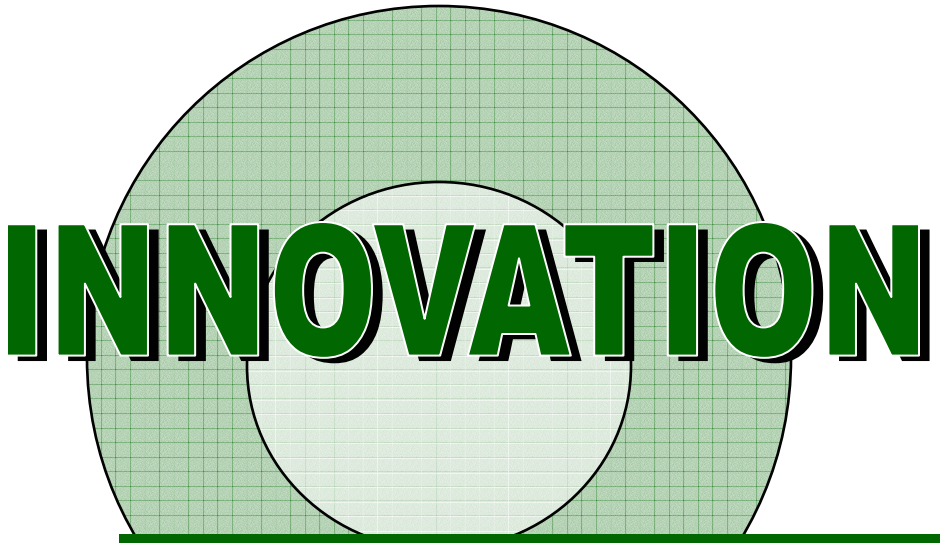
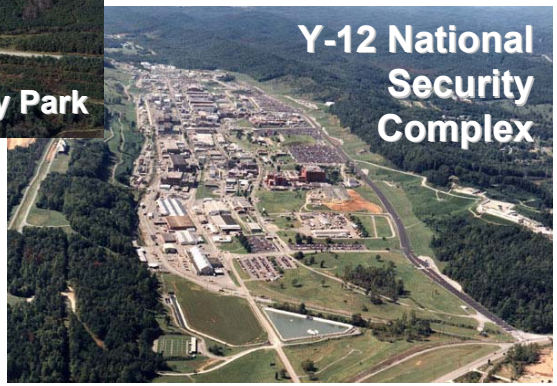


Successfully Overcoming Barriers to Development & Use of Innovative Environmental Technologies at the DOE Oak Ridge Reservation

Gerald Boyd
Oak Ridge Field Office Manager
February 27, 2008

The Oak Ridge Reservation

Oak Ridge Office

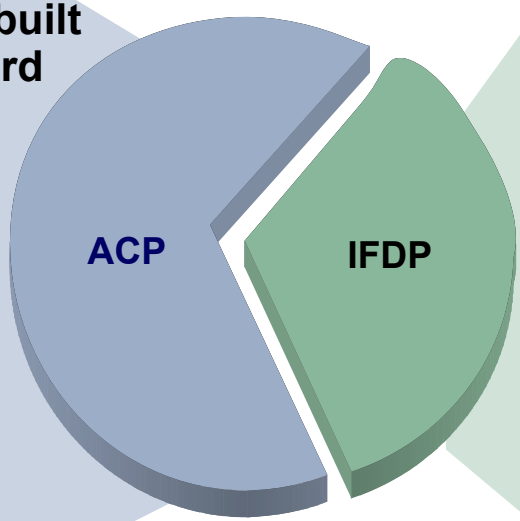


Completing the Accelerated Cleanup Program (ACP), Beginning the Integrated Facility Disposition Project (IFDP)

DOE Environmental Management (EM) has built a successful track record in Oak Ridge

- Three Building D&D Project
- Legacy Waste
- Melton Valley
- DUF6

- ETTP



Remaining Cold War legacies are impeding ongoing missions

- Major areas of the Oak Ridge site remain contaminated
- Legacy issues impair mission readiness at Oak Ridge National Laboratory (ORNL) and Y-12 National Security Complex (Y-12)
- Legacy management consumes resources needed for modernization
- Modernization efforts are not coordinated with cleanup efforts

Oak Ridge has successfully developed and utilized environmental technologies to overcome past challenges

ORNL

- Gunite Tanks Remediation Project - deployed over 30 remote and robotic tank waste retrieval and characterization technologies
- Melton Valley Project - frozen soil barrier technology utilized to prevent the spread of underground contaminants
- Kerr Hollow Quarry Project – deployed remotely operated submersible barge, and underwater shredder

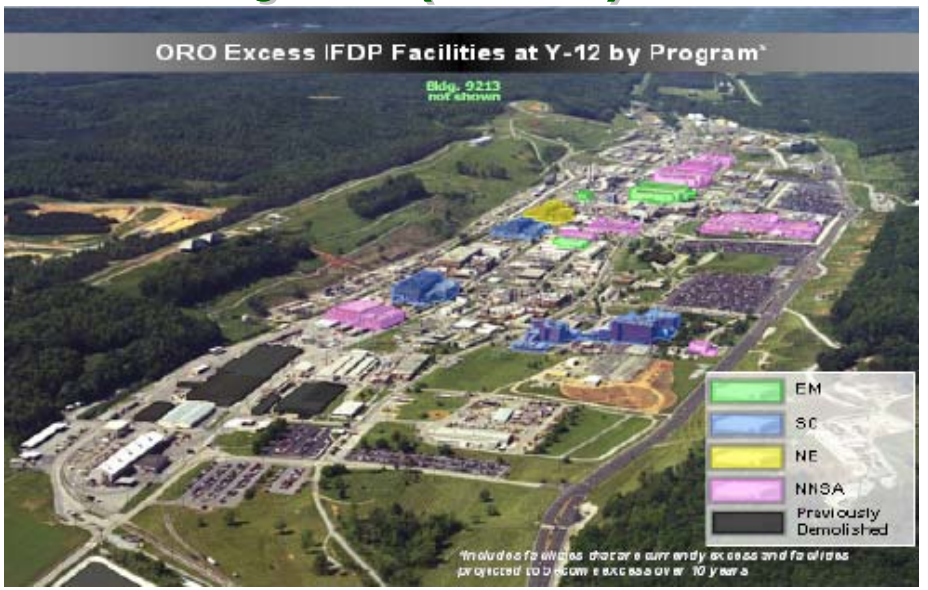
ETTP

- K-770 Scrap Yard Characterization Project – utilized several characterization technologies

Y-12

- S3 Pond Area Project - deployed 2 passive reactive barriers

Oak Ridge is preparing for the Integrated Facility Disposition Project (IFDP)



IFDP Facilities by Site and Program Office						
Site	EM	NE	NNSA	SC	Total	Excess Space (ft^2)
ORNL	159	1	0	132	292	1.3 M
Y-12	17	1	77	17	112	3.8 M
IFDP Total	176	2	77	149	404	5.1 M

Note: Includes ancillary facilities that were estimated in CD-0 but not listed in the facility count

Estimated cost range is $4 - $8 billion with a target completion range of 15 – 20 years.

Integrated Facility Disposition Project Scope

Complete the Environmental Management mission in Oak Ridge for all facilities that are planned to be surplus to DOE needs.

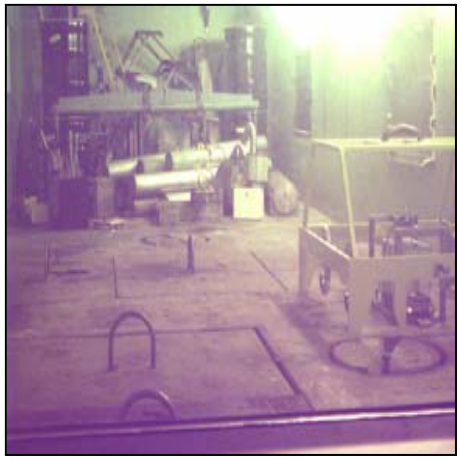
Scope

- Decontaminate and decommission over 400 facilities at ORNL and Y-12
- Treatment and disposition of legacy materials, including remote-handled transuranic waste
- Reconfiguration of waste treatment facilities
- Soil and groundwater remedial actions on the Oak Ridge Reservation
- Surveillance and maintenance of excess facilities
- Waste treatment and disposal operations

Oak Ridge has technology needs associated with the IFDP and other DOE-EM remedial projects.

Barriers to Technology Development

- Lack of Urgency
- Lack of Appreciation of difficulty in dealing with highly-complex, highly-contaminated and often one-of-a-kind facilities
- Unprecedented scope and complexity
- Available technology versus the best technology



Oak Ridge Technology Needs

D&D Challenges

- Beryllium characterization and monitoring
- D&D of high risk facilities (e.g., reactors, hot cells, unstable structures, off-gas stacks)
- Release of contaminants during D&D

Soil & Groundwater Challenges

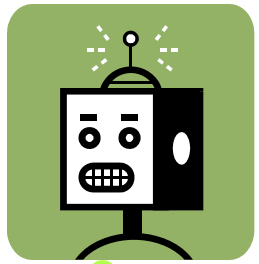
- Source, transport, and treatment of mercury contaminated water
- In-situ treatment of mercury contaminated soils
- Performance assessment, monitoring and verification technologies to support closure

Waste Management Challenges

- Disposition of No-Path-Forward Waste

Barriers to use of new D&D technologies

- **Cost/schedule/safety risks with first time deployment of new technology**
  - *Unpredictable risks associated with capital investment, planning, readiness review, operations, maintenance, etc.*
- **Uncertain technology performance under site-specific conditions**
- **Technology development duration ≠ project schedules**
- **Stakeholder and regulatory acceptance**



Mitigation of Barriers to Oak Ridge Technology Deployment

Barrier	Mitigation Strategy
Cost/Schedule/Safety Risks	▪ Share risks between DOE, the developers, and the contractors ▪ Provide incentives for assuming risks
Performance	▪ Up front end-user involvement to identify site-specific challenges during development and demonstration ▪ Modeling and visualization tools to identify potential technology shortcomings and enhancements ▪ Bench scale and cold testing
Development Schedule	▪ Include technology development, testing, and demonstration in baseline project planning ▪ Integrated technology development and deployment in the project team
Stakeholder/ Regulatory Acceptance	▪Treatability studies with potential technologies ▪ Pilot scale and cold testing of selected technologies

Keys to Success

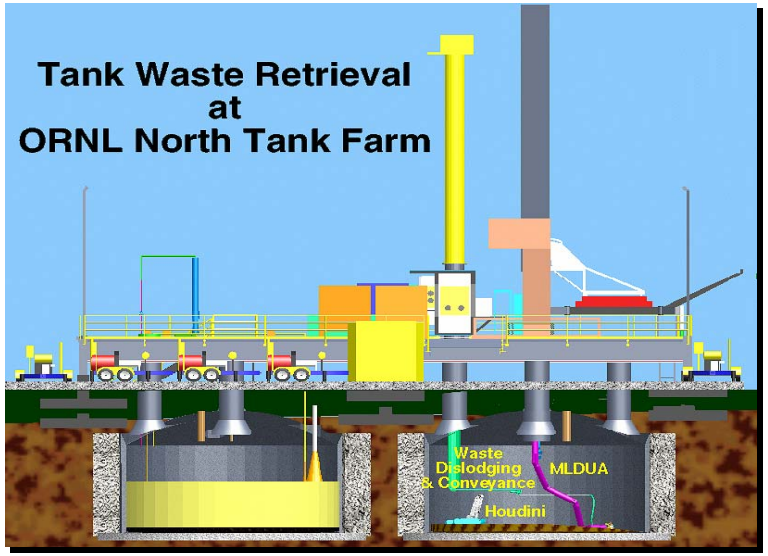
- **COMMUNICATION** among developers, end-users, regulators, stakeholders, etc.
- **Early technology identification** during project planning to allow funding and schedule allowances
- **End-user input/involvement** in design, development and testing of new technologies
- **Integration** of field technology team and field project management team
- **Teaming** between technology developers and engineering companies performing the field work

Back Up Slides

Successful Technology Deployments at Oak Ridge

Gunite and Associated Tanks Remediation

- Scope
  - *8 large tanks cleaned out and closed*
  - *Over 400,000 gallons of radioactive waste slurry removed, including ~ 87,000 gallons of TRU sludge and over 78,000 Curies of radioactivity removed*
  - *Over 30 technologies deployed*
- Keys to Success
  - *Team Integration*
  - *Organization Integration*
  - *Consistency in message and commitment*
  - *Move from low-risk to high-risk activities*
  - *Expect, plan for, and manage change*
  - *Flexibility within operating plan for development and deployment of new tools*



ORNL Tanks Remediation Results

Project	Baseline Cost Estimate ($ Million)	Revised Cost Estimate ($ Million)	Schedule Reduction
Gunite and Associated Tanks Remediation Project (Inactive)	205	90	13 years
Old Hydrofracture Facility Tanks Remediation Project (Inactive)	13	6.5	9 months
Federal Facilities Agreement Tanks (Inactive/Active)	12	8.5	7 years
Bethel Valley Evaporator Service Tanks (Active)	6.6	4	2 years
Melton Valley Storage Tanks (Active)	286	195	20 years
Liquid Low Level Waste System (Active)	13.5/year	9.5/year	Not applicable

ETTP K-770 Scrap Yard Characterization

- Problem
  - *Needed cost-effective, nondestructive characterization technology to characterize waste in a variety of configurations and containers.*
  - *Technology must be capable of isotopic discrimination and sensitive enough to certify that the waste meets the waste acceptance criteria of the disposal facility*
  - *Needed a more reliable technology and technical approach to reduce current cost contingency calculations*
- Solution
  - In-situ *gamma spectrometry*
  - *Field beta scanning*
  - *Field screening for volatile organic compounds*
  - *Limited laboratory analysis*
- Results
  - *Analysis turn around times less than one day*
  - *70% reduction in characterization costs*
  - *40% reduction in total project duration*
  - *NDA measurements that are much more representative than sampling measurements*

Kerr Hollow Quarry Cleanup

- Problem
  - *Quarry contained numerous chemically hazardous materials*
  - *Unsafe for divers*
- Solution
  - *Remotely operated submersible, barge, and underwater shredder*
- Results
  - *Over 19,000 items removed*
  - *Cleanup successfully completed with no worker injuries*

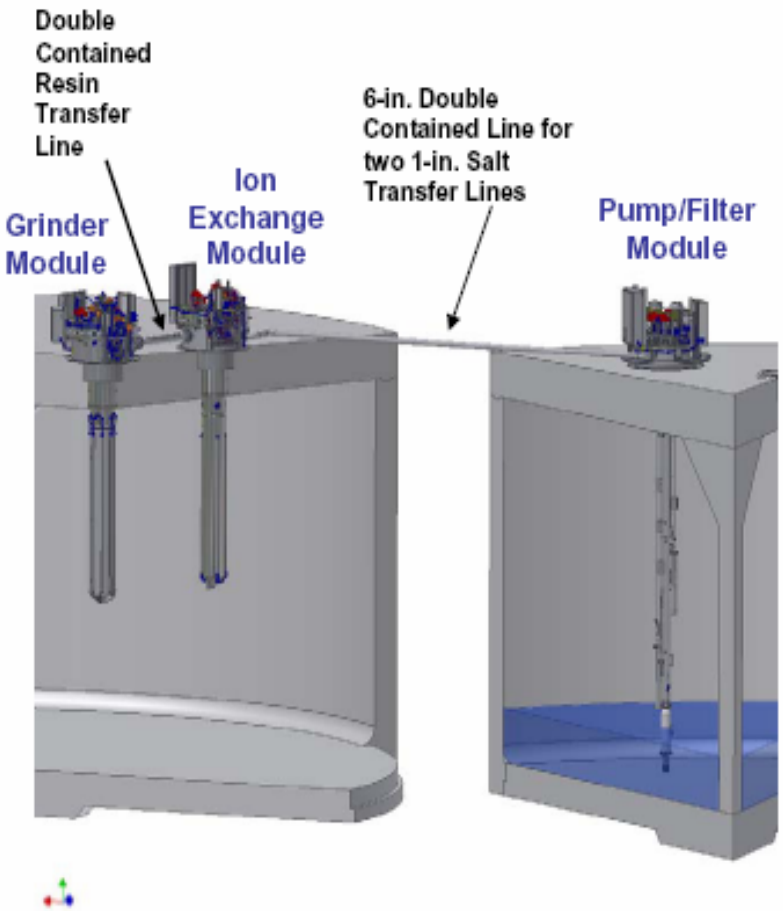
Successful Technology Support Provided by Oak Ridge

Support for Fernald – Waste Stabilization

- Problem
  - *Waste form stabilization of ~10,000 tons of uranium mill tailings*
  - *Determining the percent solids in the waste slurry was critical*
  - *Baseline technology (Coriolis meter) showed severe corrosion problems*
- Solution
  - *Microwave Densitometer*
- Results
  - *Accurate measurement of solids concentrations ranging from 0 to 60 wt%*
  - *Achieved project objectives*

Support for Savannah River – Waste Processing

- Problem
  - *Treatment of low-activity liquid waste from dissolved salt cake in the Savannah River Site's radioactive waste*
  - *High levels of cesium-137*
- Solution
  - *Small Column Ion Exchange*
- Results
  - *Reduced cesium-137 level, allowing waste to meet acceptance criteria for SRS' Saltstone Processing Facility*



In-tank modules designed for deployment via risers of type III tanks and take up minimal space.

D&D Challenges

Beryllium Characterization and Monitoring

- Problem
  - *Beryllium, used in several processes at ORNL, Y-12, and ETTP, found at varying levels in numerous facilities*
  - *Beryllium presents a significant safety hazard to workers*
  - *Current beryllium sampling techniques take days to return results, thus slowing legacy material disposition and D&D activities and leaving a possible exposure hazard*
- Data gap
  - *Real-time, field deployable, beryllium monitor that is accurate and reliable at picogram levels*
- Benefits
  - *Improve worker safety*
  - *Reduce cost and schedule*

D&D of High Risk Facilities

- Problem
  - *Structural deterioration of abandoned facilities is accelerating - safety of workers accessing facilities for D&D or S&M is questionable.*
    - Safety hazards - high rad activity, chemical hazards, facility instability (failure of upper floors and ceilings, falling debris), asbestos, PCBs, lead paint, molds, biological hazards from bird, flea, and rodent infestation
  - *Numerous nuclear facilities with confined spaces, high radiation levels (>100R/hr, >1 million Curies) and other biological and chemical hazards are unsafe for entry*
    - May require decontamination prior to demolition
    - May not have access to process waste lines for liquid decontamination
    - Some equipment/piping/ ducts contain shock-sensitive, pyrophoric material and other hazardous material (e.g., mercury and lithium hydroxide)
  - *Demolition of highly contaminated facilities in close proximity to operating facilities in densely populated areas*

D&D of High Risk Facilities – Characterization Needs

- Data Gap
  - *Remote characterization technologies to facilitate D&D of highly contaminated, deteriorated structures*
  - *Sensors capable of accurate/reliable operation in extremely high rad fields*
  - *Technologies, technical approaches, and lessons learned from past reactor and hot cell D&D projects to help reduce the cost, schedule, and risk of similar work at ORNL*
  - *Technologies and technical approaches for the characterization of facilities with high rad levels, biological and chemical contaminants, and confined spaces unsafe for human entry*
- Benefits
  - *Improve worker safety*
  - *Reduce cost, schedule, and risk*

D&D of High Risk Facilities – Decontamination Needs

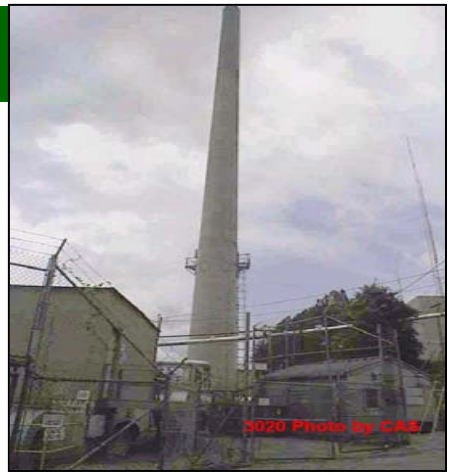
Data Gap

- *Cost-effective dry decontamination technologies that effectively remove high levels of contamination, produce minimal secondary waste, and reduce worker exposure*
- *A decision tool for determining the optimum decontamination approach (i.e., when to decon, how much to decon, what decon method to use, etc.)*
- *Cost-effective remote decontamination processes and equipment*
- *Technologies and technical approaches for the removal of equipment and sources containing high activity and hazardous materials*

- Benefits
  - *Worker safety*
  - *Reduce secondary waste generation*

D&D of High Risk Facilities – Demolition Needs

- Data Gap
  - *Understanding, predicting, and preventing release of contaminants during D&D*
  - *Technologies and technical approaches for real-time monitoring during D&D*
  - *Technologies, technical approaches, and lessons learned from past D&D of high risk facilities to help reduce the cost, schedule, and risk of similar work at ORNL*
  - *Technologies and technical approaches for demolition of off-gas stacks (>100 ft tall) and other highly contaminated structures in close proximity to operating facilities and densely populated areas*
- Benefits
  - *Improve worker safety*
  - *Reduce cost, schedule, and risk*



Release of Contaminants During D&D

- Problem
  - *Activities associated with D&D can release liquid effluents and airborne particles*
  - *Other D&D activities (e.g., turning off sump pumps and removing physical barriers) can release contaminants to soil and water*
  - *Some D&D activities will be conducted adjacent to active facilities and densely populated areas where release of contaminants is a serious concern*
- Data Gap
  - *Understanding, predicting, and preventing release of contaminants during D&D*
  - *Technologies and technical approaches for real-time monitoring during D&D activities*
- Benefits
  - *Reduce risk to workers and the environment*
  - *Reduce risk of NOV and NPDES exceedence*

Groundwater & Soil Challenges

Sources, Transport, and Treatment of Mercury Contaminated Water

- Problem
  - *Routine water monitoring of mercury concentrations at White Oak Creek exceeds NPDES permit and methylmercury in East Fork Poplar Creek fish imparts health risk to humans and wildlife*
  - *Efforts to reduce mercury levels in streams may not reduce methylmercury in fish to safe levels*
- Data Gap
  - *Identify transport pathways/mechanisms and source of mercury contamination and physical/chemical forms leaving area*
  - *Design effective groundwater treatment system to meet surface water ambient water quality criteria*
  - *Identify/evaluate alternatives to reduce methylmercury in fish without further reduce the waterborne concentration levels*
- Benefits
  - *Meet NPDES permit requirements and Clean Water Act, EPA, and TN water quality standards*

In-Situ Treatment Alternatives for Mercury Contaminated Soils

- Problem
  - *Mercury soil contamination > 20 ft deep in the 81-10 area at Y-12 (radionuclides and other heavy metals also present) and mercury contamination in Upper East Fork Poplar Creek water, sediments, and floodplains*
    - Excavation/dredging operations are expensive and time consuming
    - Traditional sampling techniques are expensive, time consuming, and may miss hot spots
- Data Gap
  - *Identify/evaluate in-situ mercury remediation approaches*
  - *Demonstrate/document performance of alternative in-situ treatments to support the Upper East Fork Poplar Creek Phase II ROD*
  - *Evaluate phytoremediation as alternative for removing mercury/heavy metal contaminants from soil and water*
  - *Evaluate reflective analysis of plants to monitor long-term stability, mobility, and bioavailability of mercury along creek beds*
- Benefits
  - *Reduce risk to the public and environment*
  - *Reduce cost, schedule, and programmatic risk*

Performance Assessment, Monitoring, and Verification Technologies to Support Closure

- Problem
  - *Caps and other engineered controls require vigilant monitoring for decades*
  - *Estimated cost of long-term monitoring is several hundred million dollars*
  - *Effectiveness of current monitoring approaches to warn of impending problems in a timely manner could be improved*
- Data Gap
  - *Identify and evaluate cost-effective and protective monitoring strategies to provide better warning of pending problems with caps and contaminant releases*
- Benefits
  - *Cost-effective compliance with closure agreements*

Waste Management Challenges

Disposition of "No-Path-Forward" Wastes

- Problem
  - *Over 400 containers of remote-handled radioactive waste and mixed waste remain in storage with no current path forward for disposal*
- Data Gap
  - *Treatment capacity for classified mixed waste*
  - *Treatment and RCRA Subtitle C disposal capacity*
  - *Treatment capacity for combustion code mixed wastes*
  - *Approved Type B casks for shipment and burial of RTGs at the Nevada Test Site*
  - *DOT-compliant packaging for remote-handled radioactive waste vaults*
- Benefits
  - *Site Closure*
  - *Environment, Health, and Safety Risk Reduction*