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Revision 0

Science & Technology Workshop
Tank Waste Retrieval Technology Activities

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
Office of River Protection under Contract DE-AC27-08RV14800

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Washington River Protection Solutions

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Science & Technology Workshop
Tank Waste Retrieval
Technology Activities

Scott Saunders

June 9, 2009

URS
Washington Division

Tank Waste Retrieval

Topics

- *Retrieval Status (Chart)*
- *SST Retrieval Challenges*
- *Retrieval Technologies*

Retrieval Status

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Hanford Tank Cleanup Status

Office of River Protection

RETRIEVED

S-112
- Capacity of tank: 758 Kgals
- Completion date: March 28, 2007
- Volume removed: 612 Kgals
- Curies removed: 608 K

C-202
- Capacity of tank: 55 Kgals
- Completion date: August 11, 2005
- Volume removed: 1.2 Kgals
- Curies removed: 2.6 K

C-204
- Capacity of tank: 55 Kgals
- Completion date: December 11, 2006
- Volume removed: ~1.3 Kgals
- Curies removed : 440

C-203
- Capacity of tank: 55 Kgals
- Completion date: March 24, 2005
- Volume removed: 2.4 Kgals
- Curies removed: 1.1 K

C-103
- Capacity of tank: 530 Kgals
- Completion date: November 1, 2006
- Volume removed: 69 Kgals
- Curies removed: 2.7 M

C-106
- Capacity of tank: 530 Kgals
- Completion date December 31, 2003
- Volume removed: 194 Kgals
- Curies removed: 8.9 M

C-201
- Capacity of tank: 55 Kgals
- Completion date: March 23, 2006
- Volume removed: 720 gallons
- Curies removed: 560

LIMITS OF TECHNOLOGY

C-109
- Capacity of tank: 530 Kgals
- Retrieval started: June 19, 2007
- Volume of waste to be removed: 63 Kgals
- Volume of waste removed to date : 53 Kgals
- Curies removed to date: 711 K of 844 K (estimate)
- Technology used: Modified sluicing, Mobil Retrieval and Foldtrack

C-110
- Capacity of tank: 530 Kgals
- Retrieval started September 27, 2008
- Volume of waste to be removed: 178 Kgals
- Volume of waste removed to date: 161 kgals
- Curies removed to date: 30K of 33K (estimate)
- Technology used: Modified sluicing

C-108
- Capacity of tank: 530 Kgals
- Retrieval started: December 20, 2006
- Volume of waste to be removed: 66 Kgals
- Volume of waste removed to date: 58 Kgals
- Curies removed to date: 148 K of 167 K (estimate)
- Technology used: Modified sluicing

S-102
- Capacity of tank: 758 Kgals
- Retrieval started: December 17, 2004
- Volume of waste to be removed: 464 Kgals
- Volume of waste removed to date: 433 Kgals
- Curies removed to date: 591 K of 704 K (estimate)
- Technology used: Saltcake Dissolution, High Pressure Mixer and Modified sluicing

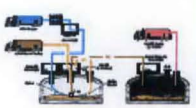
NEXT IN LINE

C-104
- Capacity of tank: 530 Kgals
- Volume of waste to be removed: 260 Kgals
- Curies to be removed: 1.2 M
- When retrieval to begin: FY 2009
- Technology to be used: Modified sluicing

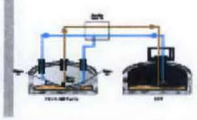
C-111
- Capacity of tank: 530 Kgals
- Volume of waste to be removed: 57 Kgals
- Curies to be removed: 1.8M
- When retrieval to begin: FY 2010
- Technology to be used: Modified sluicing

TBD TANK for MARS
- Capacity of tank: 530 Kgals
- When retrieval to begin: FY 2010
- Technology to be used: Mobil Arm Retrieval System (MARS)
- Tank C-101, C-105, or C-107 under consideration
- C-101 – 88 kgals/136K Curies
- C-105 – 132 kgals/1.0M Curies
- C-107 – 247 kgals/4.5M Curies

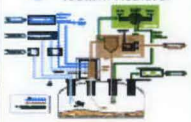
Acid Dissolution



Modified Sluicing



Vacuum Retrieval



Saltcake Dissolution

Remote Water Lance (Salt Mantis)

Mobile Retrieval Tool (Sand Mantis)

Mobile Retrieval Tool (Foldtrack)

High Pressure Mixer (Rotary Viper)

Mobil Retrieval System (MARS)

SST Retrieval Challenges

- Retrieval Challenges
  - *Tank access and infrastructure limitations*
  - *Remote locations*
  - *Limited access: 12" risers*
  - *Must add active ventilation*
  - *Must provide services (i.e., water, power)*
  - *No permanent transfer lines*
  - *Dome loading limitations – impacts crane & equipment access*
  - *Abandoned/old equipment in risers*

SST Retrieval Challenges

- Retrieval Challenges (continued)
  - *Limited knowledge of waste mineralogy and physical characteristics*
  - *Potential for leak site discovery*
  - *Radioactivity (dose, contamination potential, and equipment degradation)*
  - *Weather restrictions: heat, cold, wind, blowing sand*
  - *Cost and delays associated with deploying multiple retrieval tools for various stages of retrieval (i.e., bulk sludge, salt, hard heel)*
  - *DST space limitations until WTP is operational*

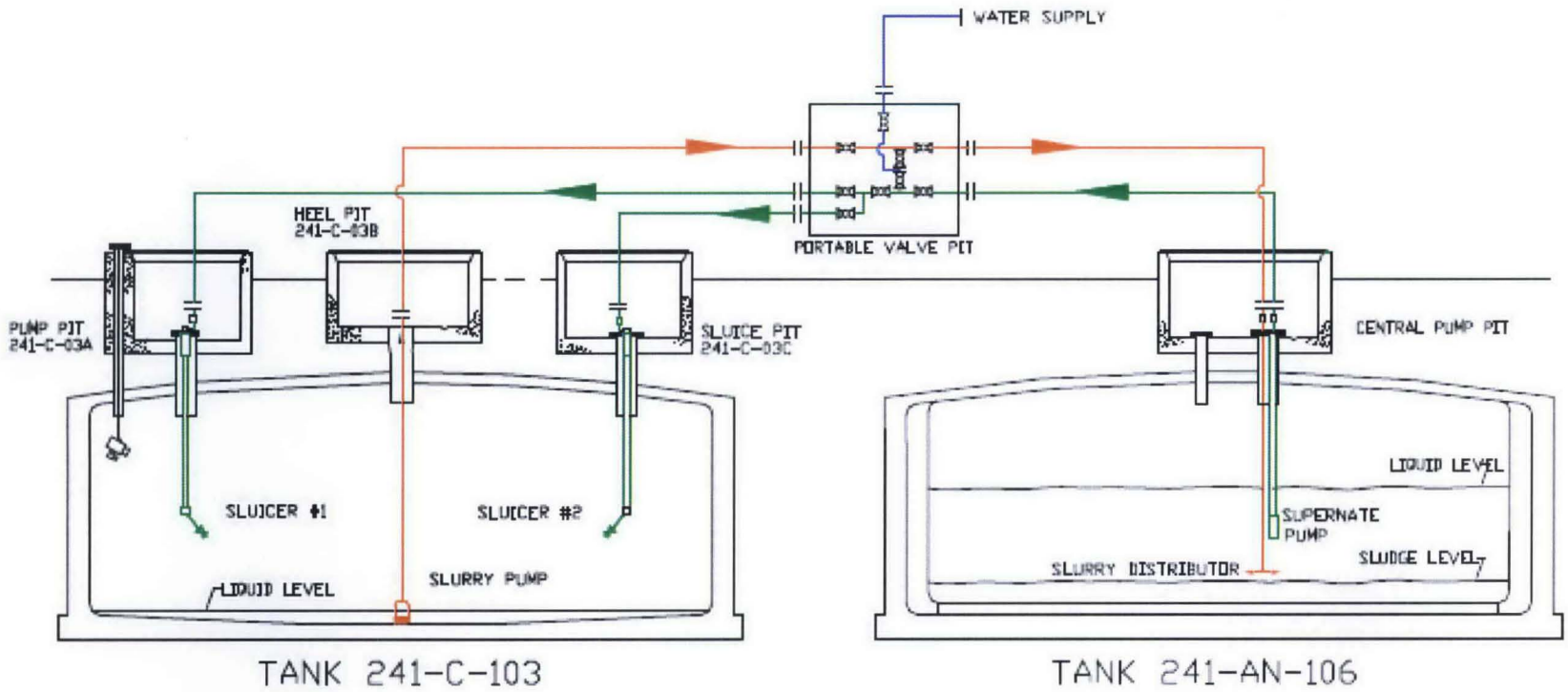
Retrieval Technologies

Challenges	Technologies	Tools	Opportunities
Bulk Retrieval	•*Modified Sluicing* •*Robotic Arm*	•*AGI Pump with Sluicing* •*Mobile Arm Retreival System (MARS)*	•*Remote Locations* •*Sluicing Media* •*Water Management* •*Pump Technology*
Heel Retrieval	•*Mobile Crawlers* •*Mechanical Cleaning* •*Chemical Cleaning*	•*FoldTrack* •*Sand Mantis* •*AREVA UV Cord*	•*Accessibility* •*Hose Management* •*Sodium Management*
Physical Properties	•*Sampling* •*Chemical & Mineral Analysis*	•*Off-Riser Sampler* •*Chemistry Control*	•*Chemical Challenges: Phosphate gels/ crystals* •*Aluminum Heels*

Retrieval Technologies

- Modified Sluicing
  - *Description*
    - *Pump centrally located in SST*
    - *Two sluicing nozzles to "push" waste to pump*
    - *DST supernate is used as sluicing media*
  - *Challenges*
    - *Limit of technology leaves remaining heel*
    - *Requires transfer of liquids from DST farm to provide sluicing media*

Modified Sluicing



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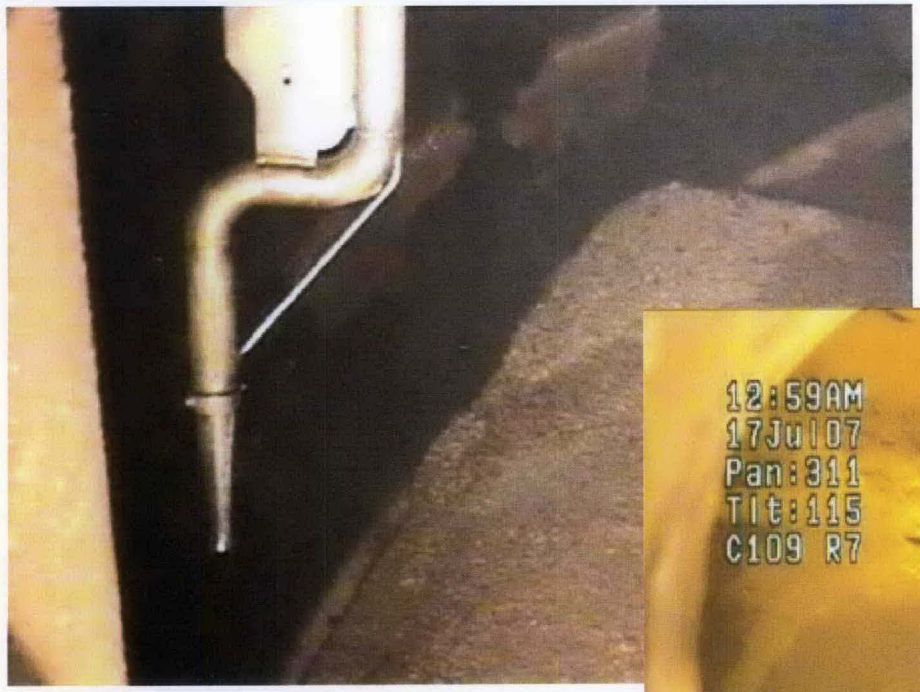
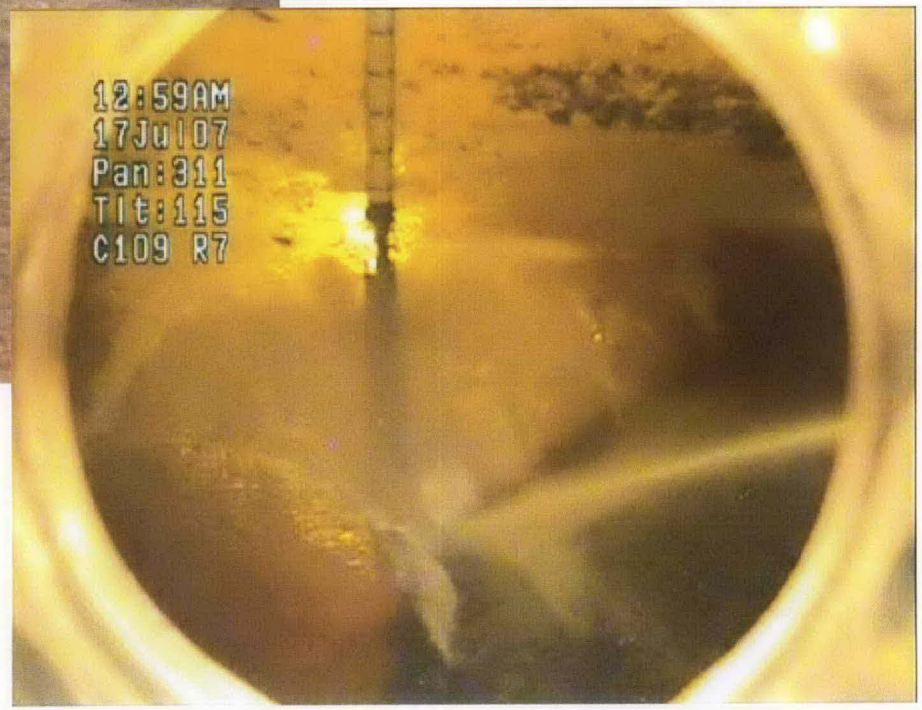
Modified Sluicing





Tank
Operations
Contract

Modified Sluicing

C-108

C-109

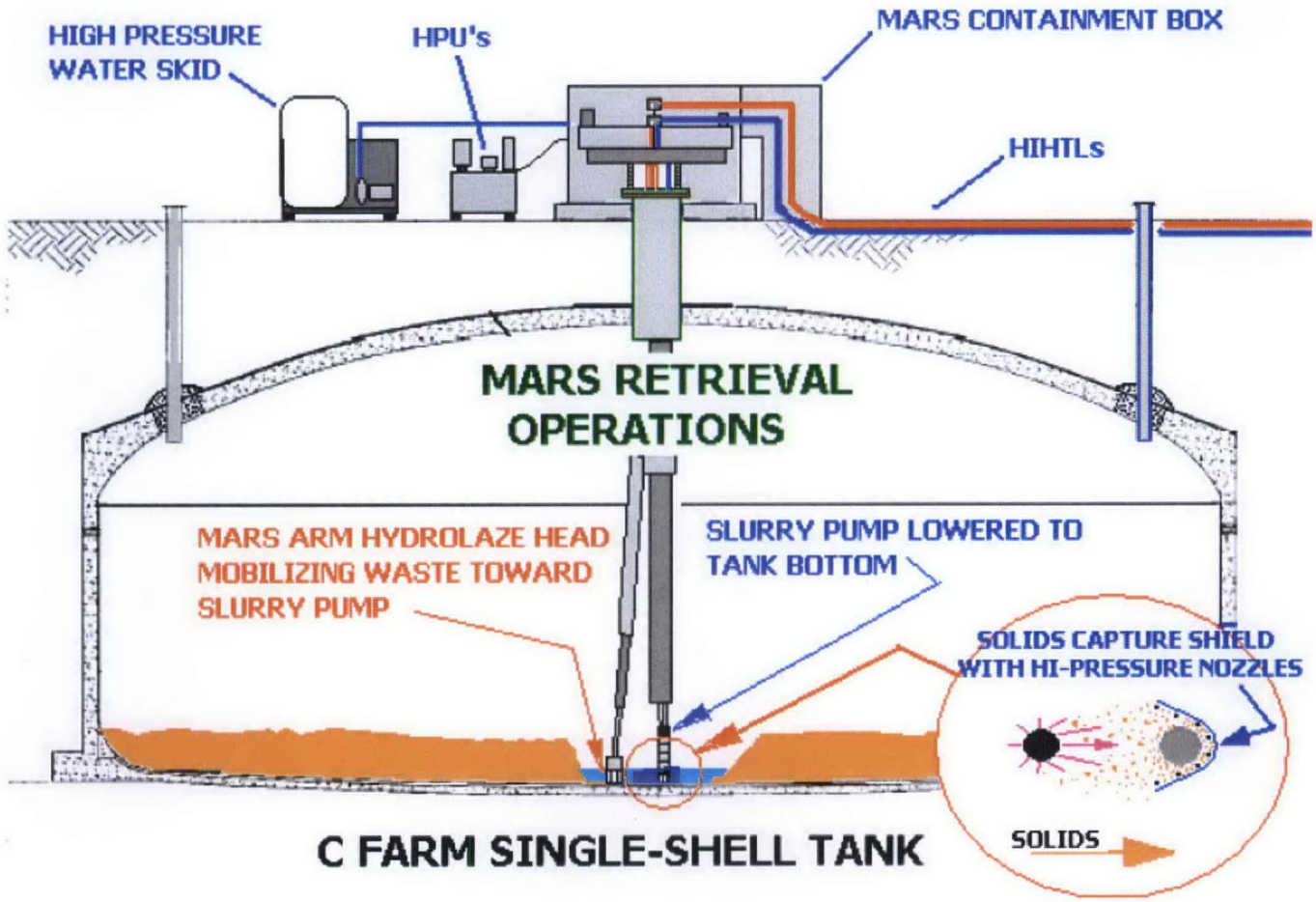
C-110

C-103

Retrieval Technologies

- Mobile Arm Retrieval System (MARS)
  - *Description*
    - *Remotely Operated Arm*
    - *Mechanical cleaning end-effectors with access all quadrants of the tank*
    - *Utilizes localized sluicing in "non-leaking" tanks*
    - *Includes vacuum system for removing waste from tanks identified as "leaking", or "presumed leaking" tanks using minimal water*
    - *Designed to be mobile for re-use in another tank*

MARS


HIGH PRESSURE
WATER SKID
HPU's
MARS CONTAINMENT BOX
HIHTLs
MARS RETRIEVAL
OPERATIONS
MARS ARM HYDROLAZE HEAD
MOBILIZING WASTE TOWARD
SLURRY PUMP
SLURRY PUMP LOWERED TO
TANK BOTTOM
SOLIDS CAPTURE SHIELD
WITH HI-PRESSURE NOZZLES
SOLIDS
C FARM SINGLE-SHELL TANK

MARS

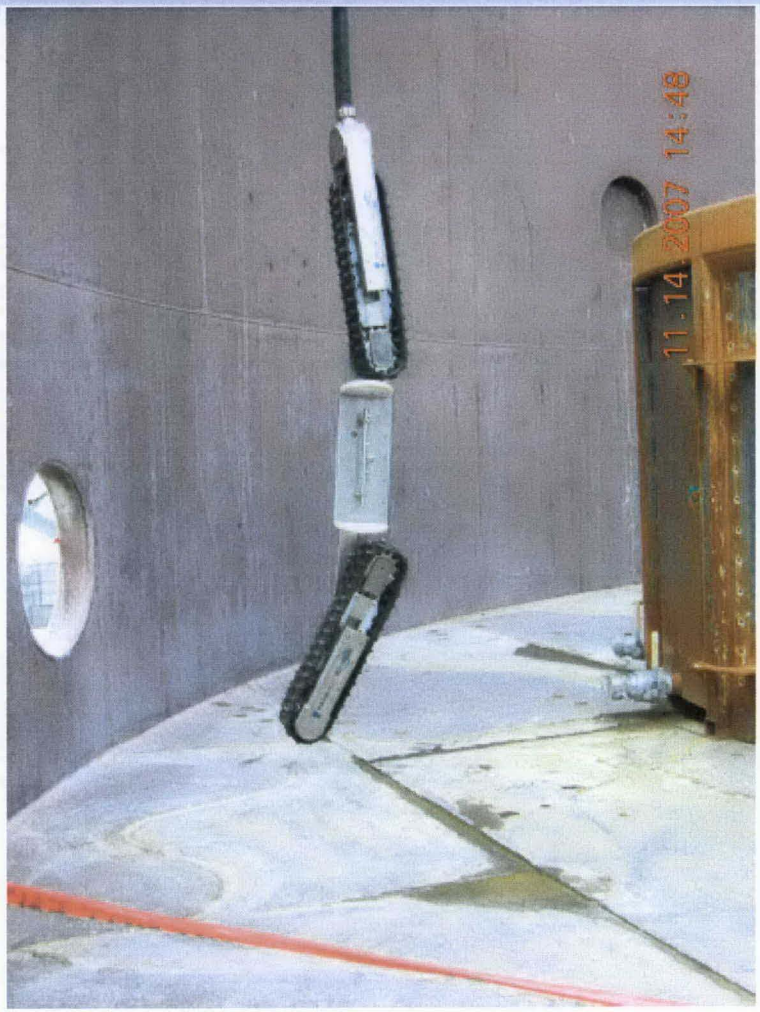
MARS

MARS

Retrieval Technologies

- FoldTrack Mobile System
  - *Description*
    - *A folding tracked vehicle system designed for vertical entry into tanks with limited access*
    - *Includes a pusher blade and two jet spray systems*
    - *Deployable through a 12-inch pipe opening*
    - *Pushes waste to pump suction*

FoldTrack Deployment



FoldTrack Deployment

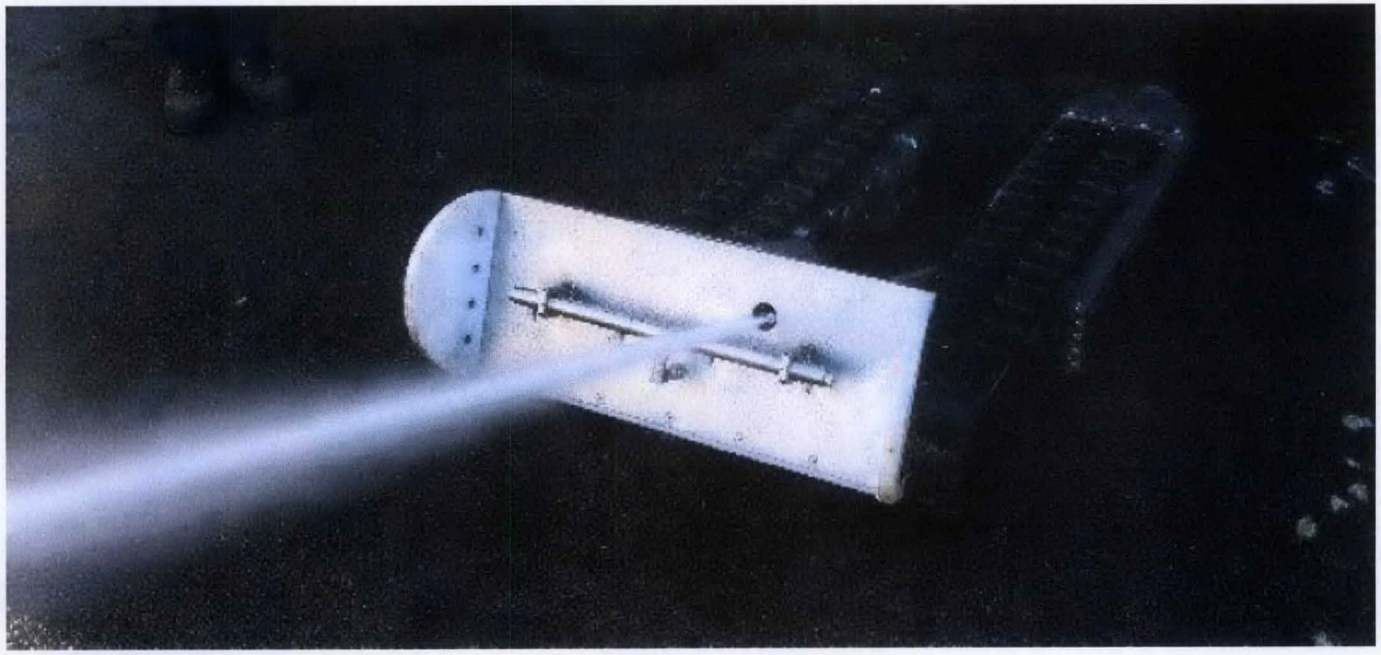
FIRST PRODUCTION UNIT

FoldTrack

FoldTrack

SCARIFIER MANIFOLD

FoldTrack



JETTING CANNON

Retrieval Technologies

- Sand Mantis
  - *Description*
    - *Mobile-tethered vacuum eductor tool powered by a hydraulic system for mobility and by very high pressure water for vacuum retrieval*
    - *Forward and downward spray nozzles uses 5,000 psig water to break up mounds and wash the floor*
    - *Deployable through a 12-inch pipe opening*
    - *Successfully deployed at SRS on two tanks*

Sand Mantis

Technology Development

- Chemical Cleaning
  - *Caustic Cleaning*
  - *Enhanced Chemical Cleaning (ECC)*

Chemical Cleaning

- Investigating chemical cleaning technologies for Hanford tanks as a heel treatment process
- Retrieval is focused on C-Farm tanks for the next 5 years
- Require a chemical simulant of the C-Farm heels for testing
  - *What is the composition of the waste heels remaining after sluicing?*
  - *How do we make a simulant of the heels?*

Chemical Cleaning

- Chemical Cleaning Techniques Under Consideration
  - *Caustic Cleaning*
  - *Enhanced Chemical Cleaning*
  - *Other?*

Caustic Cleaning

- Hypothesis:
  - *Heel composition is consistent in C-Farm*
  - *Gibbsite form of aluminum is major constituent of C-Farm waste heels*
  - *Heel sampling and analysis of C-108, C-109, and C-110 are planned*
- C-103 heel sample was ~80 % Aluminum
- Lab Test Data: Aluminum hydroxide solids can be changed to sodium aluminate solution in strong caustic (19M NaOH)

Caustic Cleaning

- C-Farm:
  - *Caustic cleaning may be effective combined with other bulk retrieval systems*
  - *Heel residue samples are planned for evaluating applicability to C-108, C-109, and C-110*
- Added caustic will impact available DST space
- Must be evaluated in conjunction with WTP flowsheet

Enhanced Chemical Cleaning (ECC)

- ECC Using Oxalic Acid May be Beneficial in Selected Tank Farms
- AREVA Patented UV Process
  - *Used in over 300 commercial nuclear projects*
- Benefit: Enables weak acid dissolution without impacting DST space or WTP processing
  - *Oxalic acid for chemical dissolution*
  - *UV light to decompose the acid prior to transfer to DST*

Enhanced Chemical Cleaning (ECC)

- Development Currently ongoing at SRS
  - *SRS Proof of principle testing using sludge simulant and salt simulant has demonstrated the viability of the concept*
  - *DOE EM-21 POC – Sharron Marra of SRNL*
  - *SRS Deployment scheduled for 2011*
- Hanford Testing Scheduled for 2009

Retrieval Technology

Q&A