



AVANTech Incorporated

SARRY Implementation at the Fukushima-Daiichi Nuclear Facility

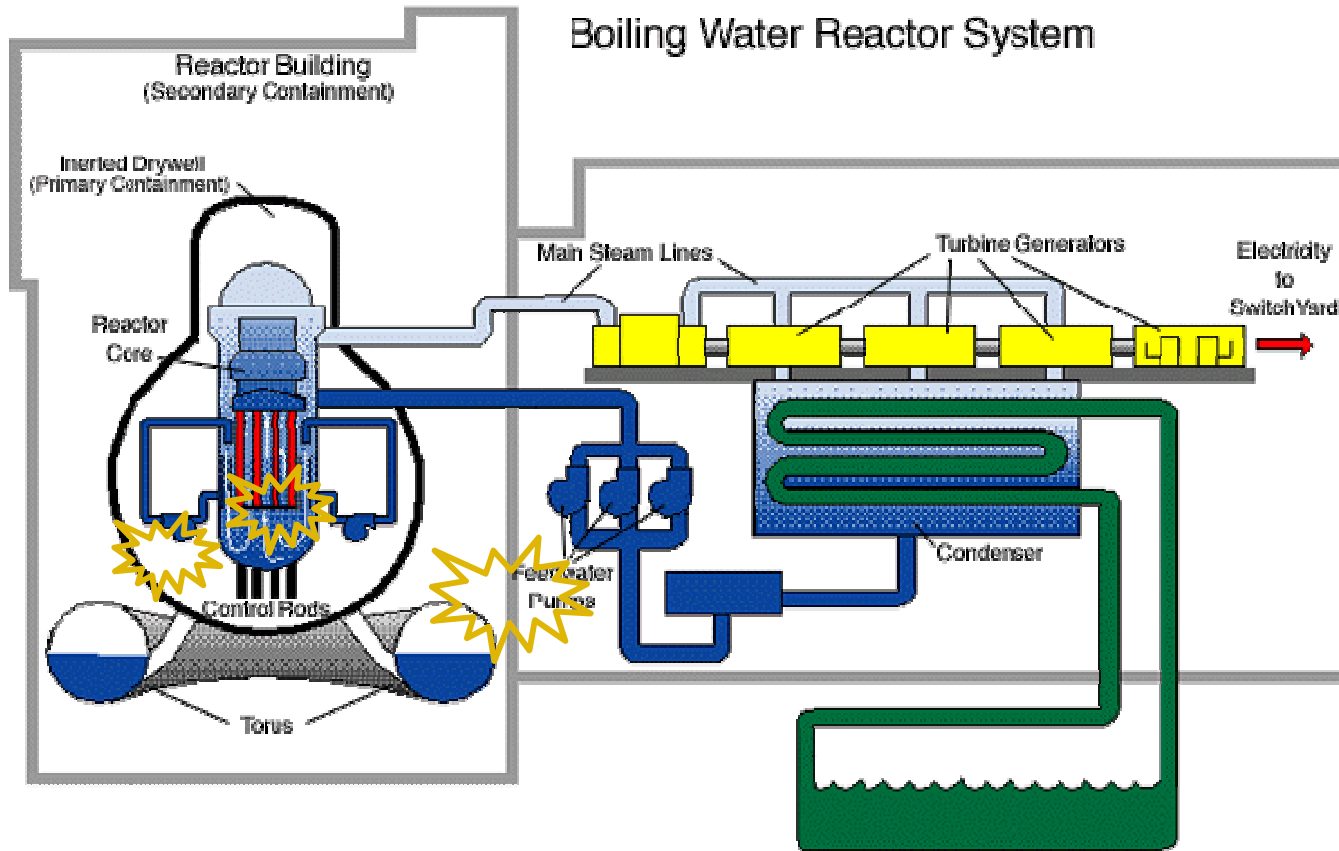
Simplified Active water Retrieval and RecoverY system

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February - 2012



Fundamentals of the Emergency



Water Characteristics

Iodine: 4×10^5 Bq/cc

Cesium: 5×10^6 Bq/cc

Cl: 15,000 ppm

Cond.: 45,000 micro S/cm

- Rx Vessel to Primary Containment (Drywell)
- Drywell to Torus
- Torus to Turbine Bldg



The Technical Challenge

- Removal of radioisotopes in Seawater
- Deliver it in less than 8 weeks
- Deliver & Start-up in less than 12 weeks
- Ensure its safe!
 - Dose Rates
 - Thermal
 - Operational Safety

**Failure Results in High Activity Accident
Water to the Ocean**



The AVANTech Solution

Challenge 1 – Activity Capture

■ Even Axial Rad Loading

- Eliminate extreme dose rates
- Overheating of media

■ Engineered Zeolite

- Primary Ion Exchange
- Distribution Coefficient (K_d) \approx 2,000 in seawater
- Good Axial Cesium Distribution

■ Crystalline Silicotitanate

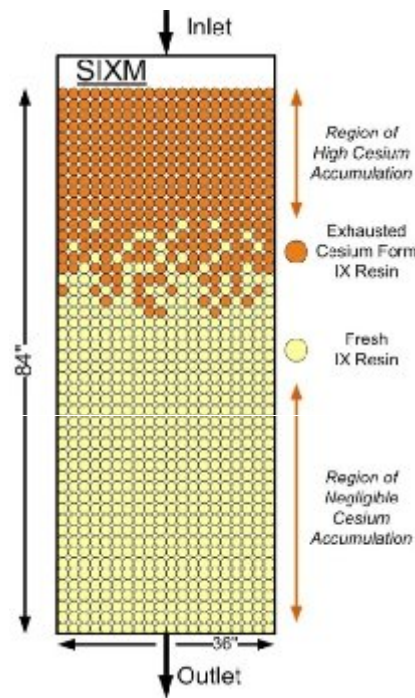
- Polishing Ion Exchange
- Distribution Coefficient (K_d) $>$ 20,000
- Needed to achieve complete activity removal with a single pass

■ Media Development

- CRADA between Honeywell/UOP & Sandia National Laboratories

Axial Cesium Loading

Cs Limited to 200,000 Ci (7.5E+15 Bq)



DOE CRADA Key to Success!



The AVANTech Solution

Challenge 2 – Shielding



Integral Shielding
≈ 6" Pb Equiv.

Loaded Wt.:
≈ 23 mt (50,000 lb)



- 200,000 Curies
- < 200 mr/hr
- Contact Handled
- No Sluicing
- Long Term Storage

Safely Managing 200,000 Curies of Radioactive Material



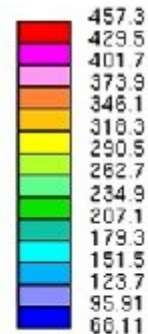
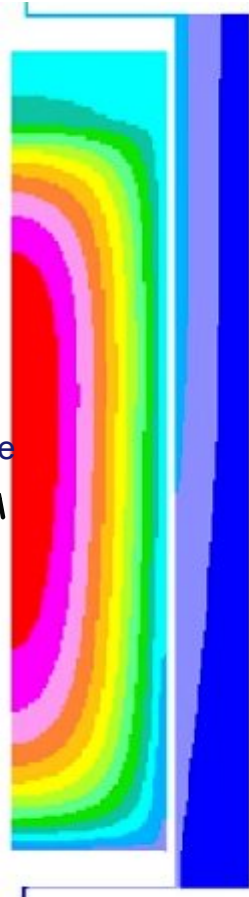
The AVANTech Solution

Challenge 3 – Heat Generation

Temperature Profile

855 °F Centerline

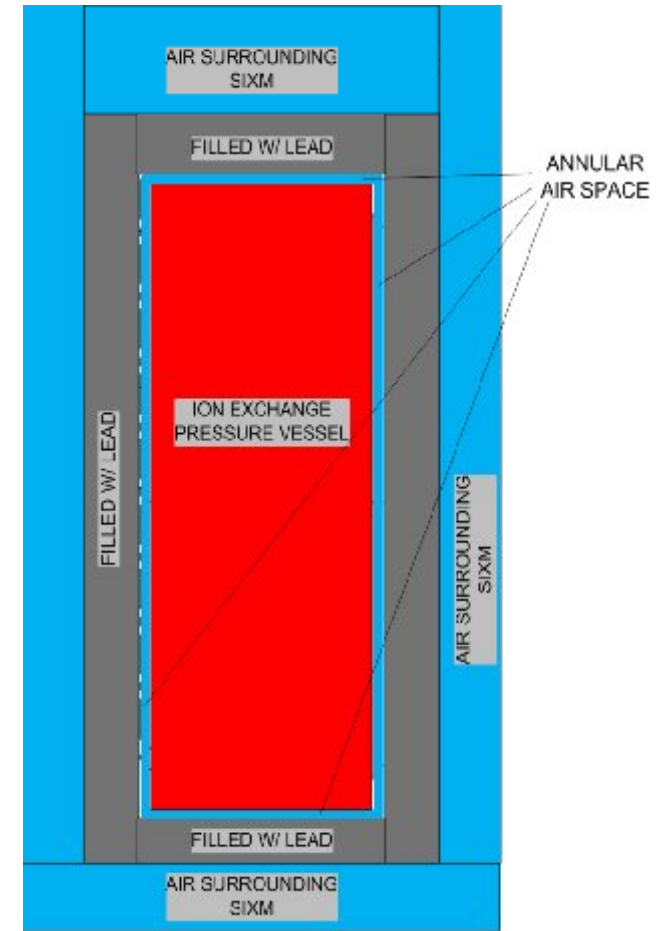
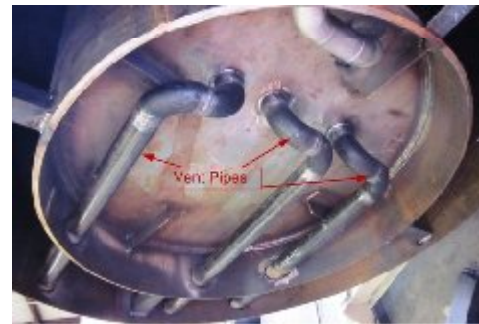
155 °F Exterior



Centerline/ Core Temperature

15.00W

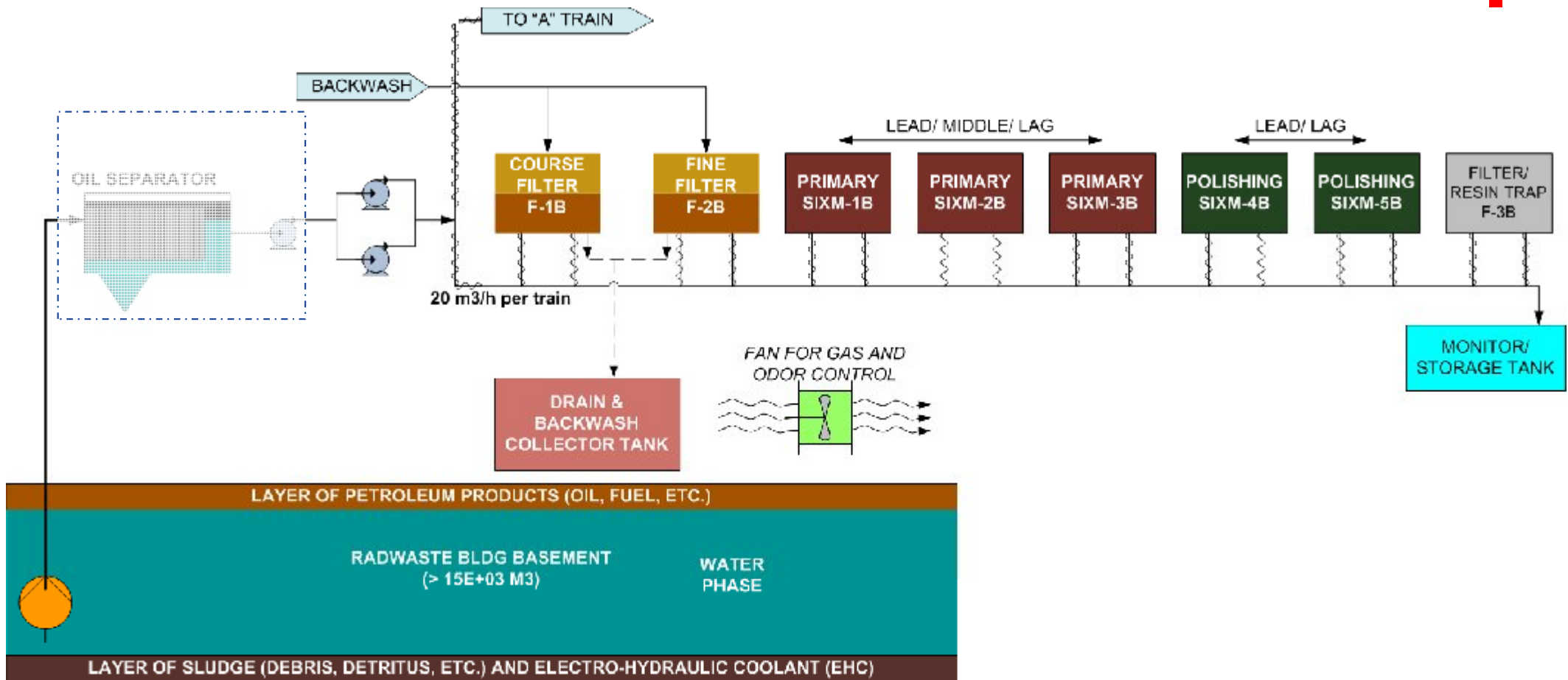
- Passive Cooling
- Contact Handled
- Long Term Storage



Thermal Capacity Limited Activity



The Integrated Process: Patent Pending



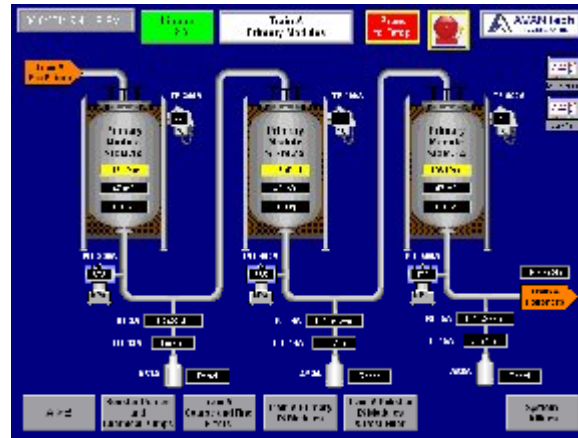
Process Optimizes Media and Decontamination Factor



Equipment Installation

SARRY

- Pipe Racks
- SIXMs
- Flexible Hoses
- H₂ Vents



- Composite Autosamplers
- Grab Samplers
- Gamma Detectors
- Remote Sampling



- Automatic Alignment
- DP (kPad)
- Throughput (m3)
- Rad Loading (TBq)
- Trending

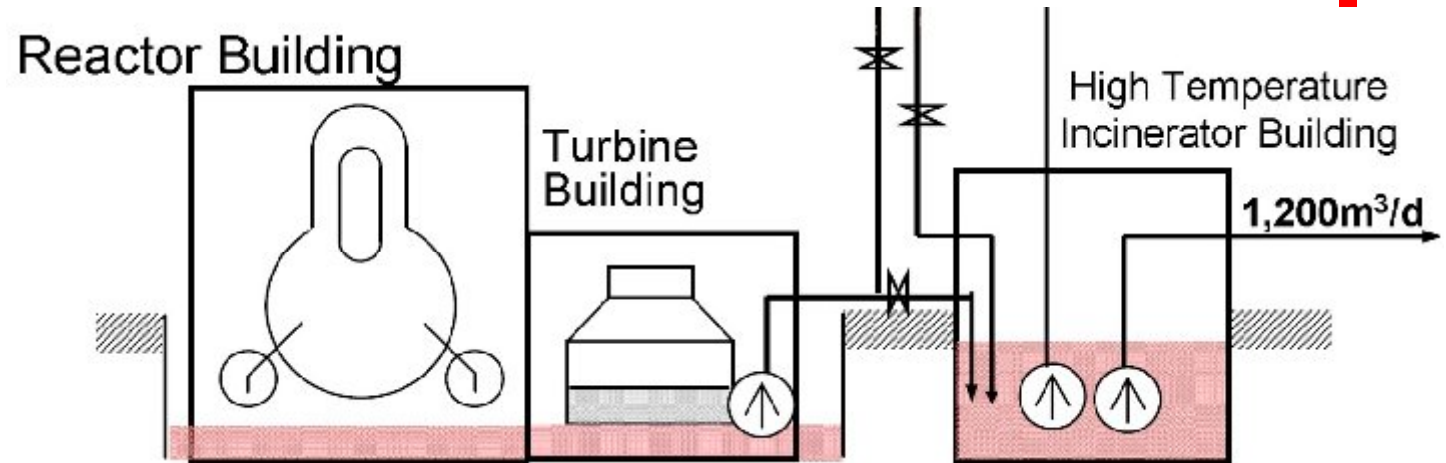


Mobile Equipment Aided Expedited Installation



Equipment Installation

- Rx, Turbine and Radwaste Building
- 24 million gallons of Storage Capacity



High Temp Incinerator Building



Submersible Transfer Pump



Transfer Hoses

Mobile Equipment Aided Expedited Installation



■ Decontamination Factor

- Non-detectible CS-137 effluent
- $DF > 2$ million

■ Waste Generation

- Primary Ion Exchanger – Lead Column
 - Operating \approx **10 days** prior to replacement
 - Accumulation of up to 200,000 Ci Cesium

- Throughput \approx **2522 BV** water per BV of waste

- ❖ Performance data from TEPCO February 15th Release, “Situation of Storing and Treatment Accumulated Water including Highly Concentrated Radioactive Materials at Fukushima Daiichi Nuclear Power Station (34th Release)”

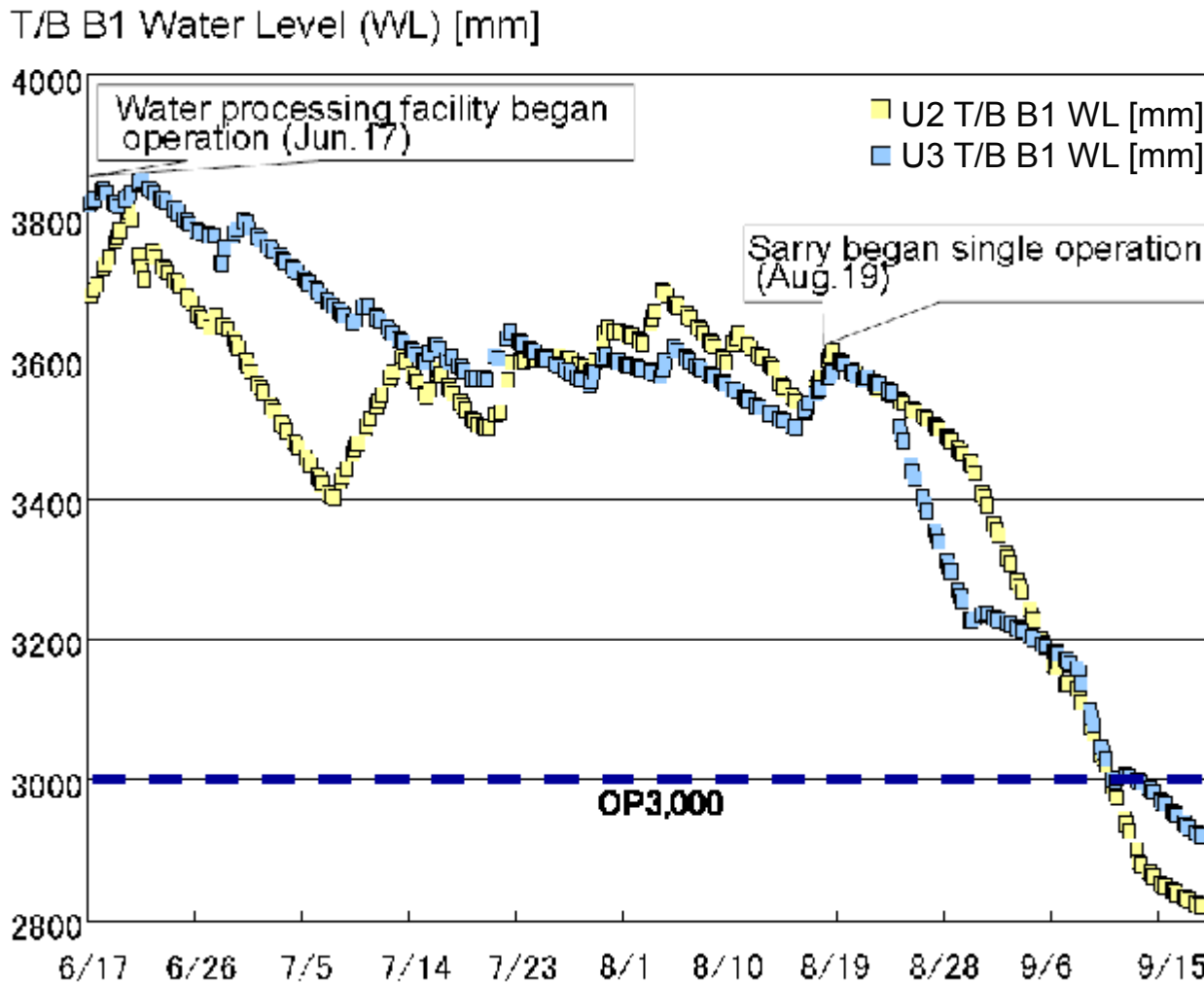
Shielded Ion eXchange Module (SIXM) Storage





Performance

■ Reduction of Accumulated Water Volume



- Graph from TEPCO:
Roadmap towards restoration from the Accident October 4, 2011
- TEPCO Statement:
According to full-scale use of SARRY, the accumulated water level has reached the target level of O.P 3,000, and has reached the point where Fukushima is able to withstand heavy rains as well as long-term processing facility outages.
- As of Oct-7th SARRY has treated 6 million gallons (\approx 23000 tons) of accumulated water



The Next Challenge – Stored Water

■ Water Storage Tanks



- RO Reject (Brine), 90000 m³
(23 million gallons)
- Evaporator Bottoms, 5500 m³
(1.5 million gallons)
- Demineralized Water, 9000 m³
(2.3 million gallons)

