Revisions to FRTR Screening Matrix & Reference Guide

FRTR Winter Meeting
9 December 2004
Washington D.C.

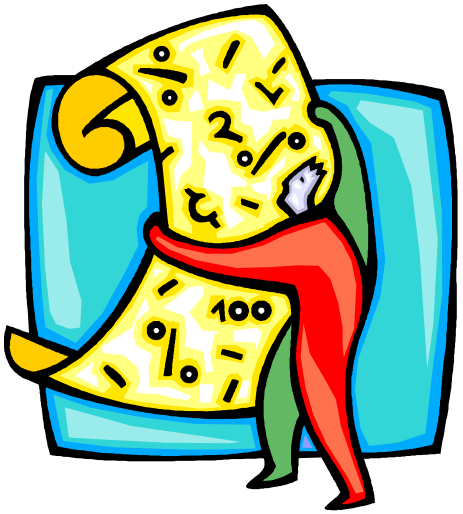
Background

- Screening Matrix (SM) developed as a user-friendly tool for screening potentially applicable remediation technologies

- SM allows screening of many *in situ* and *ex situ* technologies for either soil or groundwater remediation

Background (cont)

- Screening variables include
  - contaminant class
  - development status
  - treatment train
  - overall cost and performance
  - availability



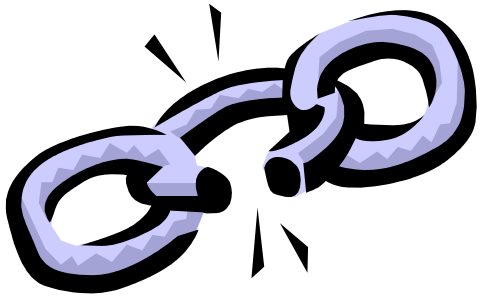
- Reference Guide (RG) provides in-depth information on each technology
- SM and RG are posted on the FRTR website
  - living document
  - direct links to database of FRTR member provided cost and performance reports

Member Agency Support

- Active SM Committee includes members from six FRTR member agencies and Interstate Technology & Regulatory Council (ITRC)
- Most recent SM update funded by US Army Environmental Center (USAEC)
- Previous updates included funding support from several member agencies

Member Agency Support (cont.)

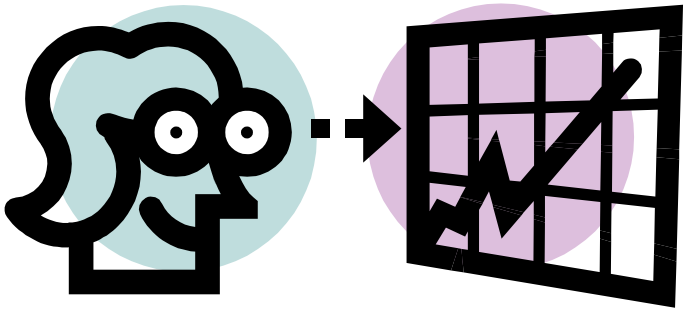
- USAEC Acquisition and Technology Division manages SM updates in close coordination with members of SM Committee
- Committee initiated revision of SM for the following reasons:
  - Technical data outdated; format confusing
  - Cost information unclear, outdated, and inconsistent
  - Many web links “broken”



Review Process

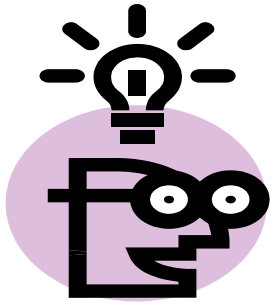
Five Phases Review Process for SM

- Phase I – Identify new technology listings
- Phase II – Review Technology Profiles
- Phase III – Review Introduction, Contaminant Perspectives, Technology Perspectives
- Phase IV – Review References, Appendices, Preface, and Rating Codes
- Phase V – Review Final Product



Current Efforts

- Continue to update technology profiles
- Create a user-friendly format - compare/contrast multiple technologies
- Update cost estimates for selected technologies



SM/Poster Revisions

- Establish consistent and uniform rating scale
- Display only three main ranking symbols similar to the *Consumer Report* format:
  - ● = Above Average
  - ◑ = Average
  - ○ = Below Average
- Eliminate and/or consolidate some categories to simplify use of legend and definitions

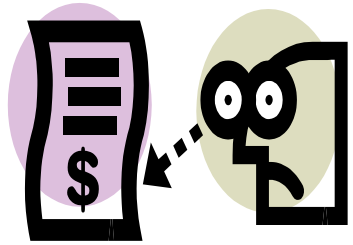
Revised Matrix

Table 3-2: Treatment Technologies Screening Matrix

Rating Codes
● Above Average
◑ Average
○ Below Average
N/A - "Not Applicable"
I/D - "Insufficient Data"
◈ - Level of Effectiveness highly dependent upon specific contaminant and its application/

	Development Status	Treatment Train	Relative Overall Cost & Performance					Availability	Nonhalogenated VOC's	Halogenated VOC's	Nonhalogenated SVOC's	Halogenated SVOC's	Fuels	Inorganics	Radionuclides	Explosives
			O&M	Capital	System Reliability & Maintainability	Relative Costs	Time									
Soil, Sediment, Bedrock, and Sludge																
3.1 In Situ Biological Treatment																
4.1 Bioventing	●	●	●	●	●	●	◑	●	●	◈	●	○	●	○	◈	○
4.2 Enhanced Bioremediation	●	●	○	◑	◑	●	◑	●	●	●	●	◈	●	◈	◈	●
4.3 Phytoremediation	●	●	●	●	○	●	○	◑	◑	◑	◑	◈	◑	◑	○	○
3.2 In Situ Physical/Chemical Treatment																
4.4 Chemical Oxidation	●	●	○	◑	◑	◑	●	●	◑	◑	○	◑	○	◈	○	◑
4.5 Electrokinetic Separation	●	○	○	◑	◑	○	◑	◑	◑	◑	◑	◑	○	●	◑	○
4.6 Fracturing	●	◑	◑	○	◑	◑	◑	●	◑	◑	◑	◑	◑	○	○	○
4.7 Soil Flushing	●	●	○	◑	◑	◑	◑	●	●	●	◑	◑	◑	●	○	○
4.8 Soil Vapor Extraction	●	○	○	◑	●	●	◑	●	●	●	○	○	●	○	○	○
4.9 Solidification/Stabilization	●	●	◑	○	●	●	●	●	○	○	◑	◑	○	●	●	○
3.3 In Situ Thermal Treatment																
4.10 Thermal Treatment	●	○	○	○	●	◑	●	●	●	●	●	●	●	○	○	○
3.4 Ex Situ Biological Treatment (assuming excavation)																
4.11 Biopiles	●	●	●	●	●	●	◑	●	●	●	◑	◈	●	◈	○	○
4.12 Composting	●	●	●	●	●	●	◑	●	◑	◑	◑	◈	●	○	○	●
4.13 Landfarming	●	●	●	●	●	●	◑	●	◑	◑	●	◑	●	○	○	◈
4.14 Slurry Phase Biological Treatment	●	○	○	○	◑	◑	◑	●	◑	●	●	◈	●	◈	○	●
3.5 Ex Situ Physical/Chemical Treatment (assuming excavation)																
4.15 Chemical Extraction	●	○	○	○	◑	◑	◑	●	◑	◑	●	●	◑	●	◑	○

Cost Updates



- Cost data became outdated and estimates were not readily reproducible.
- Improving the Estimates
  - Utilize a standardized cost estimating tool (RACER) to provide a systematic, reproducible process to develop ranges of cost estimates for technologies at sites of varying complexity
  - Present results in manner to aid all levels of SM users

RACER Approach

- The non-RACER users would be provided a simple range of costs for a standard range of site conditions – allows some very top-level comparisons.
- More detail oriented SM user can dig deeper and see a listing of the key parameters impacting total cost.
- Most detailed level of information is accessible to allow the more RACER proficient SM user to see all the significant cost elements that contribute to total cost.

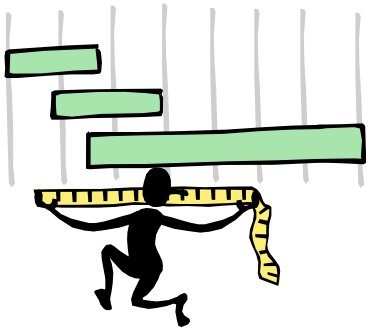
RACER Approach (cont)

- RACER has been utilized for several technologies to develop updated ranges of cost estimates, including the primary aspects of the cost drivers
- The site conditions were defined as follows:
  - Multiple scenarios (usually 4) for technology application utilized in RACER to develop the range of costs
  - Scenarios developed with varying complexity and scale of application
  - A standard “mini-matrix” was established that defines technology application varying between small/large sites with either simple/complex conditions

RACER Based Mini-Matrix

RACER PARAMETERS (BIOVENTING)	Scenario A	Scenario B	Scenario C	Scenario D
	Small Site		Large Site	
Type of Installation	Vertical Well	Vertical Well	Vertical Well	Vertical Well
Surface Area of Contamination (SF)	2,700	450	54,000	9,000
Depth to Base of Contamination (ft)	5	30	5	30
Contaminant of interest	SVOCs	SVOCs	SVOCs	SVOCs
# of Vapor Extraction Wells	8	2	143	24
Bioventing Marked-up Costs	$35,378	$23,930	$360,956	$125,772
Additional Costs:				
O&M	$35,978	$35,978	$88,076	$88,076
Years of O&M	2.0	2.0	5.0	5.0
Remedial Design	$10,000	$10,000	$36,096	$13,835
TOTAL MARKED-UP COSTS	$81,356	$69,908	$485,128	$227,683
COST PER CUBIC FOOT	**$6.03**	**$5.18**	**$1.80**	**$0.84**
COST PER CUBIC METER	**$212.8**	**$182.9**	**$63.4**	**$29.8**
COST PER CUBIC YARD	**$162.7**	**$139.8**	**$48.5**	**$22.8**

Future Efforts



- Continue the RACER-based cost update approach for applicable technologies
- Future benefits of this approach:
  - Standardized approach that would allow for reproducible updates in the future
  - RACER updates account for innovations and inflation

Future Efforts (cont)

- Post “Revised SM” on the FRTR website
- Continue to coordination and involvement with SM Committee members to keep SM as a valuable and relevant tool

Support Effort

We need support of all member agencies to make sure SM updates are completely successful, timely and relevant

- ✓Leveraging of resources and funds
- ✓Committee member representation and active participation

Questions?

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Additional Slides

Previous Screening Matrix

Table 3-2: Treatment Technologies Screening Matrix

Rating Codes ■ - Better; ○ - Average; ▲ - Worse; ◆ - See definition Y - Yes; N - No. F - Full; P - Pilot. S - Solid; L - Liquid; V - Vapor. NA - Not Applicable I - Inadequate. O&M - Operation & Maintenance; Cap - Capital; B - Both	Development Status	Treatment Train (excludes off-gas treatment)	Residuals Produced	O&M or Capital Intensive	Availability	System Reliability/ Maintainability	Cleanup Time	Overall Cost	Nonhalogenated VOCs	Halogenated VOCs	Nonhalogenated SVOCs	Halogenated SVOCs	Fuels	Inorganics	Radionuclides	Explosives
Soil, Sediment, Bedrock, and Sludge																
3.1 In Situ Biological Treatment																
Bioventing	F	N	N	N	■	■	○	■	■	◆	■	▲	■	▲	◆	▲
Enhanced Bioremediation ·· Aerobic ·· Anaerobic	F	N	N	O&M	■	○	○	■	■	■	■	◆	■	◆	◆	■
Phytoremediation ·· Enhanced Rhizosphere Biodegradation ·· Phyto-accumulation ·· Phyto-degradation ·· Phyto-stabilization	F	N	L,S	N	○	▲	▲	■	○	○	○	◆	○	○	▲	▲

SM Committee

- Robert Nash, NFESC
- Tanwir Chaudry, Intergraph
- Maj. Ivette O'Brian, AFCEE
- Andrea Leeson, OSD
- Gerald DiCerbo, DOE
- John Quander, EPA
- George Nicholas, NJDEP (ITRC)
- Robert Mueller, NJDEP (ITRC)
- Greg Mellema, USACE
- Matthew Chambers, Malcolm Pirnie
- Scott Hill, USAEC
- Layne Young, USAEC