Savannah River Remediation

We do the right thing.

Small Column Ion Exchange

Date: November 16, 2010

Presenter:
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SRR-SCIX-2010-00045 Rev. 1

Agenda

- Complex Impacts
- History
- Benefits
- Process
- Development
- Questions

DOE Complex Impacts

- EM-30 sponsored technology
- Underlying technology is applicable to SRS and Hanford
  - RMF (non-SCIX applications as well)
  - Column design is similar for both sites
- SRS and Hanford teams are integrated via conference calls and technical exchanges

SRS and Hanford Differences

- Waste characteristics
  - Competing Ions
  - Mercury
- Waste Tank configuration
- Operating downstream facilities

Ion Exchange Timeline

2001

- Ion Exchange (Large Columns with CST) was one of 4 technologies selected for Salt processing
- Unsolved issue with overheating
- Solvent Extraction was selected for SWPF

2003

- Work continues on ion exchange (sRF) for Hanford
- Issues with overheating solved by small columns
- SCIX with CST was born
- Project stopped to support MCU

2004

- Testing continues on sRF for Hanford
- Hanford baseline changed to sRF

2006

2007

- MSP was born
- High interest in sRF for SRS
- CD-0 approved
- Project suspended by DOE due to WD

2008

2009

- Technology Maturation of sRF for SRS continues under the guise of EPRR
- Results are promising

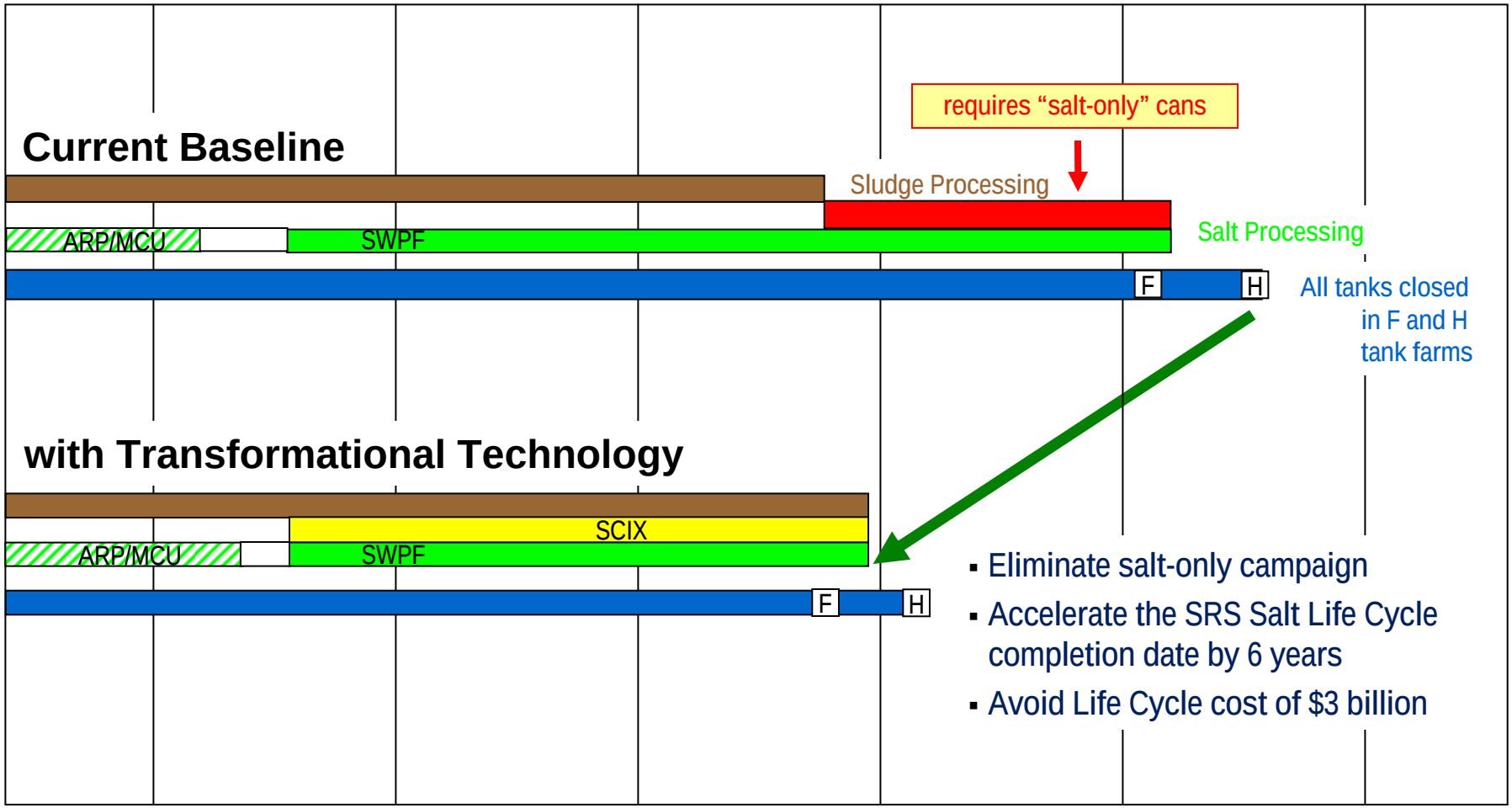
2010

- SCIX (MSP) was reborn
- CST chosen (still the more mature resin for SRS)

SRS Technology Downselect

- A formal Systems Engineering Evaluation (SEE) was performed and selected Small Column Ion Exchange columns containing Crystalline Silicotitanate (CST) in a 2-column lead/lag configuration. SEE considered use of Spherical Resorcinol-Formaldehyde (sRF).
- Advantages of approach at SRS include:
  - No new buildings
  - Low volume of Cs waste in solid form compared to aqueous strip effluent.
  - Availability of downstream processing facilities for immediate processing of spent resin.

Life Cycle Impact

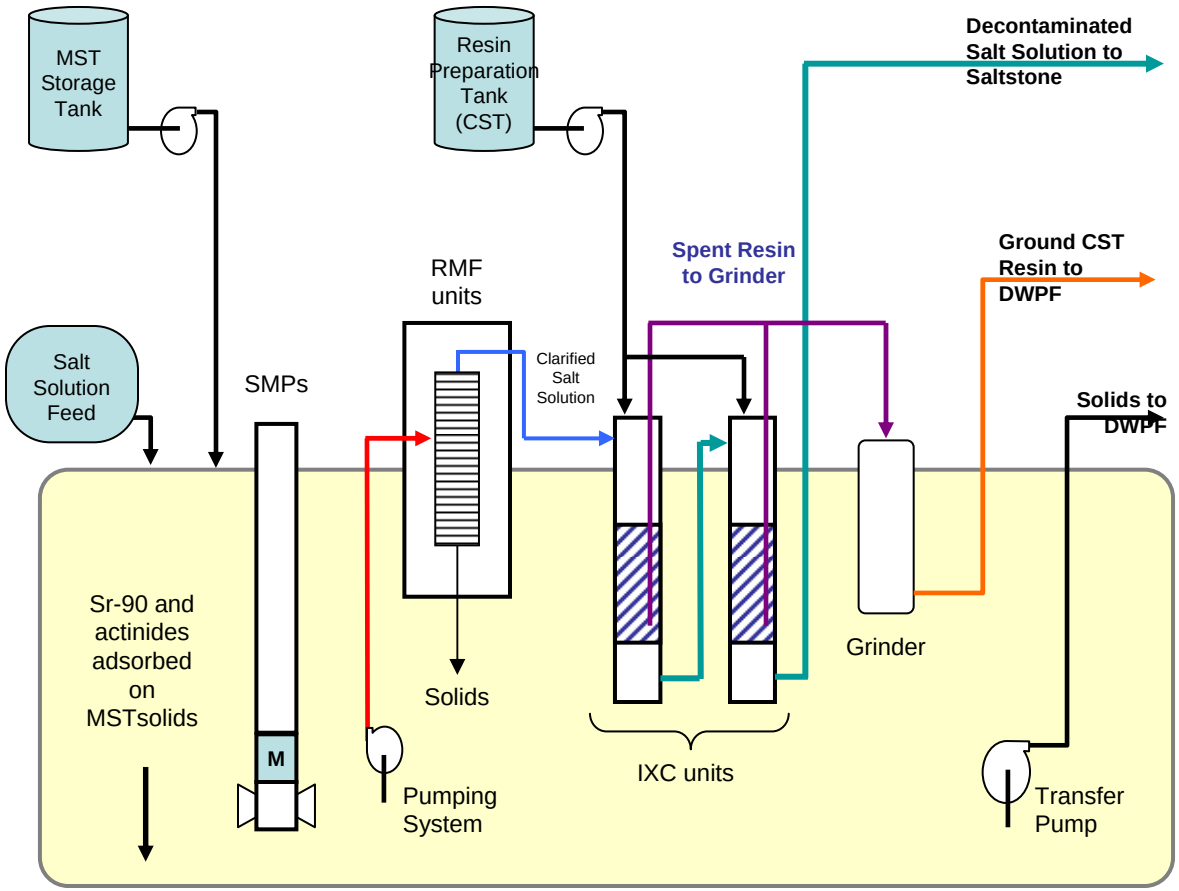


- Eliminate salt-only campaign
- Accelerate the SRS Salt Life Cycle completion date by 6 years
- Avoid Life Cycle cost of $3 billion

SCIX Process

Basic Operating Strategy

1. Add MST to waste tank
2. Mix tank contents
3. Filter sludge and MST/actinides from salt solution through the RMF
4. Pass clarified salt solution through ion exchanger
5. Transfer decontaminated salt solution to Saltstone Processing Facility
6. Transfer sludge and MST/actinide tank heel to DWPF (when necessary)
7. Transfer spent ion exchange media to DWPF (when necessary)



MST: Monosodium Titanate RMF: Rotary Micro-filter CST: Crystalline Silicotitanate IXC: Ion Exchange Column

Batch Times

Total Batch Cycle :

Fill Batch	10	days
MST add	3	days
MST Mix	3	days
Sample and Hold	7	days
Process batch	61	days
Column changeouts	10	days
Pump out solids	1	days
Total	**96**	**days**

Batch Volumes

Total Batch Cycle :

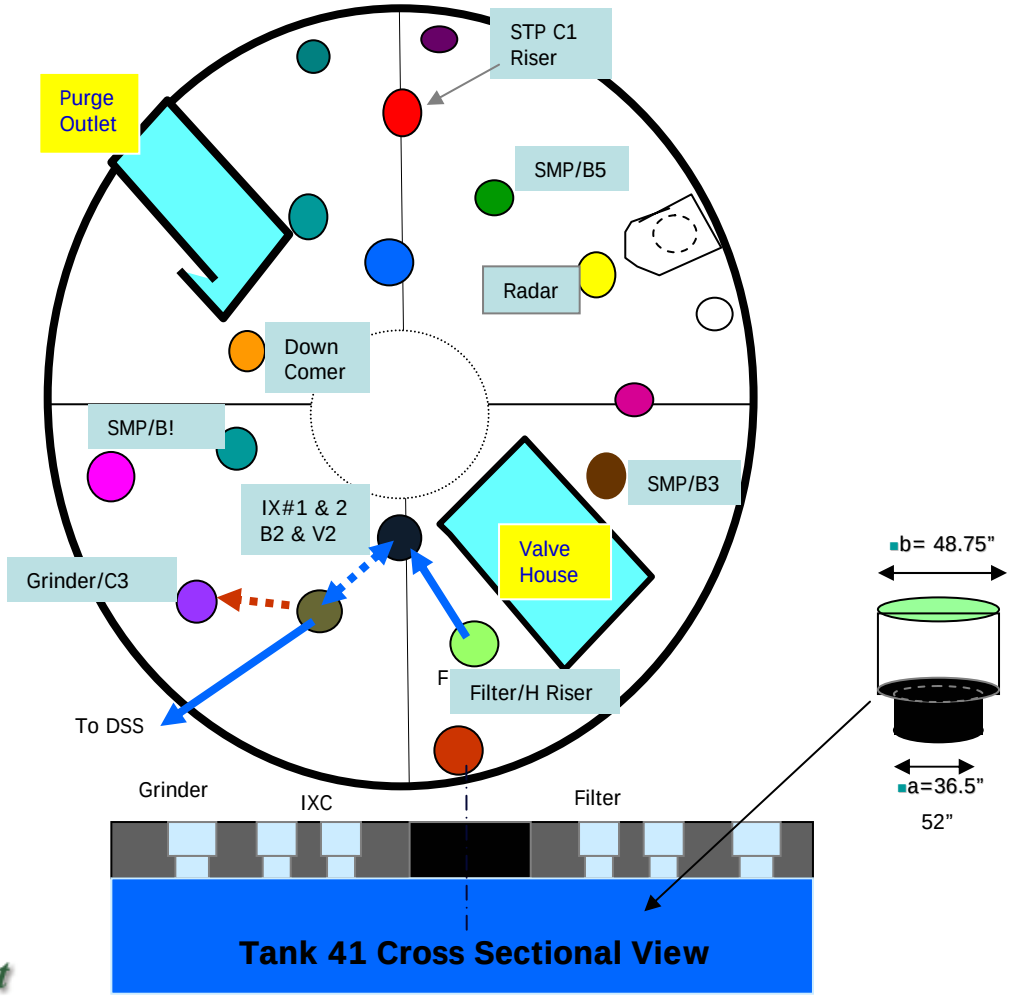
	Per Batch		Per Year	
Transfer Salt Feed in	1123200	gal	4.3	MM gal/yr
Process Salt Feed to Saltstone	877500	gal	**3.3**	**MM gal/yr**
Pump Heel to Sludge Batch	245700	gal	0.9	MM gal/yr
CST to Tank 40	8150	kg	31065	kg/yr
MST to Tank 42/51	1400	kg	5336	kg/yr

Utility

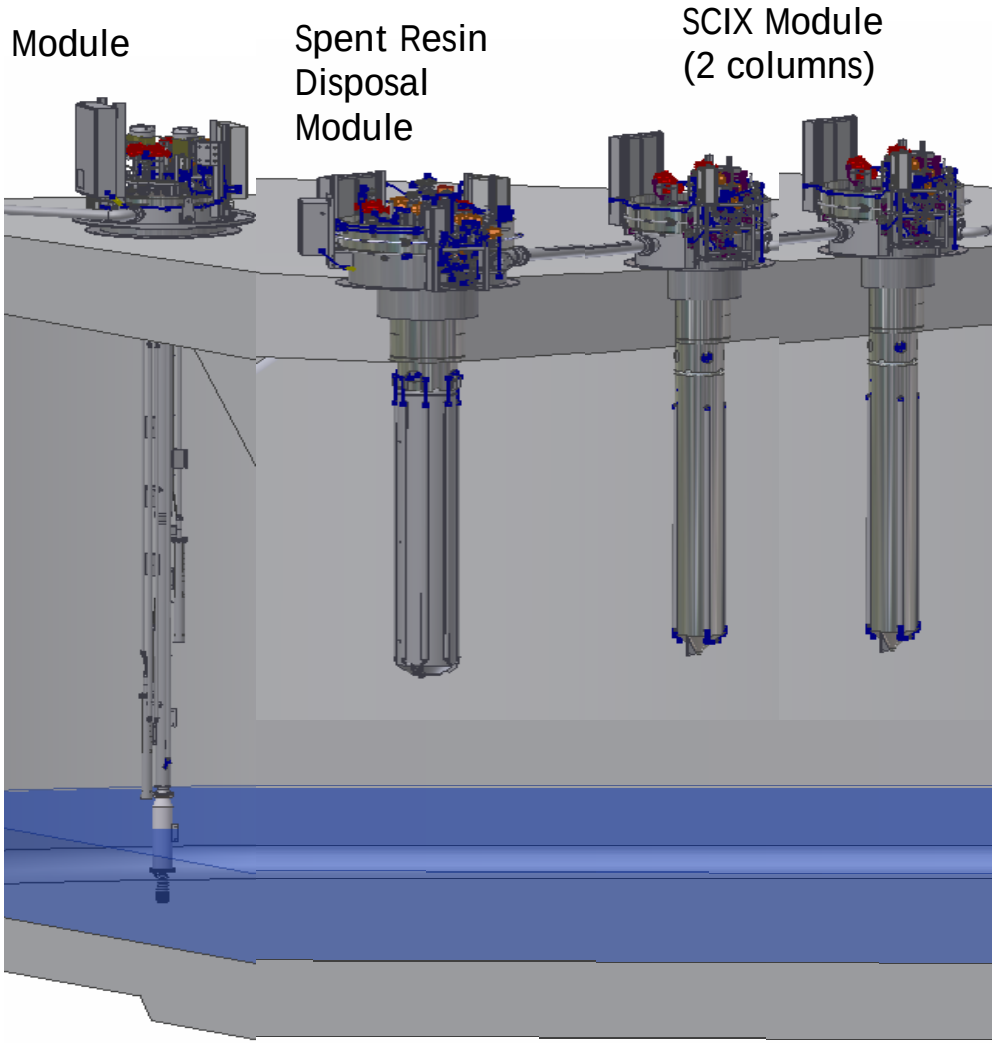
- 3.3 MM gal/year total design throughput does not account for overall utility (e.g. feed breaks, maintenance downtime)
- At 75% Utility, throughput is **2.5 MM gal/yr**

Tank 41 Riser Locations

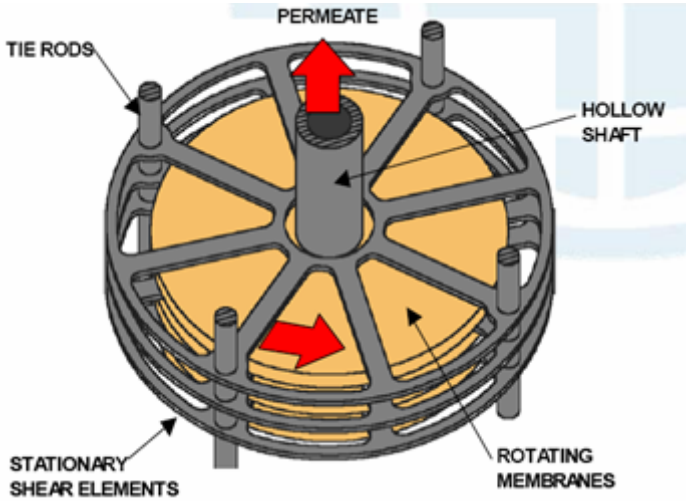
- H (RMF), 52.5” x 64.5”
- G
- B1 (SMP), 52.5” x 64.5”
- E1 (Down comer)
- C1 STP, 36.5”x 48.75”
- B5 (SMP), 52.5” x 64.5”
- B4 Radar
- B3 (SMP), 52.5” x 64.5”
- E2
- B2 (IX#2), 36.5”x 48.75”
- A3
- V2 (IX#1), 36.5”x 48.75”
- C3 (Grinder), 36.5”x 48.75”
- A4
- A1
- F
- V1



SCIX Design


Filter Module
Spent Resin Disposal Module
SCIX Module (2 columns)

Rotary Microfilter



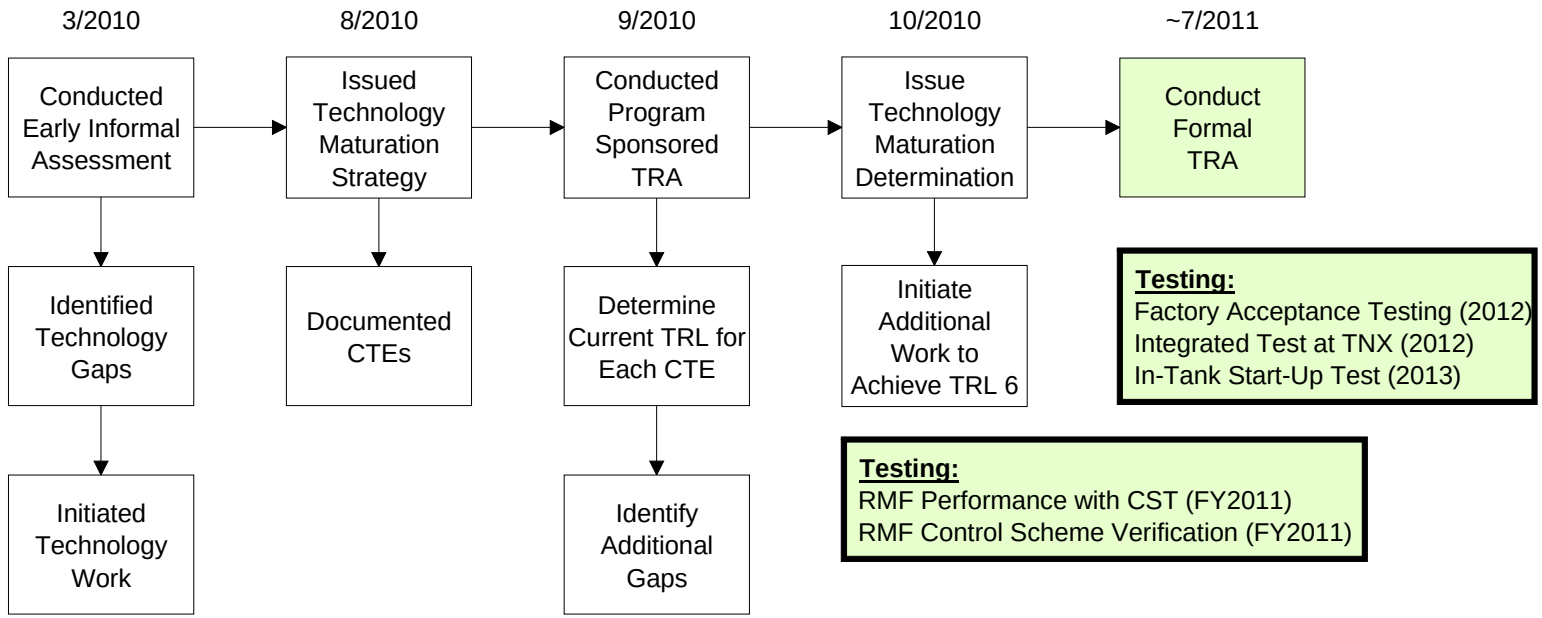
Submersible Mixer Pump

Spent Resin Disposal

Previous Development Work

- Previous testing developed the technology for CST and sRF in various configurations for both Hanford and SRS wastes.
  - Manufacturing
  - Column geometry effects
  - Cooling requirements
  - Performance modeling
  - Actual waste performance
  - Pilot testing
  - Radiation degradation
  - Chemical reactivity
  - Resin handling
  - Resin disposal

SCIX Program Technology Readiness / Testing Strategy



Testing:
Loading Studies
Mixing Studies
Thermal Modeling
NAS Formation Studies
DWPF Impact Studies
Grinding / Sluicing Tests
1,000-hr RMF Test

CST - Crystalline Silicotitanate
CTE - Critical Technology Element
DWPF - Defense Waste Processing Facility
NAS - Sodium Aluminosilicate
RMF - Rotary Microfilter
TRA - Technology Readiness Assessment
TRL - Technology Readiness Level

Complete
In Progress
Future

Balance of Testing

- Proof of basic science and process efficacy is complete.
- DOE Led Technology Readiness Assessment planned for summer 2011.
- Balance of development testing is focused in 4 areas (applicable to SRS only):
  - Boundary conditions for hazards analysis (e.g. max loadings, criticality evaluations)
  - Engineering design inputs (e.g. heat loads, mixer locations)
  - Operating parameters (e.g. feed parameters to minimize column pluggage)
  - Flowsheet integration (e.g. titanium management)
- Large scale testing of equipment will be performed as part of the module procurements.

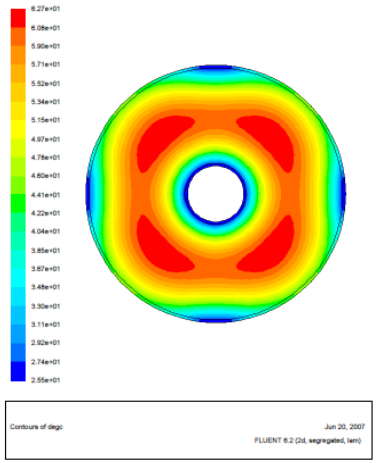
Current Testing to Support SRS SCIX

- DWPF flowsheet testing/glass chemistry
- MST loading (supports criticality work)
- CST
  - NAS formation
  - Cs loading
  - Actinide loading
- Thermal Modeling
- Rotary Microfilter
  - Filter flux with CST
  - Balance of EM-30 reliability testing
- Tank Mixing

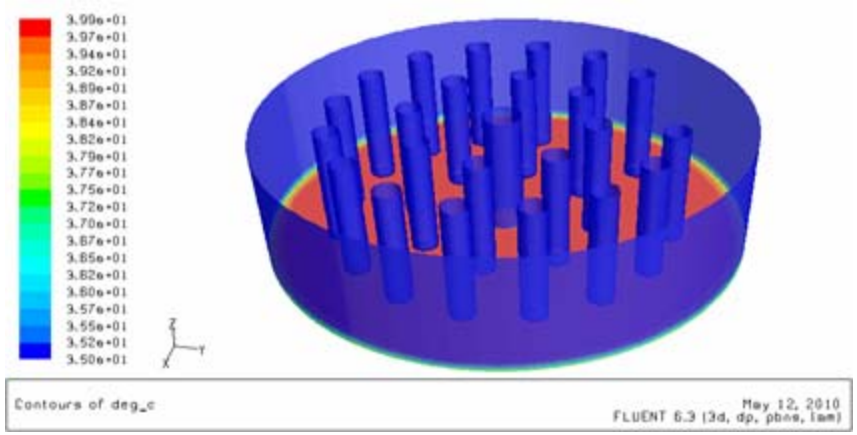
Mixing/Settling/Rheology Studies

Current Testing to Support SRS SCIX

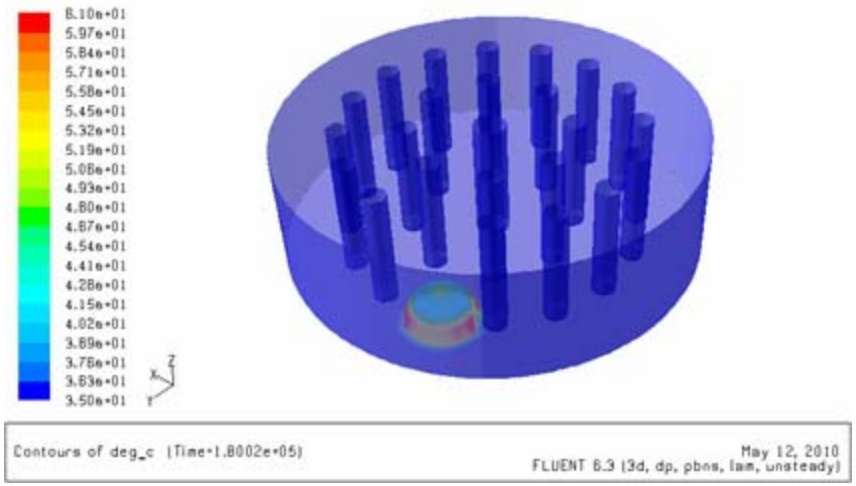
CST Thermal Modeling



Ion Exchange Column



Evenly distributed layer



In-tank mound

Summary

- SCIX leverages a suite of technologies developed by DOE across the complex to achieve lifecycle savings
- Technologies are applicable to multiple sites
- Early testing supported multiple sites
- Balance of SRS SCIX testing supports SRS deployment

Questions