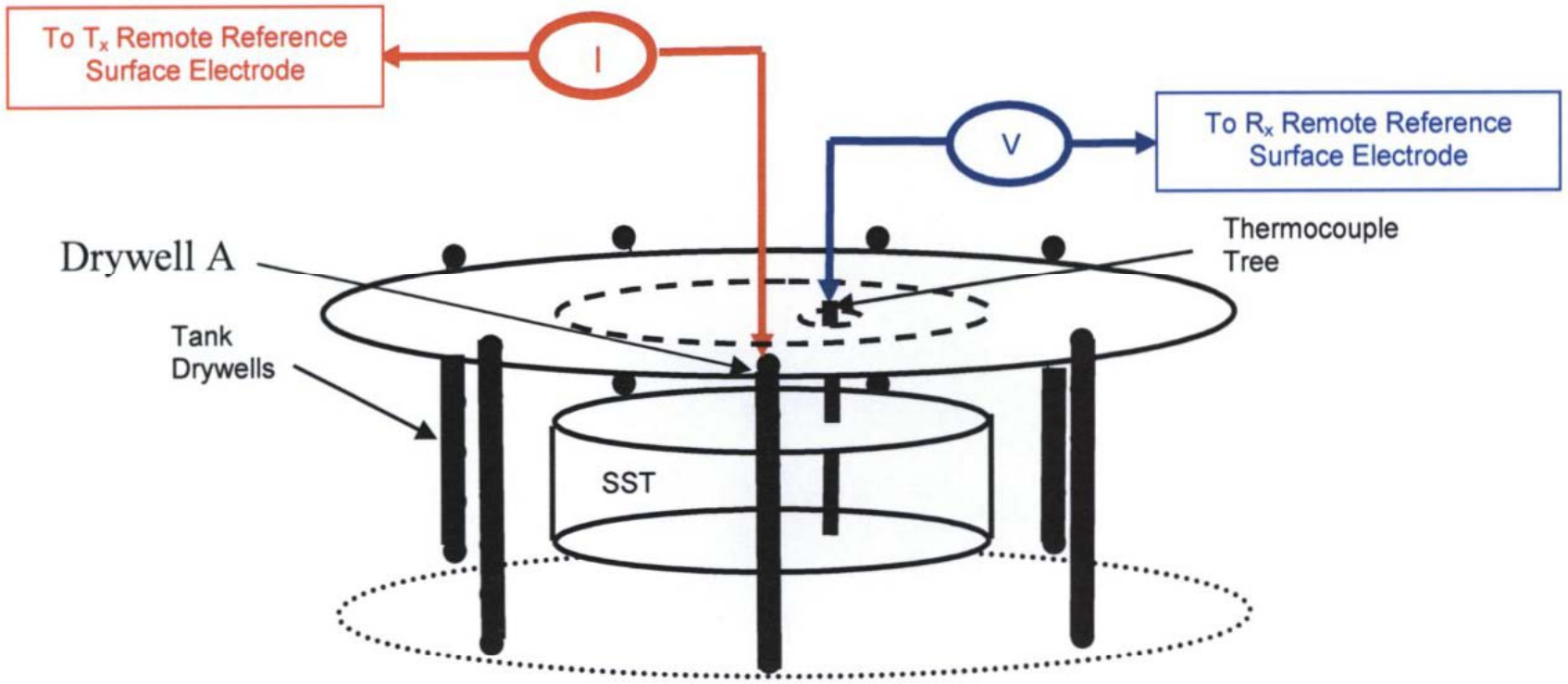
# Current SST Integrity Activities

- The Present SST Integrity program consists of the following elements:
  - Dome Deflection Surveys
  - SST Structural Analysis of Record (2002)
  - Photo/Video Archives (Dome Interior)
  - Leak History Archive
  - Surveillance
    - Liquid Observation Wells (LOWs)
    - Drywell Monitoring
    - ENRAF(s)™ *(the product name for automated servo level gauge sold by Honeywell Enraf of Holland)*
    - Material Balance during Retrieval
    - Transfer Route Monitoring
    - Waste Retrieval Waste Leakage Minimization

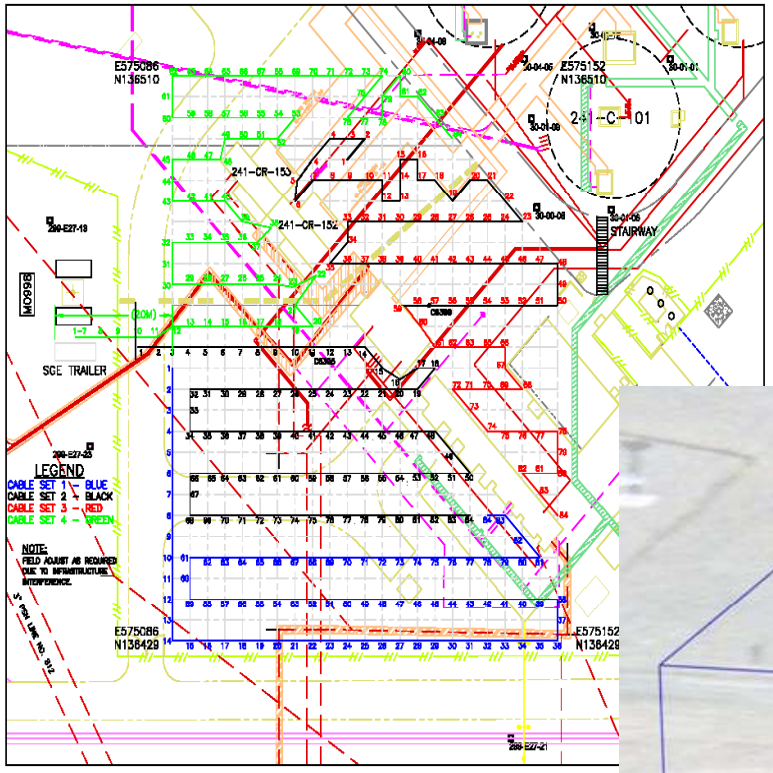
# Current SST Integrity Activities (cont.)

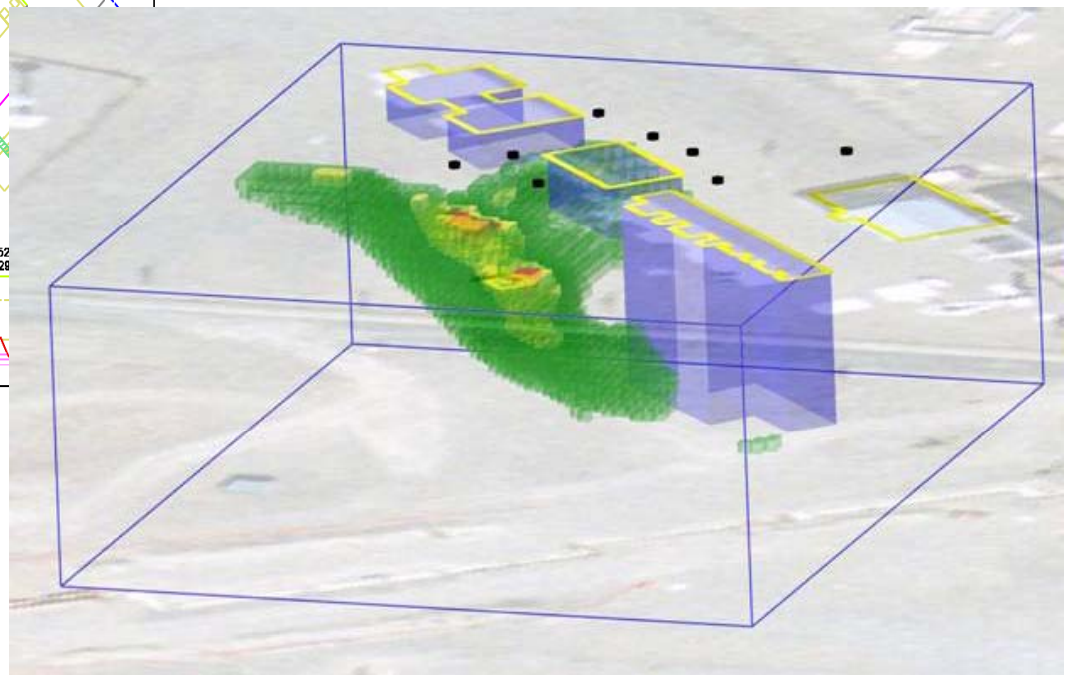
- High Resolution Resistivity (HRR) Leak Detection and Monitoring (LDM) System
  - Demonstrated on 241-S-102
  - Estimates of detection capability ranged from 800 to 2,000 gallons
- Surface Geophysical Exploration (SGE) Technologies
  - Demonstrated in 241-C Tank Farm
  - Identifies area of higher conductivity (e.g., water and nitrate), but doesn't quantify leak volumes
- Transfer Route Monitoring (Rad, Tox, Visual)
- Formal tank leak assessment process using tank operating procedure (TFC-ENG-CHEM-D-42)

# High Resolution Resistivity Measurements

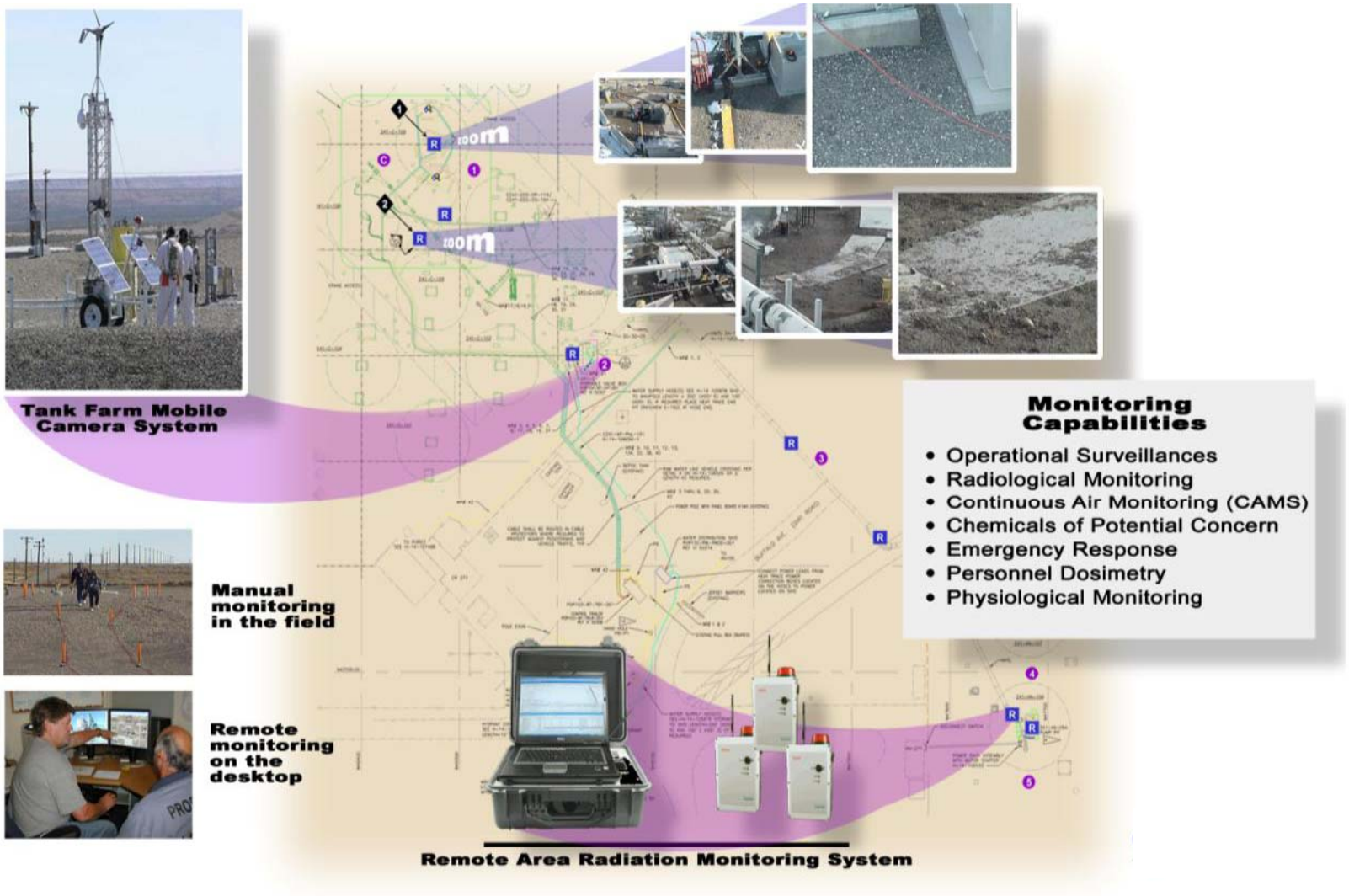


# SGE Test Layout in C-Farm



# Safety Through Remote Monitoring



# SST Integrity Panel Workshop Scope

- Two Expert Panel Workshops for SST Integrity were held in 2009.
- Scope:

  Recommend Single Shell Tank Integrity Program activities to support extension of the operational life of the tanks

- Enhancements to the SST Integrity Program would be based on this panel's recommendations and provide the programmatic guidance for the next five years

# Single-Shell Tank Integrity Panel Members

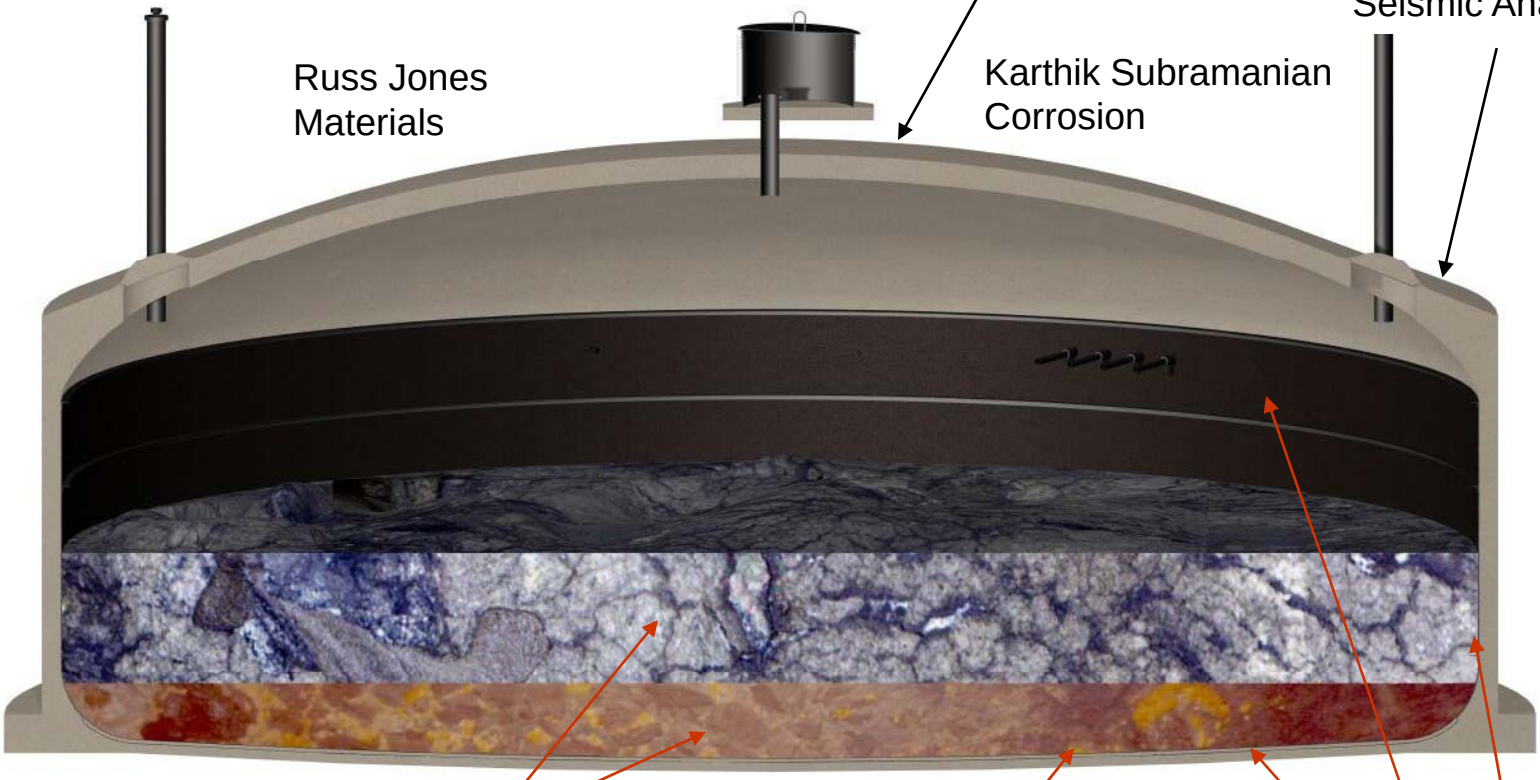
Mike Terry Chair
Todd Martin Co-Chair
Mike Rinker Analysis Lead

Bruce Thompson
Non-Destructive Evaluation

Bob Kennedy
Structural and
Seismic Analysis

Russ Jones
Materials

Karthik Subramanian
Corrosion



Steve Cullen
Soil and Vadose
Zone Analysis

Leon Stock
Waste Chemistry

John Beavers
Stress Corrosion Cracking

Jerry Frankel and
Bruce Wiersma
Electrochemistry

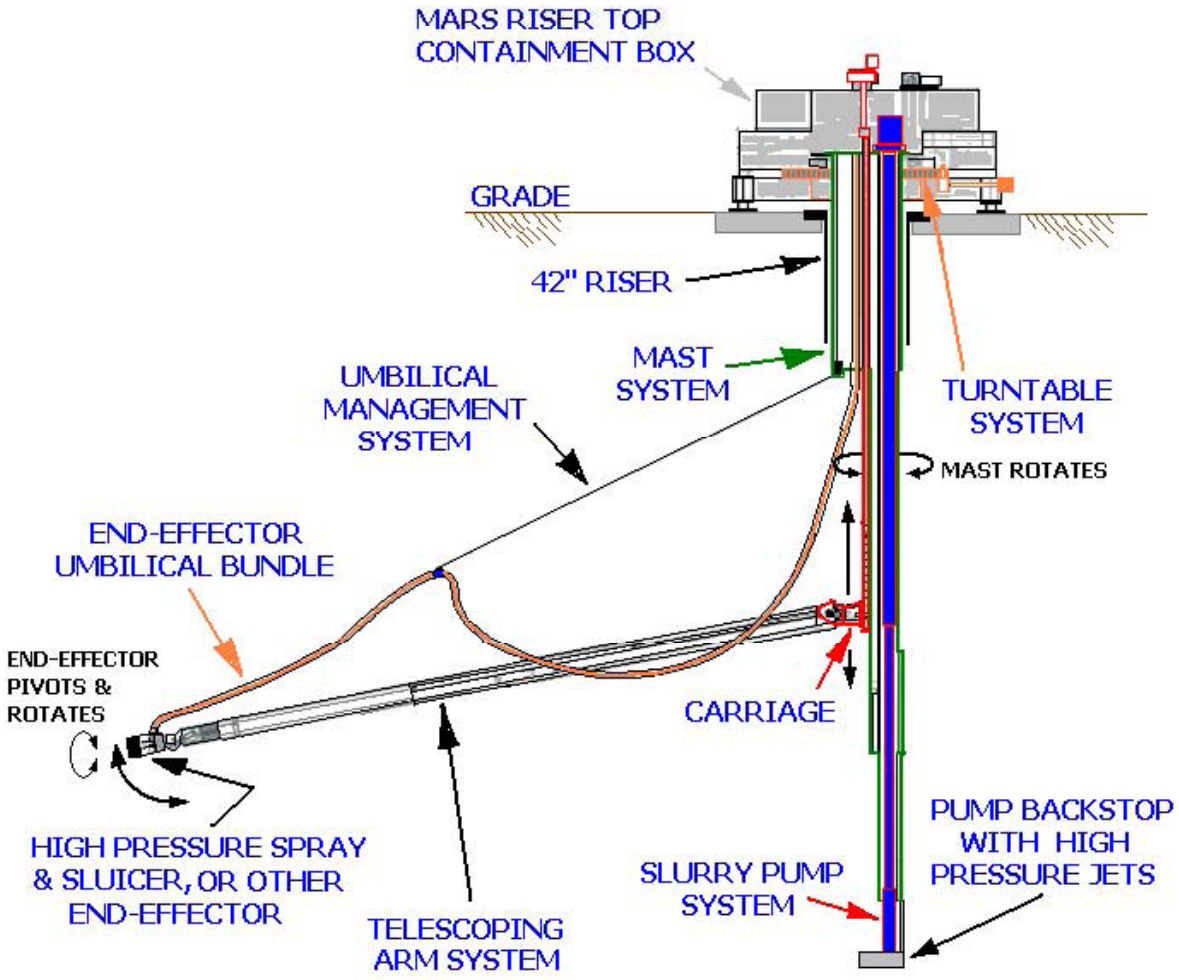
# Workshop Activities

- Expectations
- 12 Technical Presentations
  - SST History, Current Status, and Chemistry
  - Retrieval Technologies
  - DOE M 435.1-1 and BNL-UC-406 (BNL-52527)
  - Structural Integrity
  - Visual Inspections and Other Examinations
  - Hanford SST Corrosion Summary
  - Stress Corrosion Cracking at SRS
  - Vadose Zone Characterization
  - Tank Leak Detection, Monitoring and Mitigation
  - Concrete NDE
- Working Sessions
- Closed Panel Sessions
- Management Out Brief
- Final Stock Take

# Expert Panel Recommendations

- Continue Present SST Integrity Program Elements
- For FY 2010 Establish High Priority Enhancements
  - Begin Finite Element SST Structural/Seismic Analysis
  - Initiate Waste Corrosion Testing to Bound SSTs
  - Initiate Systematic under-dome visual survey
  - Develop Plan for Ionic Conductivity Leak Monitoring
  - Plan for extracting full height concrete core samples from high heat SST
  - Perform Evaluation to Attempt to Statistically Group SSTs for NDE and Chemistry
  - Plan for Post-retrieval Steel Liner Examination
- Maintain Expert Panel Steering Committee

## Mobile Arm Retrieval System (MARS) Concept



# Expert Panel Recommendations

- Continue SST Integrity Program Upgrades FY 2011
  - Continue Finite Element SST Structural/Seismic Analysis
  - Complete Waste Corrosion Testing to Bound SSTs
  - Progress Systematic under-dome visual survey
  - Establish/deploy Concrete NDE techniques such as rebar potential mapping
  - Extract and Analyze full height concrete core samples from high heat SST
  - Evaluate and Deploy Steel Liner NDE Methods (EMAT, vibro-thermography, UT, etc.)
  - Evaluate SST Liner Coatings or Liner Bladder Inserts for potential SST Re-Use or waste Consolidation
  - Evaluate Electric Field Technetium Immobilization

# Conceptual Structure for an Enhanced SST Integrity Program