Attachment E

Presentation Materials

General Presentations

- LTS S&T Roadmap Management Process – Larry Davis
- Environmental Decision Making Involving Multiple Stakeholders – George Apostolakis

Site Operations Presentations

- LTS S&T Needs and Observations – Larry Davis
- RFETS LTS S&T Needs and Observations – Lane Butler
- Mound LTS S&T Needs and Observations – Don Krause
- Stewardship Technology Needs For Closure At The Fernald Environmental Management Project – Don Paine
- SRS LTS S&T Needs and Observations – Dave Freeman
- Mound Long Term Stewardship Science and Technology Needs – Kliss McNeel

Long-Term Stewardship Science and Technology Roadmap

LTS S&T Roadmap Management Process

E. Larry Davis, Chair
Executive Committee

March 18, 2002

Long-Term Stewardship Science and Technology Roadmap

LTS Roadmap Management Process "As is" and "Desired State"

Requirements	"As is" Condition	Desired State	Proposed Action
1. LTS Elements and Processes (What is Long Term Stewardship?)	Uncertainty as to what elements and processes of LTS are important. (The LTS elements and processes were provided in the reading material.)	Clear understanding by all board members of the elements and processes of LTS and how they relate to remedial actions. (This desired state could be only partially achieved by reading the background material provided.)	Develop a model (Cartoon) that integrates the LTS mission, elements, functions, technology areas with the action of the working groups – **George Apostolakis**
2. Roadmap Process and Product (What is a roadmap and how is it developed?)	Uncertainty of the Roadmap Process.	Clear understanding by all board members of the roadmap process and how we will implement it to develop a roadmap for LTS. (The November meeting was intended to achieve this desired state – questions remain.)	Develop objectives to be achieved at the March and May Meeting – **Bruce Hallbert** Decliver a presentation an Decision Analysis Theory – **George Apostalakis** Note: Model development is a precursor.
3. Customer Expectations and Objectives (What does DOE want us to do?)	Uncertainty of the customer expectations, objectives, and deliverables.	Clear understanding by all board members of the customer expectations, objectives, and deliverables. (Some discussion at the November meeting focused on this issue; uncertainty exists that we achieved the desired state. Written expectations and objectives should solidify this desired state.)	Meet with Jesse Roberson to assure congruence with expectations - **Jim Wooford**
4. Board of Directors' Responsibilities (What does the Board do?)	Uncertainty and differences of opinion regarding the roles and responsibilities of the Board of Directors and Executive Committees.	Clear understanding by all board members of the roles and responsibilities of the Board of Directors. (Chairman's desire is to assure clarity of purpose of both the Board and Working Groups, set priorities and schedules, and monitor progress.)	None

LTS S&T Roadmap Needs Assessment Workshop, January 28-20, 2002, Dallas, TX 2

LTS Roadmap Management Process
"As is" and "Desired State"

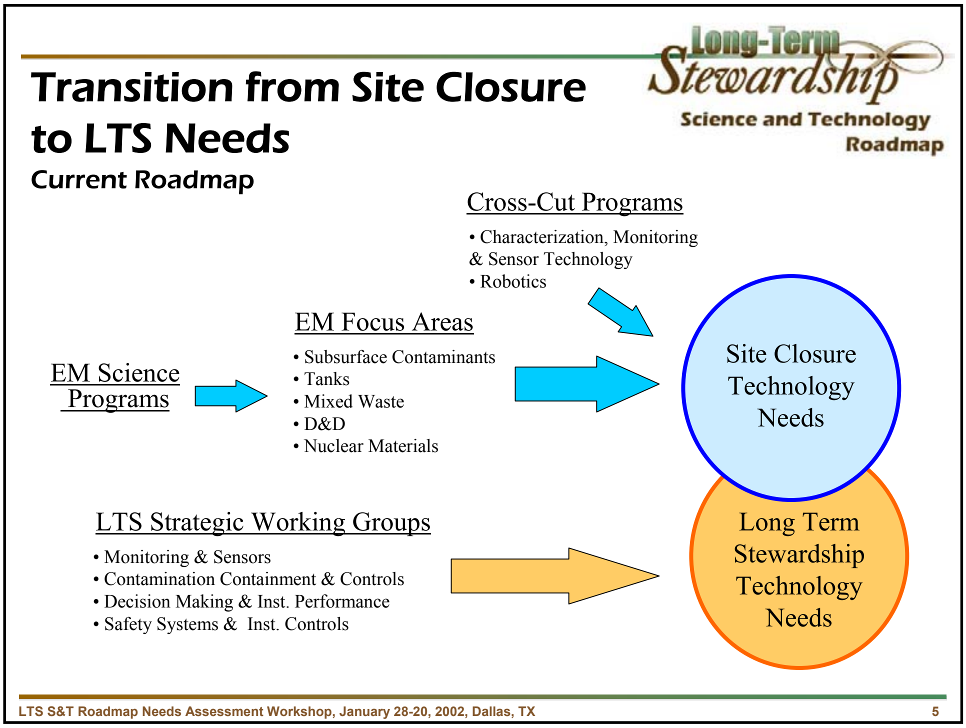
Long-Term Stewardship Science and Technology Roadmap

Requirements	"As is" Condition	Desired State	Proposed Action
1. General Working Group Responsibilities (What do the working groups do, in general?)	Uncertainty and differences of opinion regarding the roles and responsibilities of the working groups.	Clear understanding by all board members and working group members of the roles and responsibilities of the working groups. (Same as above.)	None
2. Individual Working Group Identification and LTS assigned focus area. (Are we doing the right work?)	We seem to have a pretty good understanding of the four working groups that are currently identified based on presentations and discussions in the November meeting. However, confidence that these groups are the correct groups needs to be established (i.e. Do we have the correct groups? Do we need additional groups? Have we appropriately addressed all the potential stewardship issues in the current groups?)	High confidence and unity of the board that the groups as established fully address all the potential stewardship issues and build on work already accomplished in identifying Science and Technology needs.	-Working Group 1, Perform Self-Assessment to assume that they have addressed OST's CMST Goals. Ref: *Office of Science and Technology Investment, Characterization, Monitoring, and Sensor Technology: A Crosscutting Analysis* (CMST – CP, June 28, 2001) **Dave Bores** -BOD to listen well to Operations Briefing and develop *Self-Assessment Lines of Inguiry g* to be used by each working group. **BOD** -All working groups Perform Self-Assessments. Against lines of inquiry- WG Chairs

LTS Roadmap Management Process
"As is" and "Desired State"

Long-Term Stewardship Science and Technology Roadmap

Requirements	"As is" Condition	Desired State
Working Group Staffing (Do we have the right people?)	We appear to have a reasonable level of comfort that the appropriate staffing has been proposed.	The board will maintain confidence throughout the process that the staffing selected have the appropriate knowledge and skills to produce the right product within the required schedule. (Need to develop criteria for measuring progress.)
Specific Working Group Plans and Pathway to Success (Do we have a clear and achievable path to success?)	Uncertainty of the individual working group plans and pathway for successful completion of the project.	Clear understanding of the plans and approach of each working group and high confidence that each group has identified a path forward that can be implemented within the resources available to produce an acceptable product on the schedule required.
Monitoring Performance against Plans (How do we know that we are on track?)	We currently have no management system or structure to allow us to effectively monitor the progress of each working group to ensure that each working group stays on course and the project objectives are achieved.	Identify or develop a management process to effectively monitor the progress of each working group and provide opportunity for course correction as required to ensure that project objectives are achieved.


Long-Term Stewardship
Science and Technology Roadmap
Transition from Site Closure to LTS Needs
Current Roadmap
Cross-Cut Programs
• Characterization, Monitoring & Sensor Technology
• Robotics
EM Focus Areas
• Subsurface Contaminants
• Tanks
• Mixed Waste
• D&D
• Nuclear Materials
EM Science Programs
Site Closure Technology Needs
LTS Strategic Working Groups
• Monitoring & Sensors
• Contamination Containment & Controls
• Decision Making & Inst. Performance
• Safety Systems & Inst. Controls
Long Term Stewardship Technology Needs
LTS S&T Roadmap Needs Assessment Workshop, January 28-20, 2002, Dallas, TX
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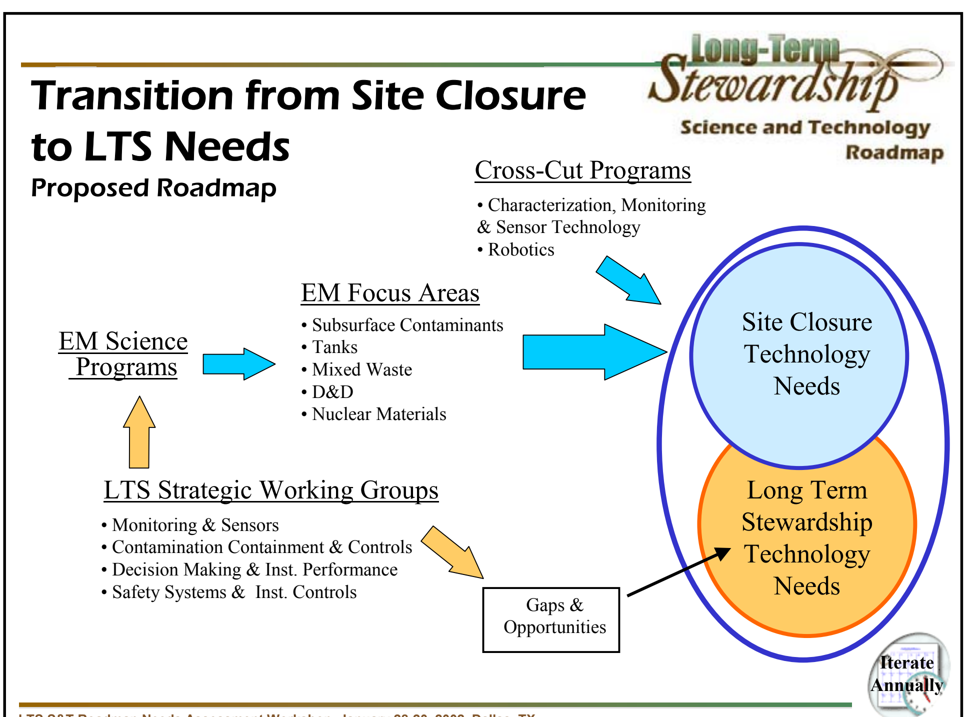
Long-Term Stewardship
Science and Technology Roadmap
Transition from Site Closure to LTS Needs
Proposed Roadmap
Cross-Cut Programs
• Characterization, Monitoring & Sensor Technology
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LTS Strategic Working Groups
• Monitoring & Sensors
• Contamination Containment & Controls
• Decision Making & Inst. Performance
• Safety Systems & Inst. Controls
Gaps & Opportunities
Long Term Stewardship Technology Needs
Iterate Annually
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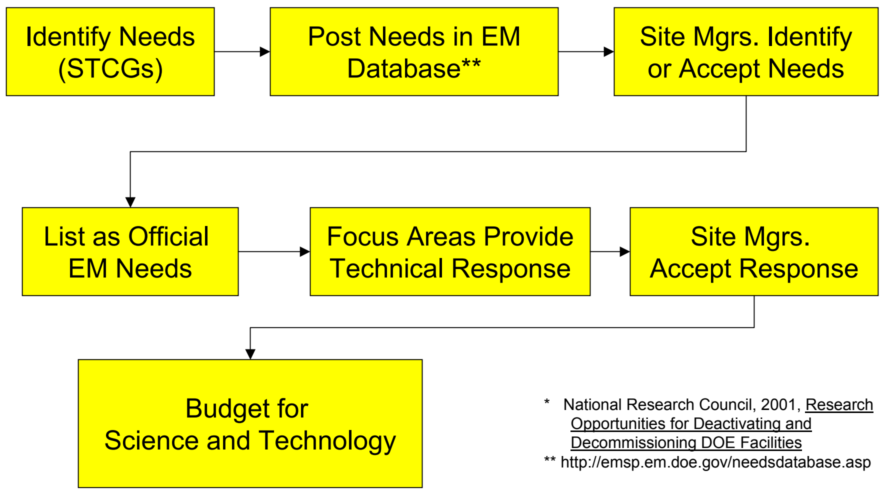
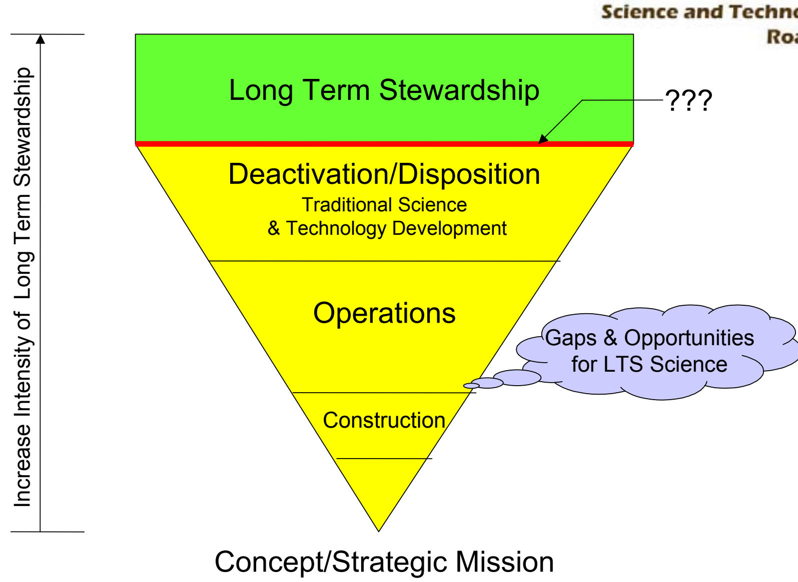
Long-Term Stewardship
Science and Technology Roadmap

Process for Needs for S&T*



* National Research Council, 2001, Research Opportunities for Deactivating and Decommissioning DOE Facilities
** http://emsp.em.doe.gov/needsdatabase.asp

Long-Term Stewardship
Science and Technology Roadmap



Justification for Continuous Process of Science &Technology

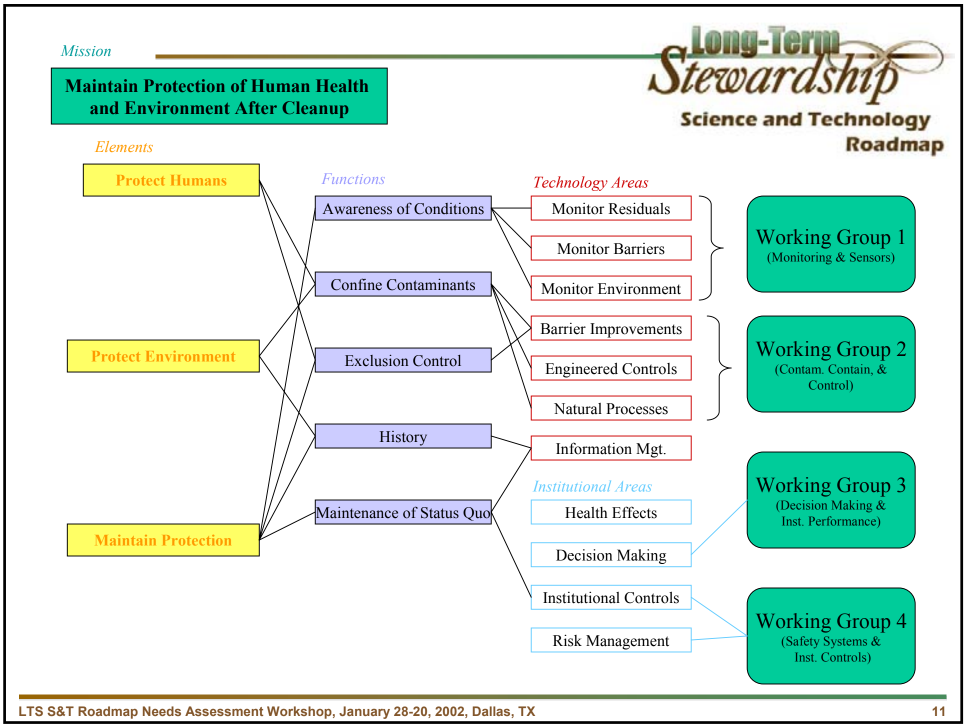
Long-Term Stewardship Science and Technology Roadmap

- Life Cycle Asset Management
  - DOE Order 430.1A
    - The process for physical asset acquisition shall be an integrated, systematic approach that shall ensure … consideration of maintainability, operability, disposition, life-cycle cost, and configuration integrity in designs and acquisitions.
- Preliminary Safety Analysis Report (PSAR)
  - DOE Order 5480.23 & DOE-STD-3009-94
    - Requires conceptual plans for final decommissioning be addressed in the PSAR during planning for operations & design

Justification (continued)

Long-Term Stewardship Science and Technology Roadmap

- 104th Congress Appropriations Bill (1995)
  - DOE's Environmental Management Science Program (EMSP) created to
    - "stimulate basic research, development, and demonstration efforts to seek new and innovative cleanup methods to replace current conventional approaches, which are often costly and ineffective."


Mission
Maintain Protection of Human Health and Environment After Cleanup
Long-Term Stewardship
Science and Technology Roadmap
Elements
Protect Humans
Protect Environment
Maintain Protection
Functions
Awareness of Conditions
Confine Contaminants
Exclusion Control
History
Maintenance of Status Quo
Technology Areas
Monitor Residuals
Monitor Barriers
Monitor Environment
Barrier Improvements
Engineered Controls
Natural Processes
Information Mgt.
Institutional Areas
Health Effects
Decision Making
Institutional Controls
Risk Management
Working Group 1
(Monitoring & Sensors)
Working Group 2
(Contam. Contain, & Control)
Working Group 3
(Decision Making & Inst. Performance)
Working Group 4
(Safety Systems & Inst. Controls)
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Environmental Decision Making Involving Multiple Stakeholders

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Stakeholder Involvement

"Risk assessment can and should be used to involve stakeholders and provide a mechanism for the consideration of their cultural, socioeconomic, historical, and religious values, in addition to the risks to human health and the environment associated with the contamination of DOE facilities and their remediation."

National Research Council, *Building Consensus*, 1994

The Analytic-Deliberative Process

- *Analysis* uses rigorous, replicable methods, evaluated under the agreed protocols of an expert community - such as those of disciplines in the natural, social, or decision sciences, as well as mathematics, logic, and law - to arrive at answers to factual questions.

- *Deliberation* is any formal or informal process for communication and collective consideration of issues.

National Research Council, *Understanding Risk*, 1996.

The Case Study

- 1.9 Acres
- Disposal 1962 to 1981
- Solvents, PCBs, metal acids, lab trash, misc debris
- 4 miles to nearest drinking - water well
- 3 miles to nearest spring
- 480 feet to water table
- Network of vapor extraction wells to reduce TCE vapor plume
- Landfill-wide excavation to top 15 ft to remove shallow primary sources of potential contamination

Stakeholders

Stakeholder	Organization
1	Real Estate Agent
2	National Laboratory Employee
3	City Environment and Health Department
4	Middle Rio Grande Council of Governments
5	National Laboratory Employee
6	Community Advisory Board

Remedial Action Alternatives

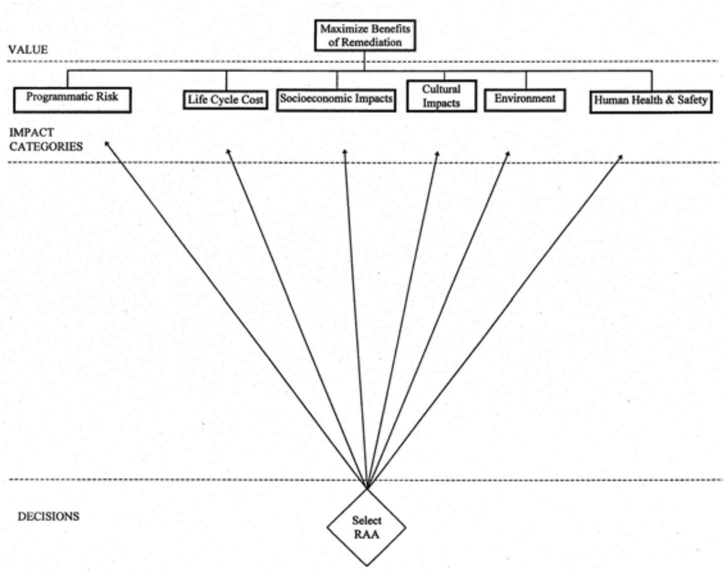
Remedial Action Alternative	Treatment of Cr	Treatment of TCE
A	in-situ vitrification	soil vapor extraction
B	in-situ stabilization	in-situ bioremediation
C (excavation; on-site disposal of treatment residuals)	stabilization/ solidification	thermal desorption
D (excavation; off-site disposal of treatment residuals)	stabilization/ solidification	thermal desorption
E (excavation; off-site treatment and disposal)	off-site treatment	off-site treatment
F (No action)		

Formal Analysis

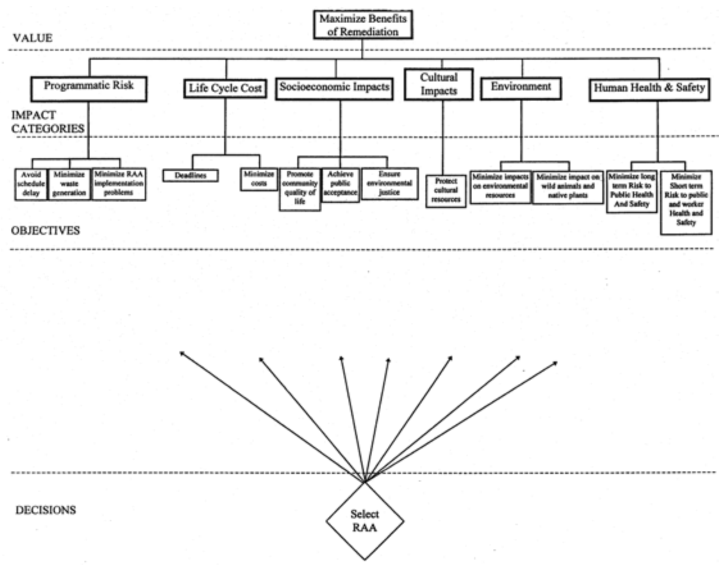
- **What is important? (*Objectives)***
- **To what extent are the objectives satisfied? (*Performance Measures*)**
- **What is the relative importance of the performance measures? (*Weights)***
- **How does the decision option rate with respect to each of the performance measures? (*Utility Functions)***
- **How do I decide? (*Decision Rule*)**

$$\overline{PI}_j = \sum_{i=1}^{N_{PM}} w_i \, \overline{u}_{ij}$$

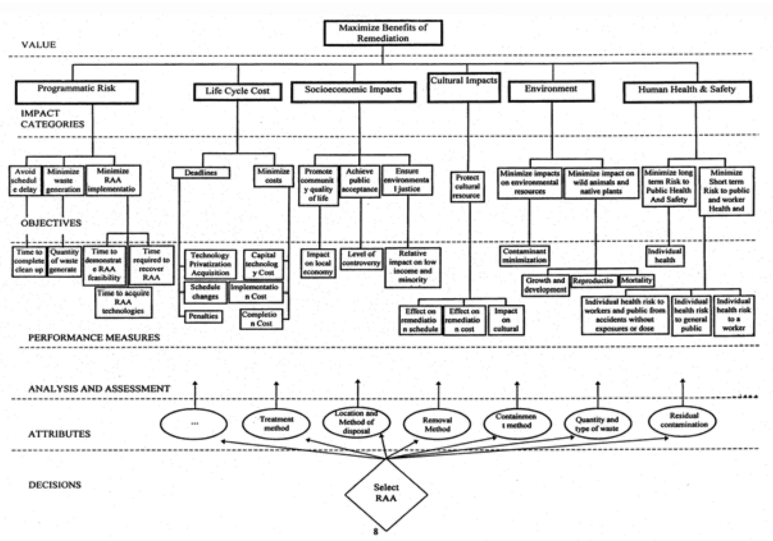
Building the Value Tree (1)



Building the Value Tree (2)



Building the Value Tree (3)



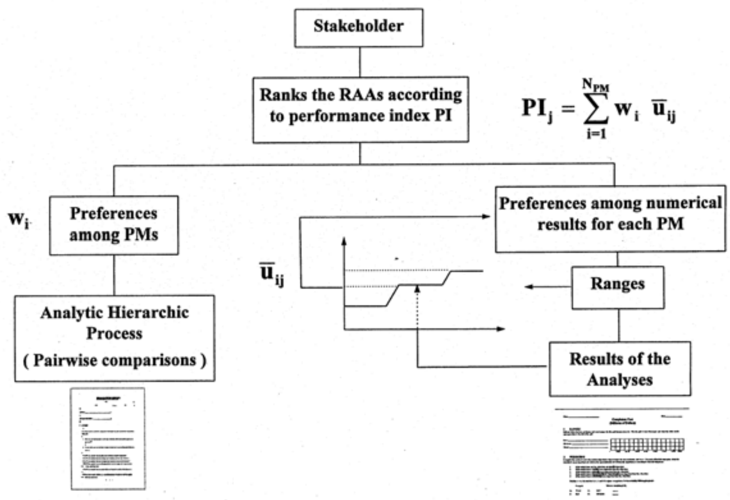
Stakeholder Changes

- Most agreed with the tree on slide 10.
- Some stakeholders placed long-term public risks under the category "environment."

Ranges of PM Values

Category	Objective	Performance Measure			Minimum	Maximum	Unit of Measure
Programmatic Assumptions	Minimize Waste	Quantity of Waste Transported			0	15,000	yd^3
		Quantity of Process Waste Generated			0	300,000	yd^3
		Quantity of ER Waste Generated			0	15,000	yd^3
Life Cycle Cost	Minimize Direct Costs	Implementation Costs			0	8	$M
		Completion Costs			0	8	$M
Socioeconomic Issues	Promote Community Quality of Life	Impact on Local Economy			0	35	$M
		Changes in Ambient Condition			5% Improvement	20% Degradation	Percent Change
	Promote Environmental Justice	Compare Total Population Health Effects			0	50%	% Difference Compared to Population
Cultural, Archaeological & Historic (CAH) Resources	Protect CAH Resources	Number Impacted / Severity Impacted			0	5 major / 25 minor	Number and Significance
Environment	Protect Environmental Resources	Contaminant Concentration	TCE		0	15	ppb
			Cr		0	10	ppm
		Changes in Resources			15% Degradation	15% Improvement	% Change in Soil Characteristics
	Minimize Risk to Public Health & Safety	Individual Health Risk	Long Term	Incremental Cancer	10^{-9}	10^{-5}	Dimensionless
				Hazard Index	0	40	Dimensionless
			Short Term	Incremental Cancer	10^{-12}	10^{-8}	Dimensionless
				Accidents Death	10^{-10}	10^{-4}	Dimensionless
Health & Safety	Minimize Risk to Worker Health & Safety	Individual Worker Health Risk	Routine Accidents / Incremental Cancer		10^{-10}	10^{-6}	Dimensionless
			Number of Fatalities		0	5	Number per 100 Workers
			Number of Injuries		0	30	Number per 100 Workers

INTEGRATION METHODOLOGY



The Weights

- Recall that

$$\overline{PI}_j = \sum_{i=1}^{N_{PM}} w_i \bar{u}_{ij}$$

- The weights are scaling factors that sum to unity

$$\sum_{1}^{N_{PM}} w_i = 1$$

- They represent trade-offs between PMs. They can be assessed directly or using structured approaches, such as SMART and AHP. The DM has the final approval.

The Analytic Hierarchy Process

- Not used as an alternative to decision theory but, rather, as a supporting methodology.
- Relative rankings of the objectives are determined with respect to an overall goal.
- Pairwise comparisons are used to derive weights representative of the decision maker's concerns.

T.L. Saaty, *The Analytic Hierarchy Process*, RWS Publications, Pittsburgh, 1996.

Relative Importance Assessment

- RELATIVE IMPORTANCE ASSESSMENT

- *Objective categories*

Compare the following with respect to the OVERALL DESIRABILITY objective

1. Socioeconomic / Cultural vs. Life Cycle Cost ___
2. Programmatic vs. Environment ___
3. Life Cycle Cost vs. Human Health & Safety ___
4. Environment vs. Human Health & Safety ___
5. Environment vs. Life Cycle Cost ___
6. Socioeconomic / Cultural vs. Environment ___
7. Programmatic vs. Life Cycle Cost ___
8. Human Health & Safety vs. Socioeconomic / Cultural ___
9. Programmatic vs. Socioeconomic / Cultural ___
10. Human Health & Safety vs. Programmatic ___

- Key for the evaluation:

1 equally 3 weakly 5 strongly 7 demonstrably or very strongly 9 absolutely

Use even numbers to express compromise.

The Practice

- People are not consistent in their assessments.
- Redundant information is elicited.
- Define the *consistency index* as

$$CI = \frac{\lambda_{max} - n}{n - 1}$$

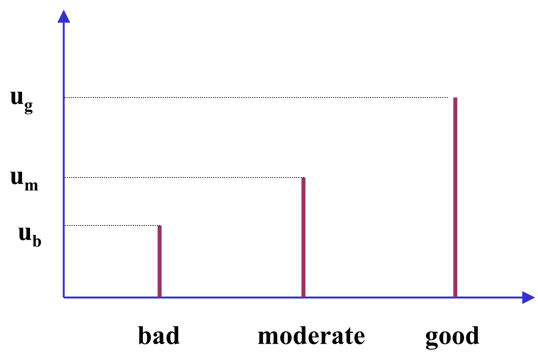
- If CI > 0.2, identify inconsistencies and inform the assessor.
- The assessor always approves the final weights.
- The CI is for internal consistency only, not for consistency among stakeholders.

Stakeholder Rankings and Weights

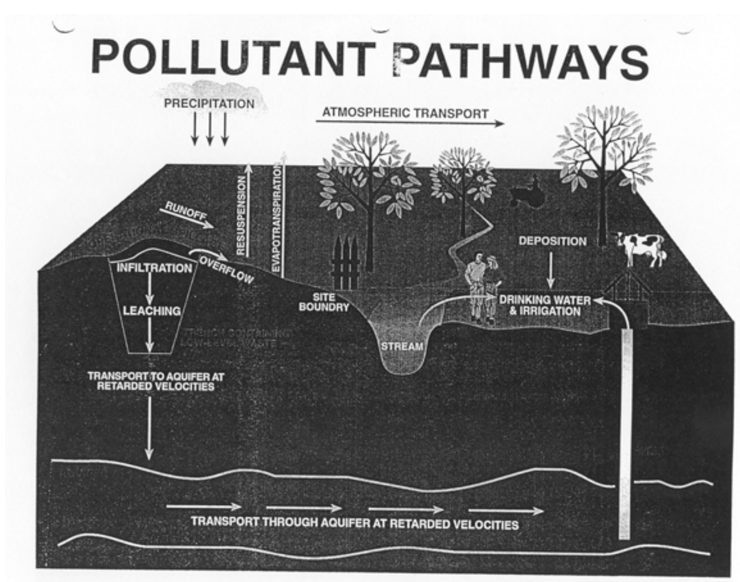
Category / Stakeholder	Programmatic	Life Cycle Cost	Socioeconomic	Cultural	Environment	Human Health & Safety
SH1	4 (8)	3 (11)	6 (4)	6 (4)	2 (34)	1 (39)
SH3	6 (2)	4 (7)	5 (4)	3 (8)	2 (39)	1 (40)
SH4	5 (5)	4 (8)	2 (25)	6 (4)	3 (17)	1 (41)
SH6	4 (12)	6 (5)	3 (13)	5 (10)	2 (27)	1 (33)

SH2	5 (2)	3 (14)	6 (2)	4 (6)	1 (38)	1 (38)
SH5	6 (3)	4 (10)	5 (4)	3 (11)	2 (20)	1 (52)

Utilities

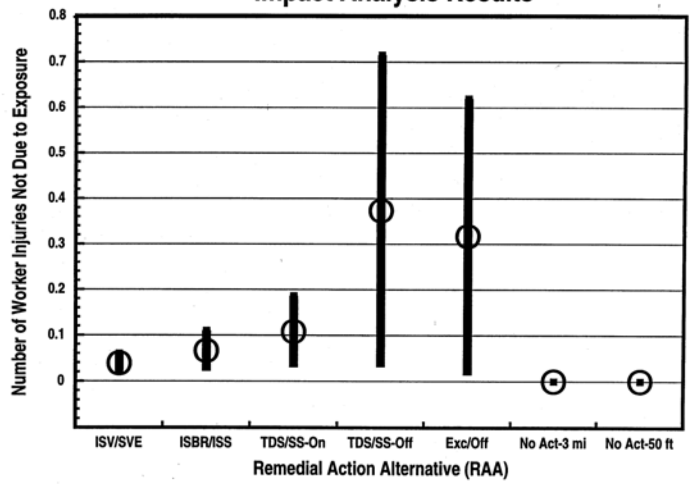


u_g
u_m
u_b
bad
moderate
good



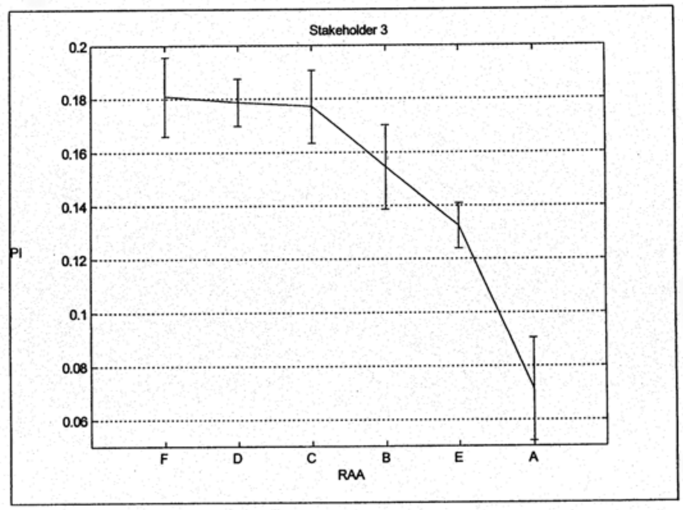
POLLUTANT PATHWAYS
PRECIPITATION
ATMOSPHERIC TRANSPORT
RUNOFF
RESUSPENSION
EVAPOTRANSPIRATION
INFILTRATION
OVERFLOW
LEACHING
SITE BOUNDRY
DEPOSITION
DRINKING WATER & IRRIGATION
STREAM
TRANSPORT TO AQUIFER AT RETARDED VELOCITIES
TRANSPORT THROUGH AQUIFER AT RETARDED VELOCITIES

Environment and Human Health and Safety Impact Analysis Results



RAA	STAKEHOLDERS 1	2	3	4	5	6
A	.094 (6)	.048 (6)	.071 (6)	.053 (6)	.050 (6)	.130 (5)
B	.205 (4)	.172 (3)	.154 (4)	.111 (5)	.091 (2)	.159 (2)
C	.216 (3)	.128 (4)	.177 (3)	.122 (3)	.091 (3)	.155 (3)
D	.183 (5)	.115 (5)	.179 (2)	.120 (4)	.082 (5)	.139 (6)
E	.223 (2)	.185 (2)	.132 (5)	.135 (1)	.107 (1)	.114 (4)
F	.258 (1)	.205 (1)	.181 (1)	.128 (2)	.089 (4)	.194 (1)

Performance Indices and RAA rankings for all stakeholders.



Stakeholder 1	Stakeholder 2	Stakeholder 3
RAA F is preferred *Does not employ workers, no worker health risk* *Does not generate waste* *Leaves contaminant in the ground* **RAA C and RAA E are less preferred than RAAF** *B and C have substantial reduction in groundwater contaminant risks* *RAA F performs better in Worker health risk* *C has higher completion costs* *E transports more wastes off-site* **RAA B is slightly less preferred than C & E** *Yields a higher amount of contaminant in the groundwater* **RAA D is less preferred than B** *Transports more waste off site* *RAA D has a higher completion cost* **RAA A is inferior to other RAAs** *High completion cost* *High worker health risk* Uncertainty analyses on performance output indicates that the rankings of RAA B, C, and F are not significantly different. RAA F and B indicate a lower uncertainty & perhaps less likely to fluctuate in the deliberation. E and A appear stable (quantitatively).	**RAA F is preferred** *No short term public accident risks* *Strong concern for public health* **RAA E performs worse than RAA F** *E has more transported wastes* *lower performance on implementation costs,* *due to the number of workers and trucks involved* *E is better than F in removal of contaminant yet poor performance in short term health due to transportation of waste* **RAA B is similar to E in preference** *B is on-site and thus lower costs and less transported waste* *B has higher long term public risk of cancer* **RAA C and D are less preferred** *higher completion cost due to technology (thermal desorption) and the cost of the disposal of the treatment of the residuals.* **D transports wastes off-site which leads to higher costs** *RAA A is least preferred* *Poor performance under worker and public health risks* *High completion cost.*	**RAA F is slightly preferred over the other RAAs** *No worker injuries unlike the other RAAs yet leaves the contaminant in the ground* *Transportation of waste is the performance measure which adversely affects the other RAAs in comparison to F* **RAA C and RAA D perform closely with RAA F** *The tradeoff here is that they remove the contaminant which counteracts their poor performance in regards to worker health* **RAA B is average** *B performs worse than C and D in contaminant removal since the contaminant remains on site* *B has a lower Completion Cost than C and D* **RAA E is less preferred** *High Implementation Cost* *Significant ER and Transported Waste compared to C and D* *Higher volume of transported waste, therefore E is more costly* **RAA A gives substantially lower performance** *In-situ Vitrification which yields high worker health risks* Uncertainty analyses on the performance output of the RAAs show that these preferences are rather stable and that F, D and C are not markedly different.

Major Contributors to Individual Stakeholder Preferences

Proposal	Reasons For	Reasons Against
1. A is the least preferred alternative	• Both worker and short-term public health risks are high due to airborne Cr particulates released • All stakeholders put a strong value on worker health risks • Highest completion costs • Five stakeholders rank it #6; one stakeholder ranks it as #5	
2. C is neither strongly disliked nor liked by stakeholders	• Smaller worker risks • Some impact on local economy • Less transported wastes • Removes some of the contaminant	• High completion costs vs. B • C results in greater short term public cancer risk • C results in a lower impact on local economy
3. D is less preferred than C by all except possibly one SH	• All stakeholders put a high weight on worker health risk • Off-site treatment • More transported wastes • More worker health risks	
4. F is a candidate to be the"preferred" alternative	• Avoids risks to workers (weighted strongly by all stakeholders) • Low cost	• Leaves the contaminant in the ground • Greater long term public health risk
5. E is a candidate to be recommended	• Removes all of the contaminant • Low long term public cancer risk • Impact on the local economy	• High Worker Health Risks • Requires a lot of workers • Large amounts of transported wastes • High implementation costs
6. F and E are the two preferred options	Reasons for E • Long term public • Impact on local economy • Removal of contaminant Reasons for F • Worker injuries and fatalities • Costs • Wastes generated	Reasons against E • Worker injuries and fatalities • Implementation costs • Wastes generated • Reasons against F • Long term public risk • Impact on local economy • Removal of contaminant

Tentative Conclusions for Deliberation

Role of the stakeholders

- **Influence the decision maker's choice**
- **Communicate concerns, interests, and ideas**
- **Listen actively**

Role of the Analysts

- **Provide clarification on technical questions**
- **Provide technical data on the impacts of each RAA**

Role of the Mediator

- **Guide deliberation**
- **Promote understanding of all viewpoints**
- **Facilitate discussion**
- **Promote a fair and wise process**
- **Identify major reasons for agreement and disagreement**

Points of Agreement

- Dislike of in-situ vitrification of RAA A.
- Dislike of "no action" alternative F.
- Dislike of RAA E; do not transport waste to other communities.
- Cr is not a primary concern for long-term health, consequently, the stakeholders are willing to tradeoff more CR left in the ground for less TCE left in the ground.

Final Consensus

Hybrid RAA	Changes from original	Description
C^{+}	Off-site, rather than on-site, disposal of organics (TCE).	Excavation and thermal desorption of organics to be disposed of off-site. Soil stabilization of metals (Cr) with on- site treatment.
A^{+}	No in-situ vitrification.	Soil vapor extraction for TCE . In-situ stabilization for Cr.
F^{+}	Added action of focused soil vapor extraction for TCE.	Continue with Voluntary Correction Measures, with the addition of focused soil vapor extraction for TCE. No action for Cr.

References

Accorsi, R., Apostolakis, G., and Zio, E., "Prioritizing Stakeholder Concerns in Environmental Risk Management," *Journal of Risk Research*, 2:11-29, 1999.

Accorsi, R., Zio, E., and Apostolakis, G.E., "Developing Utility Functions for Environmental Decision Making," *Progress in Nuclear Energy*, 34:387-411, 1999.

Apostolakis, G.E. and Pickett, S.E., "Deliberation: Integrating Analytical Results into Environmental Decisions Involving Multiple Stakeholders," *Risk Analysis*, 18:621-634, 1998.

Bonano, E.J., Apostolakis, G. E., Salter, P.F., Ghassemi, A., and Jennings, S., "Application of Risk Assessment and Decision Analysis to the Evaluation, Ranking, and Selection of Environmental Remediation Alternatives," *Journal of Hazardous Materials*, 71:35-57, 2000.

Zio, E. and Apostolakis, G.E., "Sensitivity and Uncertainty Analysis within a Methodology for Evaluating Environmental Restoration Technologies," *Computer Physics Communications*, 117:1-10, 1999.

LTS S&T Needs and Observations

LTS Roadmapping Workshop
Orlando, Fl
March 19, 2002
Larry Davis

savannah river site

LTS Roadmapping Near Term Considerations

- Thrust 1 - Closure Site Support
  - Storage of Nuclear Material
  - Deactivation, Decontamination and Demolition of Structures and Facilities
  - Remedial Actions
  - Waste Disposal and Storage

savannah river site

LTS Roadmapping Near Term Considerations

- Thrust 2 - Alternatives and Step Improvements to Current High Risk/High Cost Baselines
  - Disposition of Stored Nuclear Materials
  - Disposition of Legacy Materials
  - Deactivation of Structures & Facilities
  - Reduction in Surveillance & Maintenance Costs

What Should the S&T Focus be to Support LTS?

- Continue on Roadmapping for LTS
- Continue S&T Support for Closure Sites (Thrust 1)
- Continue S&T Support for Cost Reduction of Baseline (Thrust 2)
- Focus on LTS Implications of Remedial Actions and Waste Disposal

SRS
savannah river site

RFETS LTS S&T Needs and Observations

LTS Roadmapping Workshop

Orlando, Fl

March 19, 2002

Lane Butler

RFETS S&T Needs and Opportunities

- D&D
- Remedial Action
- Waste Treatment and Disposal
- Long Term Stewardship Issues

KAISER-HILL COMPANY, LLC

Site History

- RFETS is a 6,550-acre site located approximately 16 miles northwest of Denver, Colorado
  - Most buildings were constructed between the early 1950s and the mid-1970s and are within the 400-acre Industrial Area
  - Site produced weapons parts from plutonium, uranium, beryllium, and stainless steel
    - Weapons production ceased in 1989
  - Hazards associated with Site operations included:
    - Radiological and chemical contamination from industrial operations
    - Physical hazards common to standard industrial environments
- The Site goal is to achieve accelerated cleanup and closure in a manner that is safe to workers and the public, and protective of the environment.

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RFETS Contaminants of Concern

- Radionuclides (Pu, Am, U)
- Volatile Organics (TCE, PCE, CCl_4)
- Metals (Be, Pb, etc.)
- Asbestos
- PCBs

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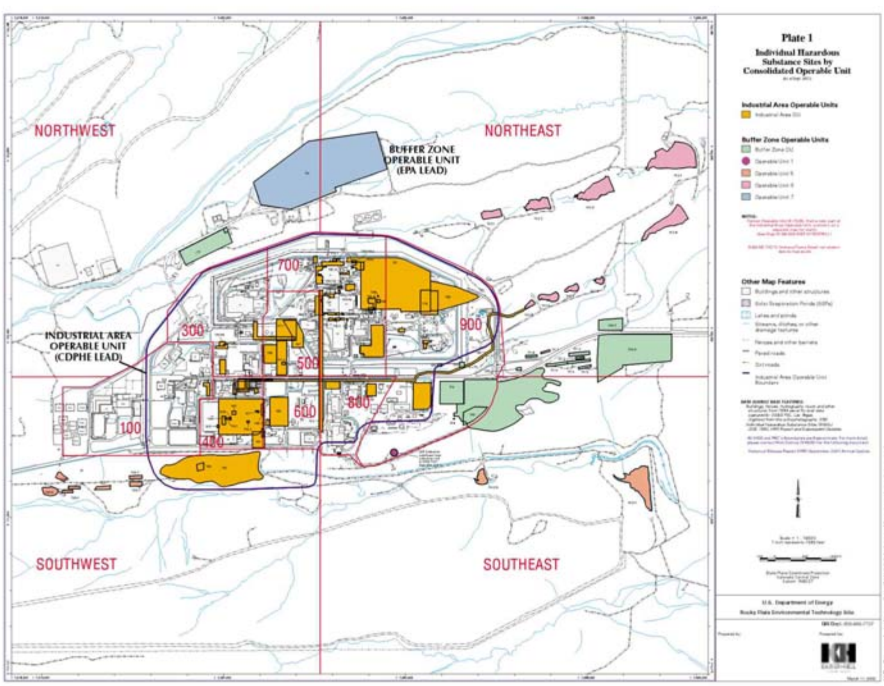

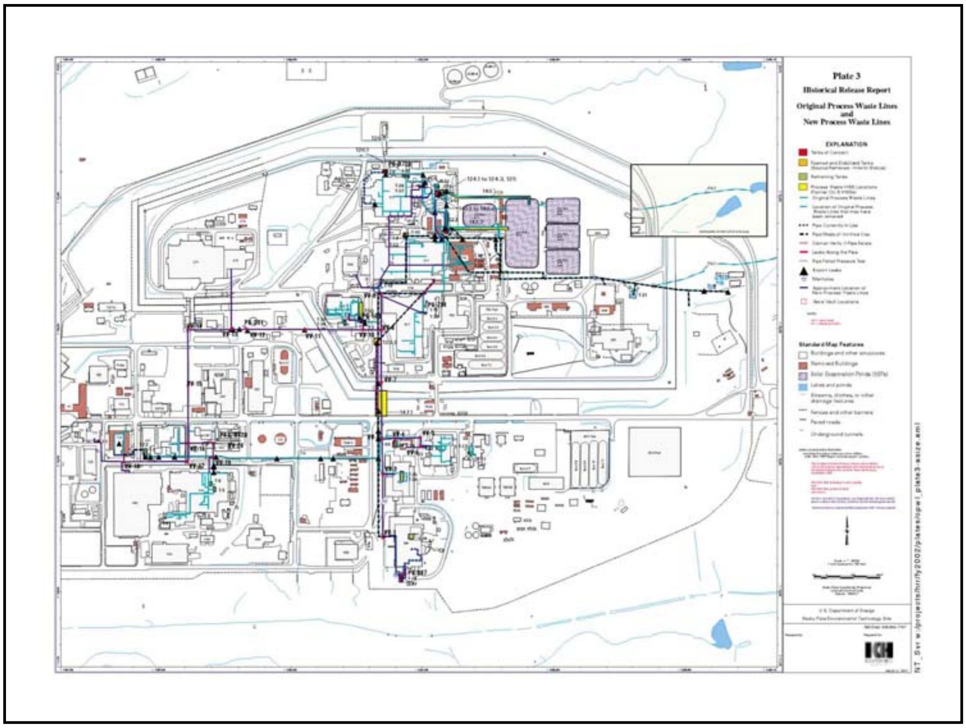
Plate 3
Historical Release Report
Original Process Waste Lines
and
New Process Waste Lines
EXPLANATION
Standard Map Features

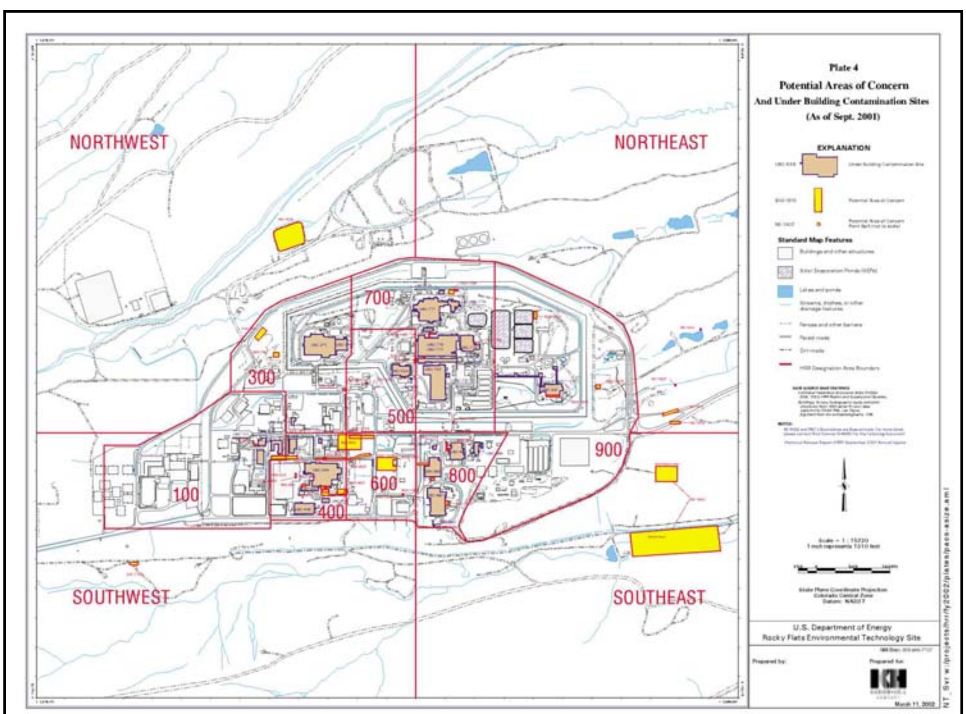
Plate 4
Potential Areas of Concern
And Under Building Contamination Sites
(As of Sept. 2001)
EXPLANATION
Standard Map Features
NORTHWEST
NORTHEAST
SOUTHWEST
SOUTHEAST
700
300
500
900
800
600
100
400
U.S. Department of Energy
Rocky Flats Environmental Technology Site
Prepared by:
Prepared for:
March 11, 2002

Geologic Setting

- Contaminated groundwater is present in thin alluvium/colluvium deposits underlain by some sandstones
- Thick claystone lies between the contaminated groundwater and nearest aquifer
  - Natural barrier to downward migration of groundwater
  - Equivalent to a RCRA liner on a landfill
- Groundwater exits to surface water prior to exiting plant site

RFETS Geology

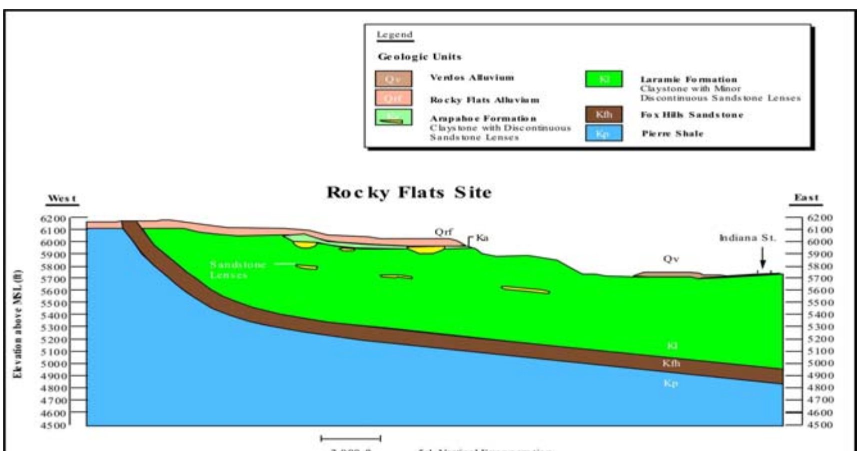

Figure 2-1 Generalized Geologic Cross-Section of the Rocky Flats Area

Groundwater Contamination

- Groundwater is managed or treated to protect surface water.
  - Volatile Organic Compounds in groundwater are most likely to impact surface water
  - Other contaminant plumes are addressed where there is a potential to impact surface water
  - Groundwater contaminant plumes were identified based on RFCA action levels

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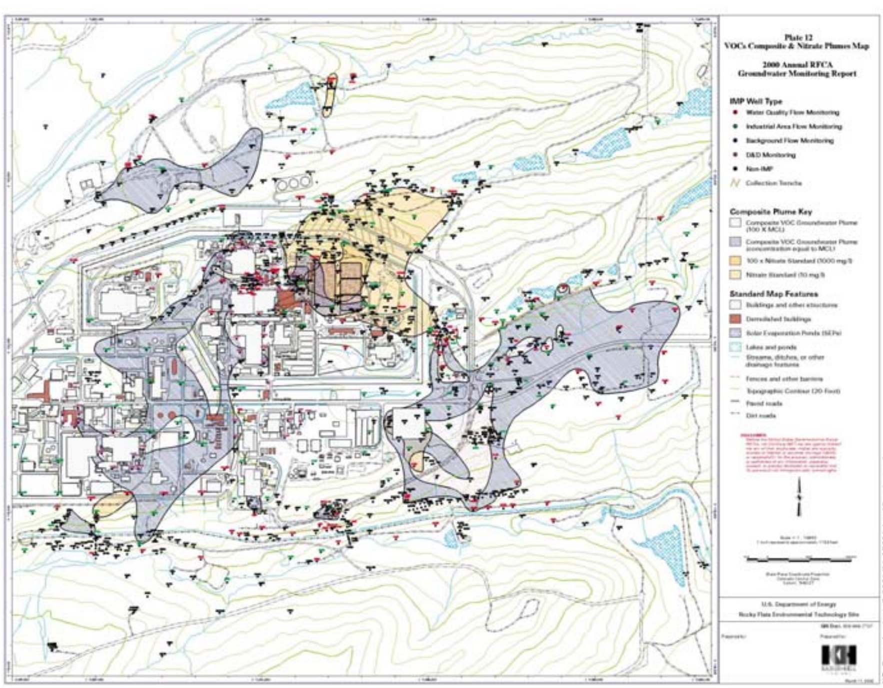
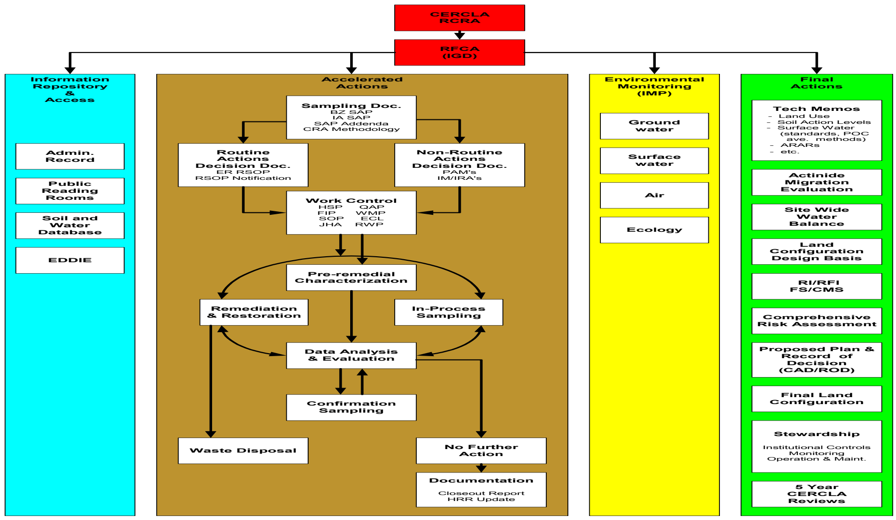


RFETS Regulatory Framework



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RFETS Remediation Strategy

- Contaminated Soil to be removed and disposed of off-site
- Contaminated Groundwater to be treated with passive barrier treatment systems

  (currently investigation enhanced bioremediation)
- Landfills will be covered with evapotranspiration covers

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RFETS Waste Streams

- TRU and TRU mixed wastes
- LLW and LLMW
- TSCA
- Orphan Waste Streams
- Sanitary

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Mound LTS S&T Needs and Observations

Don Krause
Project Manager, Technology Programs

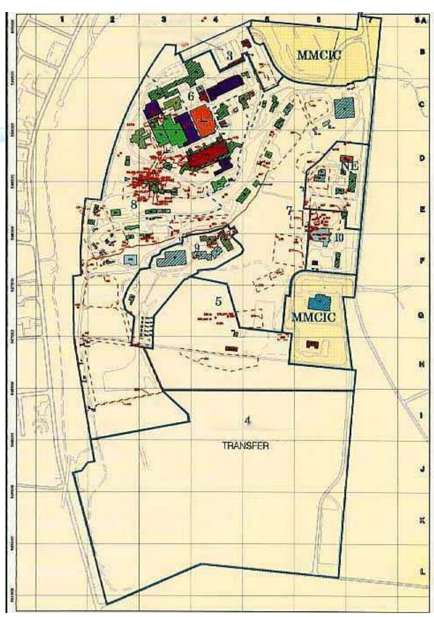
LTS Roadmapping Workshop
March 19, 2002

History

- 304 Acre Site about 10 miles Southwest of Dayton, Ohio within the city of Miamisburg.
- Part of Manhattan Project
  - Polonium (Monsanto Dayton Project 1943)
- First permanent A.E.C. facility constructed after WW II
  - Started in 1946,
  - Weapons participation ended 1998

Current / Future

- Sold to City of Miamisburg for industrial park
- Clean to industrial standards
  - CERCLA / RCRA
  - Transition as areas are cleaned
  - ROD for each transition parcel
- O&M Plan - The regulatory document
  - More than a ROD - Living document which will be added to as more parcels are transferred
  - Delineates how, when, what will be accomplished to ensure that the site remains protective



Concerns

- Concerns from 40+years of weapon components production both nuclear and non-nuclear
  - H-3, Pu-238, Pu-239, Th-238, Th-232, Po-210, U-238, U-235, Am-241
  - Lead, beryllium, mercury, arsenic, PCBs, VOCs, Asbestos
- Site goal - closure by 2006
  - Protective of worker, public, and environment

Geology

- Situated upon the Upper Ordovician horizon.
- Topographic high areas generally covered by a relatively thin layer of glacial till (silt, clay, and some fine gravel).
- Valley is a wedge of glacial outwash between the upper tills and the bedrock.
- Area relatively stable
  - No evidence of folding, thinning, or faulting

Hydrology

- No perennial streams on the site.
- A drainage basin is associated with the deep valley.
- Buried Valley Aquifer, immediately west
  - Declared a "Sole Source Aquifer"
  - About 70 ft thick at the extreme southwest corner of the site with a maximum thickness of about 150 ft near the river channel.
  - Contains extensive interstratified layers of clayish till that impedes infiltration.

Remediation Strategy

- No waste cells.
  - OU1 landfill - old dump
- “Brown fields” Industrial standards cleanup.
  - Buildings
    - Decon’d & released for reuse
    - Demolished and removed - disposed off-site
  - Soils
    - Contaminated soils removed and disposed off-site
  - Groundwater
    - Monitoring VOCs
    - Small area using Soil Vapor Extraction

Waste Streams

- LLW and LLMW
- Sanitary
- TRU and TRU Mixed wastes
- TSCA and RCRA
- Orphans & Unknowns

Current LTS Issues

- Data Management
- Minimal DOE presence in monitoring
  - Movement of Soils off-site
  - Installation of Water Wells
  - Ground Water
  - Adherence to “Industrial” Land Use

Data Management:

- Data management technology:
  - Considerations of long term storage, accessibility, usefulness, ease of use and location.
  - Maintained and kept current as additional activities occur or new information is gathered.
  - The public has indicated that accessibility of this data will continue to be important to them.

Monitoring Soil Movement

- Institutional controls/deed restrictions prohibiting the removal of soil from the site without regulatory approval.
  - Associated with the property transfers.
    - **Soil can't leave the site without prior approval.**
  - This insures that "industrially-clean" soil does not end up in a residential setting
  - Monitored amount is ~"A pickup truck full"~ about 1000 lbs. or about 1 cubic yd.

Monitoring Installation of Wells

- The Site sits atop the Great Miami Buried Valley Aquifer (A Designated Sole-Source Aquafer) and is on a rock formation above / overlooking the City of Miamisburg.
- Levels of metals have been detected in the soil (such as chromium and arsenic) which, if in the future, become mobile could present a risk.

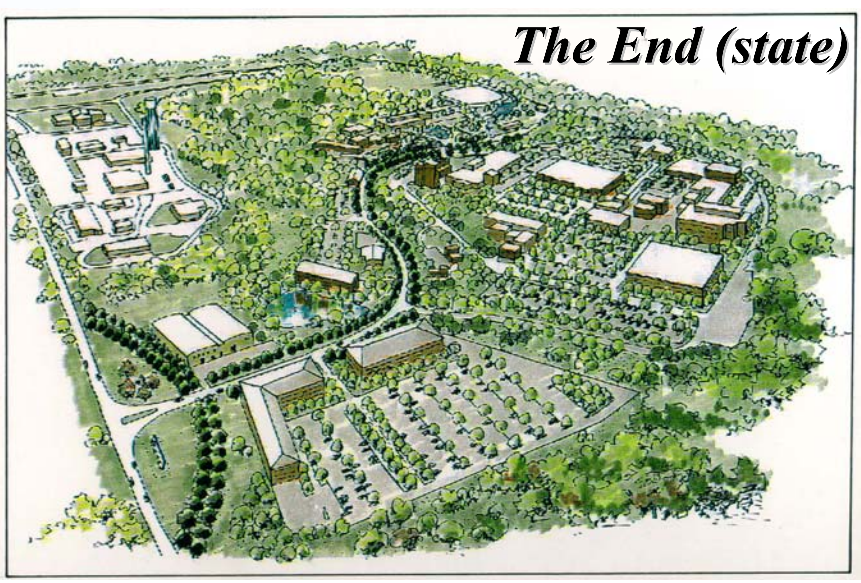
Well Installation Monitoring (cont.)

- To prevent this metals mobility, a deed restriction has been placed to prevent wells to be placed on Site.
  (We believe that this control will not be applied to the major aquifer under a portion of the site.)
  - Prohibits the installation of wells or borings on the site without regulatory approval.

Ground Water Monitoring

- Presently there are several hundred monitoring wells located at the facility.
  - At the time of the last property transfer, it is anticipated the majority of these wells will be closed.
  - The remaining wells will be monitored to ensure that no significant contamination develops.

The End (state)



Stewardship Technology Needs For Closure At The Fernald Environmental Management Project

Orlando, Florida

March 19 - 20

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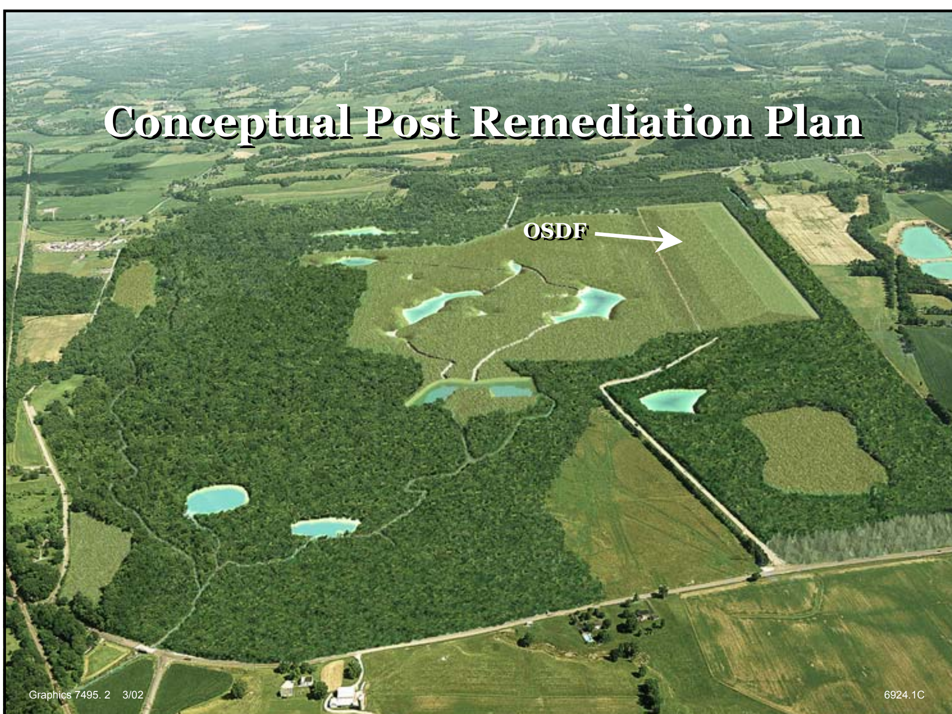

Fernald Stewardship Technology Needs
Priority on OSDF

- Home of the majority of the site's residual contamination
- Only major engineered structure to be left after remediation is complete
- Isolate, waste, to the extent achievable for 1000 years
- Stakeholder and regulator priority

Fernald Stewardship Technology Needs
Post Closure Conditions

Current	Expected
• On-site lab services	• No on-site lab
• On-site technicians	• No on-site technicians
• On-site maintenance personnel	• No on-site maintenance people
• On-site security	• No on-site security
• On-site Advanced Waste Water Treatment (AWWT)	• No AWWT

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Fernald Stewardship Technology Needs
Vital to Site Closure & Transition to LTS

- Supports Fernald closure by:
  - Verifying performance against design criteria
  - Anticipating and preventing major failures
  - Improving ability to extrapolate maintenance needs and costs
  - Assuring accurate and timely diagnostic capability for stewardship
  - Results and "lessons learned" exportable to the rest of the complex

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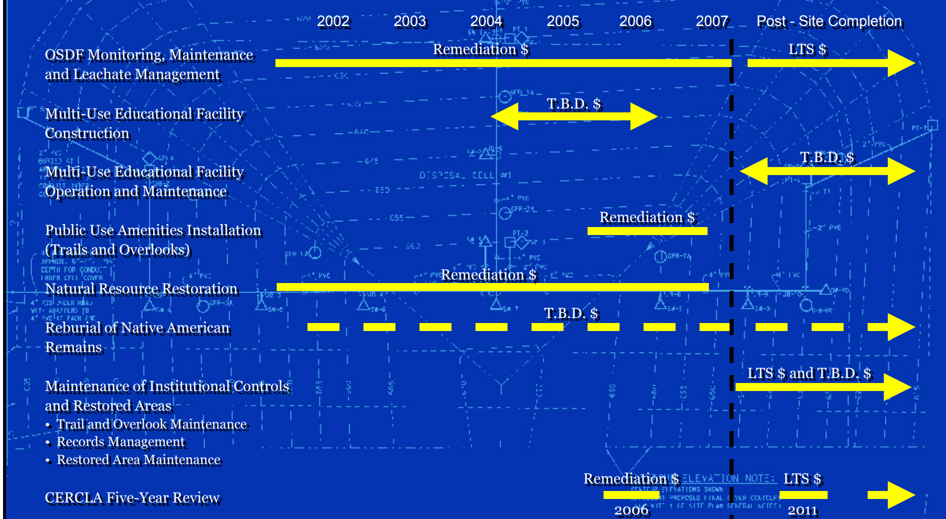
Funding and Implementation Time Line



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Fernald Stewardship Technology Needs

Post Closure Stewardship Technology Project Objectives

- Identify critical focus areas/monitoring needs
- Research viable technologies, focusing on those capable of providing remote, autonomous, "real time" monitoring
- Demonstrate technologies and deploy those which facilitate post closure stewardship at Fernald (upon DOE approval)
- Minimize long-term stewardship costs/labor requirements
- Serve as test bed within DOE complex for post closure stewardship monitoring technology

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Fernald Stewardship Technology Needs
PCSTP Progress

- Identified initial list of Fernald stewardship technology needs
- Initiated work on OSDF Cell 1 cover system
- Designed, engineered and installed Cell 1 monitoring system in 2001 and 2002

Fernald Stewardship Technology Needs
Required for Closure

<u>Priority Needs</u>

- Final cover system monitoring - Cells 2 - 7
- Leachate flow and quality monitoring
- Perched/Great Miami Aquifer groundwater monitoring
- Passive leachate treatment system
- Buffer area institutional control monitoring
- Automated meteorological station
- Long-term data and image repository
- System diagnosis, maintenance, and repair

Fernald Stewardship Technology Needs

Technology Need	Year(s) Implemented	Funding Required
Final cover system monitoring (Cells 2-7)	FY03 - FY06	$5,400K
Leachate flow and quality monitoring	FY04 - FY06	$800K
Perched/GMA groundwater monitoring	FY04 - FY06	$850K
Passive leachate treatment system	FY05 - FY06	$2,000K
Buffer area/institutional control monitoring	FY04 - FY07	$950K
Automated meterological station	FY06 - FY07	$150K
Long - term data/image repository	FY04 - FY07	$1,000K
System diagnosis, maintenance and repair	FY05 - FY07	$3,475K
Total		$14,625K

Future Stewardship Technology Needs

Ecological/Geochemical Issues

- Biological/chemical properties of on-site ponds and Paddy's Run
- Erosion and runoff from OSDF and remediated areas
- Perimeter groundwater characteristics (water elevation, contaminant levels, etc.)

Cell Integrity

- Intrusion of moisture and groundwater into the OSDF
- Integrity of leachate collection system lines
- OSDF penetration
- Real-time leak detection system

General Maintenance

- Technology to examine cell contents
- Technology to unplug leachate collection and transmission lines

Future Stewardship Technology Needs to Monitor and Measure

Technology Need	Year(s) Implemented	Funding Required
Biological/chemical properties of on-site surface waters (restored area ponds, Paddy's run)	FY05-FY07	$500K
Erosion and runoff from remediated areas	FY06-FY07	$225K
Groundwater characteristics (water elevation, contaminant levels, etc.)	FY05-FY07	$150K
Status, health, quantity of flora and fauna (invasive species, over browsing, etc.)	FY05-FY07	$300K
Total		$1,175K

Fernald Stewardship Technology Needs
Total Funding Requirements

- Priority technology needs: $14,625K
- Future stewardship technology needs: $1,175K
  - FY03 - $2,500K
  - FY04 - $5,850K
  - FY05 - $4,650K
  - FY06 - $2,050K
  - FY07 - $750K
- Total - $15,800K

OSDF Flow Monitoring

Real-time technology for detection and quantification of flow volume in the Leachate Collection System (LCS) and Leak Detection System (LDS) beneath each cell

Parameters

- Cell-specific LDS and LCS flow rates in gallons per acre per day to be recorded post closure on monthly basis with potential for later reduction
  - Expected to be less than one gallon per day

Baseline

Technicians collect measurements weekly.

Reports distributed to on-site personnel.

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Leachate Quality Monitoring

Real-time analytical technology for uranium and total organic halogens in water found in cell-specific LCS and LDS

Parameters

- Periodic analysis of uranium and total organic halogens after OSDF closure
  - Ideal detection limits: less than 5 ug/L for uranium and 25 ug/L for total organic halogens

Baseline

Technicians collect samples weekly that are analyzed by an on-site lab. Reports distributed to on-site personnel.

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Perched/Great Miami Aquifer (GMA)

Groundwater Monitoring

Installation of perched and GMA wells up-gradient and down-gradient of OSDF with automated monitoring capability

Parameters

- Capable of measuring/monitoring:
  - Water level
  - TOC
  - TOX
  - Boron
  - Uranium

Baseline

Technicians manually collect samples from wells that are analyzed by on-site laboratory. Reports distributed to on-site personnel.

Passive Leachate Treatment and Monitoring

Parameters

- A passive, flow-through treatment system that will remove Uranium from leachate through physiochemical reactions between the leachate and inorganic or organic media
- Must handle approximately 10 gpm inflow and reduce U level from about 0.1 mg/L to less than 0.02 mg/L

Baseline

Leachate sent to on-site AWWT

Buffer Area/Institutional Control Monitoring

Parameters

Capable of automated measuring/monitoring:

- effectiveness of institutional controls (fencing, signs, etc.)
- trespassing
- removal of soil, flora, fauna

Baseline

On-site security, maintenance, and ecological restoration personnel currently perform the tasks.

Automated Meteorological Monitoring

Parameters

- Capable of data collection at surface level, 2 meters, and 10 meters:
  - Wind speed and direction (10 m)
  - Ambient air temperature
  - Relative humidity (2 m)
  - Precipitation (surface)
  - Barometric pressure (surface)
  - Solar radiation (2 m)

Baseline

Current meteorological station data downloaded periodically by on-site technicians and reports distributed to on-site personnel.

Long-Term Data/Image Repository & Retrieval System

Parameters

- Database capable of storing data and digital images in support of post closure monitoring needs
- Accessible to regulators, DOE, and stakeholders
- Storage and retrieval of new monitoring data and relevant historical data/documentation

Baseline

Records, images, data currently stored in a variety of formats not designed or intended for long-term storage and retrieval.

System Diagnosis, Maintenance and Repair

Comprehensive Owner's Manual for Stewardship

Parameters

- Contain preventative maintenance schedules
- Decision trees/matrices for collected data, and visual observation of cell and other remediated areas
- All operational and maintenance procedures

Baseline

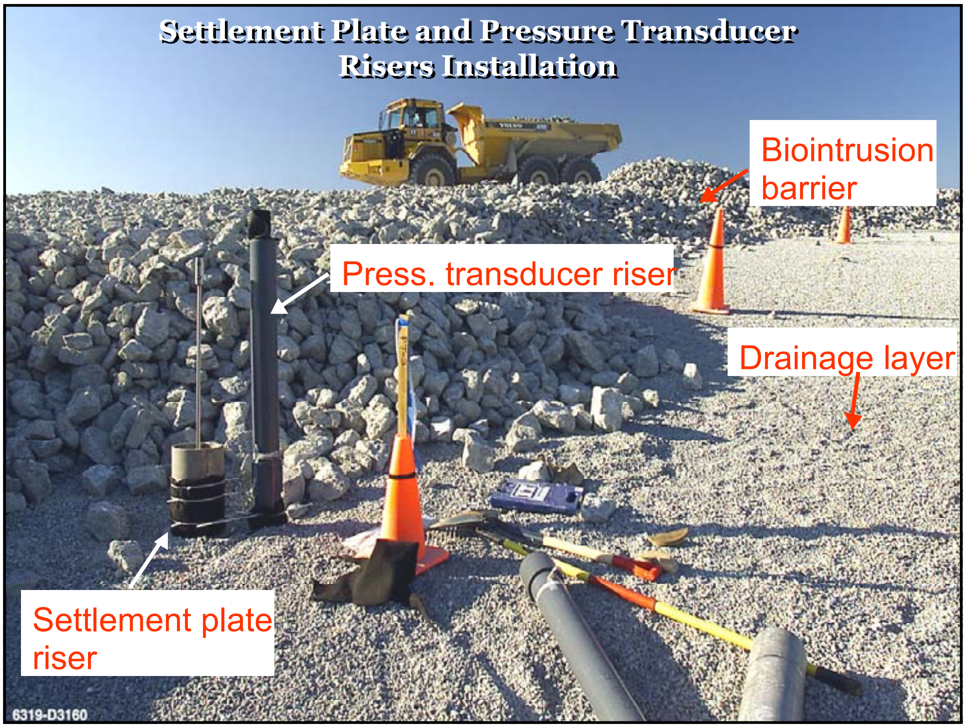
Engineering, construction and maintenance personnel use existing - generic guidelines for facilities and restored areas.

Fernald Stewardship Technology Needs

OSDF Cell 1 Cover System Monitoring Parameters

- Geophysical
- Ecological
- Institutional controls

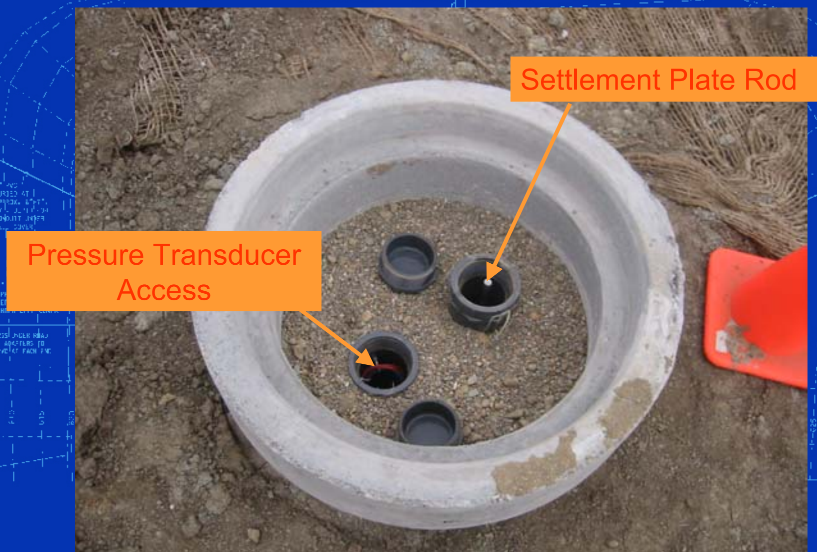
Parameters	Critical Elements	Technologies
Differential settlement	Condition of barrier layer, drainage	Topographic survey with settlement plates, GPR targets
Head in drainage Layer	Stability of cover system	Pressure transducers
Drainage layer temperature, barrier temperature	Stability of cover system, frost protection of barrier layers	Thermistor embedded in transducer
Root zone status	Erosion control	Water content reflectometers, heat dissipation units
Vegetative health & coverage	Erosion control	Topographic surveys, web cam, remote sensing



Differential Settlement: Settlement Plates

- Information regarding distortions and displacements can be made using conventional surveys with robust settlement plate design
- Potential for incorporating remote sensing technologies as they are developed
- Must not impact barrier systems

Surface Access Manhole



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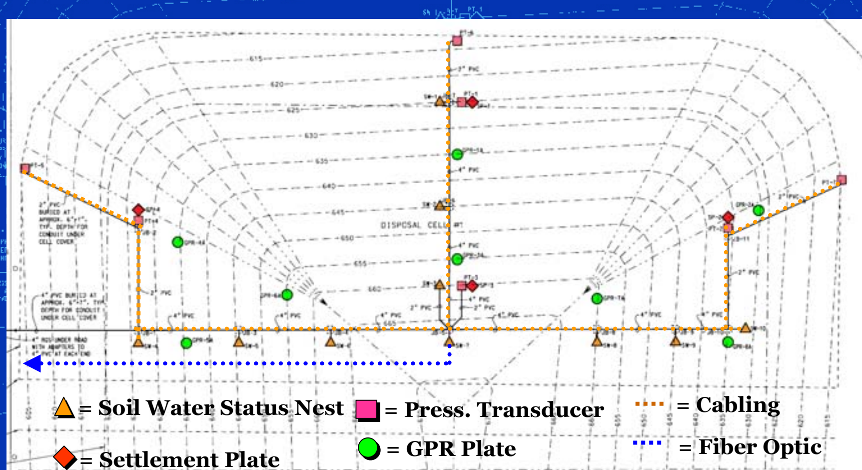
Fernald Stewardship Technology Needs

Cell 1 Cover System Instrumentation Plan



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SRS LTS S&T Needs and Observations

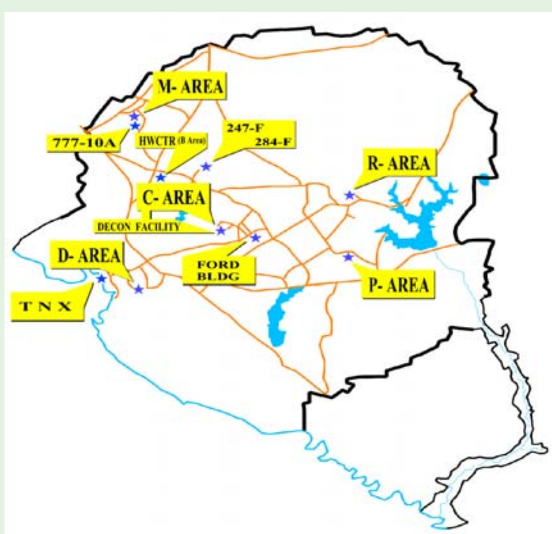
LTS Roadmapping Workshop

Orlando, Fl

March 19, 2002

Dave Freeman

Savannah River Site



300 Square Mile Site

~ 600 Operating Structures and Facilities

~ 180 Inactive Structures & Facilities

SRS S&T Focus

- SRS is Not Identified as a Closure Site
  - Individual facilities may close
  - Closed facilities are deactivated, awaiting final disposition
  - Final disposition is not planned before 2020
- LTS Begins After Deactivation
- Key Thrust is Cost Reduction of Baseline

SRS S&T Needs and Opportunities

- Methodology to Determine Necessary Entry Frequency for Inactive Facilities
- Disposition of Legacy Materials
  - Production by-products, in-process materials
- Remote Monitoring of Inactive Facilities
  - Identify step changes in facility baseline
  - Pre-entry conditions (air quality, radiation, visual conditions, etc.)

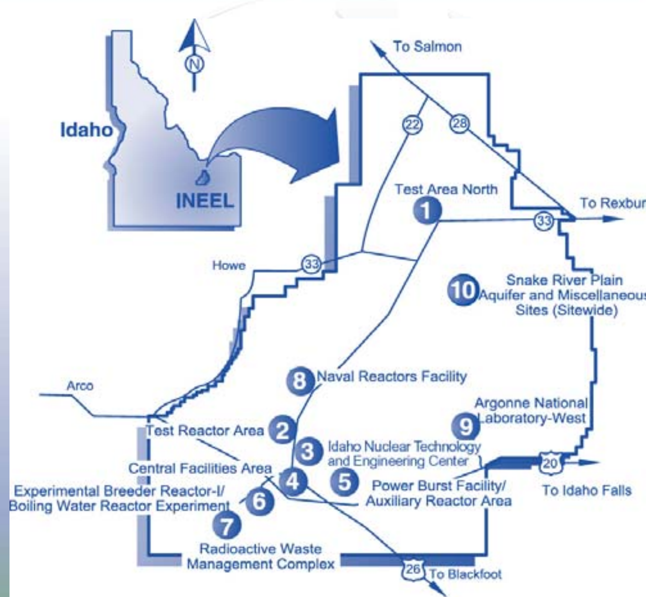
SRS
savannah river site

Idaho National Engineering and Environmental Laboratory

INEEL Long-Term Stewardship Science and Technology Needs

Kliss McNeel
INEEL LTS Program Manager

March 19, 2002



INEEL's Legacy Challenges

- ~250 Metric Tonnes Heavy Metal spent nuclear fuel
  - Over 80% by weight in dry storage
- 3 million gallons of highly radioactive liquids in tanks
  - All high-level waste calcined; 6 of 11 tanks emptied to heel
- Several thousand cubic meters of low-level and mixed radioactive and hazardous waste
  - 25,000 cubic meters of low-level waste and 2,780 cubic meters of mixed low-level waste disposed

INEEL's Legacy Challenges

- 65,000 cubic meters of stored transuranic waste
  - 1,283 cubic meters shipped to WIPP under 3,100 cubic meter project
  - Construction 58% complete on Advanced Mixed Waste Treatment Project

- 596 potential release sites
  - Over 70% cleaned up or determined not to require cleanup
- 526 buildings totaling 5 million ft^2
  - D&D of 103 structures complete

Future Challenges

- *Disposition of high-level and sodium bearing waste*
- *Closure of high-level waste and Voluntary Consent Order tanks*
- *Characterization, treatment, and disposition capabilities for remote-handled transuranic waste*
- *Improved characterization of spent nuclear fuel and calcine for treatment and shipment offsite*
- *Large scale cost effective D&D technologies*

Future Challenges

- *Defensible, cost-effective post-cleanup monitoring and analysis for contaminants remaining at the INEEL*
- *Monitoring the integrity and effectiveness of engineered barriers*

Future Challenges

- *Characterization and treatment of contaminated soils*
- *Better understanding of the migration of contaminants in the vadose zone*

INEEL S&T Needs/Uncertainties

- *Groundwater (vadose zone/aquifer)*
  - *Predicting physical transport*
  - *Transformation processes: geotechnical and microbial*
  - *Simulating and estimating contaminant source terms*
  - *Monitoring, characterization, instrumentation, and data analysis*
- *Soil*
  - *Real-time field instrumentation*
  - *Identification of specific radionuclide*

INEEL S&T Needs/Uncertainties (cont'd)

- Air
  - Remote sensing and delivery systems
  - Continuous real-time monitoring systems
- Biota
  - Multi contaminant monitors
  - Real-time instrumentation for specific radionuclides
- Containment
  - Integrity sensors
  - Alternative caps