Performance-based Environmental Management

Based on the RPO Team’s Technical Regulatory Guidance Document:

Improving Site Remediation Through Performance-Based Environmental Management

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ITRC (www.itrcweb.org) – Shaping the Future of Regulatory Acceptance

- Network
  - State regulators
  - Federal government
  - Industry
  - Consultants
  - Academia
  - Community stakeholders

- Documents
  - Technical and regulatory guidance documents
  - Technology overviews
  - Case studies

- Training
  - Internet-based
  - Classroom

Host Organization

ITRC State Members

Federal Partners

DOE  DOD  EPA
State government-led initiative that brings the environmental community together

- Fostering collaboration
- Focusing on mutual priorities
- Leading to partnered solutions
- Creating consensus-based tools

Advances innovative environmental decision-making

- Achieving better environmental protection
- Reducing the technical/regulatory barriers
- Expanding the regulatory acceptance of new technologies and approaches
2007 ITRC Technical Teams

- Alternative Landfill Technologies
- Brownfields
- Diffusion Samplers
- Radionuclides
- Remediation Process Optimization (RPO)
- Risk Assessment Resources
- Sampling, Monitoring, Characterization
- Unexploded Ordnance
- Bioremediation of DNAPLs
- Ecological Land Re-Use
- Enhanced Attenuation: Chlorinated Organics
- Perchlorate
- Vapor Intrusion

Pending teams
- Arsenic in Groundwater
- Mining Waste
- Concentrated Animal Feeding Operations

Proposal process for new topic areas
ITRC Technical Team Process

- State-led teams
- Target audience is state regulators
- Tools and resources for decision making
- Work toward consensus-based solutions
Consensus-based Tools and Resources

- Technology overviews
- Case studies
- Regulatory and technical guidance
- Peer exchange / network
- Technology advocates
- Classroom training courses
- Internet-based training courses
ITRC Course Topics Planned for 2007

Popular courses from 2006
- Characterization, Design, Construction, and Monitoring of Bioreactor Landfills
- Direct Push Well Technology for Long-term Monitoring
- Evaluate, Optimize, or End Post-Closure Care at MSW Landfills
- Perchlorate: Overview of Issues, Status and Remedial Options
- Planning & Promoting Ecological Re-use of Remediated Sites
- Real-Time Measurement of Radionuclides in Soil
- Remediation Process Optimization Advanced Training
- Risk Assessment and Risk Management
- Site Investigation and Remediation for Munitions Response Projects

New in 2007
- Performance-based Environmental Management
- Protocol for Use of Five Passive Samplers
- Survey of Munitions Response Technologies
- Vapor Intrusion Pathway: A Practical Guideline
- More in development...

Training dates/details at www.itrcweb.org
Training archives at http://cluin.org/live/archive.cfm
Performance-based Environmental Management (PBEM)

Presentation Overview

- Definition
- Goals and Benefits
- Related Concepts
- Components of PBEM
- Systematic Planning
- Effective Communication
- Land Use Risk Strategy
- Conceptual Site Model
- Decision Logic

- RPO
- ARARs
- Exit Strategy
- PBCs
- When to Use PBEM
- Regulatory Concerns
- Case Studies
- Your feedback
- Questions and answers
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What You Will Learn…

► Basic Concepts of Performance-based Environmental Management
  • What is PBEM?
  • How and when to use it?
  • Benefits of using PBEM
  • Regulators concerns
► Why should you care?
  • PBEM is being proposed and implemented at many sites
  • Considered a best management practice
► Tech Reg document on: *Improving Environmental Site Remediation Through Performance-Based Environmental Management (RPO-7, June 2007)*
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Performance-based Environmental Management: Definition

What is Performance-based Environmental Management (PBEM)

- PBEM is a strategic, goal-oriented uncertainty management methodology that is implemented through effective planning and timely decision-logic that focuses on the desired end results
- Promotes accelerated attainment of cleanup objective in an efficient process

Relationship of PBEM to

- RPO
- Performance-based contracting (PBC)
Performance-based Environmental Management: Goals and Benefits

- **Goals of the Tech Reg document**
  - Introduce PBEM concepts
  - Explain relationship to other related concepts
  - Discusses regulator concerns

- **PBEM Benefits**
  - Promote cleanup efficiencies
  - Expedite decision-making and minimizes risks
  - Increase cleanup rates
  - Reach site goals
Performance-based Environmental Management: State Survey Results

- 21 States Responded
  - Most states had limited knowledge with PBEM/PBCs
  - 11 States have participated in PBEM/PBCs
  - A variety of regulatory programs involved
  - 72% of respondents stated most important PBEM concept is problem definition
Federal Agency Implementation

- DoD mandated clean up performance goals
- DOE, EPA, other federal agencies also implementing PBEM process
- Federal Acquisition Regulations provide implementing guidance
Related Concepts

Other Best Management Practices/Concepts Related to PBEM

- DQO
- Value Engineering
- Optimization
- Triad
- Better Business Practices
- Other

Systematic Planning
Performance-based Environmental Management
Performance-based Environmental Management (PBEM)

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Components of PBEM
Systematic Planning

Decision Logic and Analysis
Expert Team Collective Thinking

Define Problem
Streamlined Characterization
Risk Management Strategy
ARAR Analysis
Restoration Exit Strategy
Process Optimization

Contracting Strategy: Emphasis on PBC

PA/SI RFA Discovery
RI/FS – RD/RA RFI - CMS Study/Design
RA-O, LTM CMI - PCC Site in O&M

Site Restoration Management

Attain No Further Action Determination (Site Closure)

Decommission Systems
PBEM – Expert Team

- **Essential team qualities**
  - Interdisciplinary team
  - Support from senior management, regulators, and potential stakeholders
  - Trust
  - Common interest and goals
Effective Communications

Communications

• Ensure timeliness and accuracy
• Promote trust between management, team, and stakeholders
• Use best available communications technologies
• Interact with community
• Explain risk
PBEM – Social Capital

► Social Capital
  • Ensure all parties understand each others concerns
  • Win-win solutions

► Stakeholder
  • Include all stakeholders at appropriate decision points
  • Utilize communication tools
## Performance-based Environmental Management (PBEM)

### Presentation Overview

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<th>RPO</th>
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Problem Statement and Objectives
PBEM – Problem Statement and Objectives

- Problem Statement and Objectives
  - Defining the current and past conditions at the site causing the concern
  - Reason for undertaking the actions to resolve the concern.
  - Understanding regulatory, political and non-technical issues e.g. ARARs
  - Timeline to complete remedial objectives
  - Uncertainties
Problem Statement and Objectives (contd.)

- More Complex – divide into sub
- Develop Performance Objectives based on:
  - Future development of the site and its impacts on social, economical, and political issues
  - A reality check – funding, staffing, etc. vs. set goals
- Develop a schedule of Implementation
- Periodic verification and update goals as needed
PBEM – Land Use Risk Strategy

Land Use Risk Strategy
PBEM – Land Use Risk Strategy

- Land use impact on site remediation
  - Current and future land uses considered
  - Identification of risks
  - Remedial action objectives determined
Land Use Risk – Information for Future Land Use determination

- Examples of land use would be commercial, industrial, residential, agricultural or recreational.
- Land use risk strategy refers to the management of risks through control of current and future use of real property.
- A remediation project would need to identify and take into consideration future land usage.
- The land use risk strategy provides the bridge between land planning activities and environmental cleanup activities.
Remedial action objectives (RAO) are specific goals to protect human health and the environment.

They are usually developed in the remediation investigation (RI) and feasibility (FS) phase of a project.

They provide the foundation upon which remedial action cleanup alternatives are developed.

These objectives are developed considering exposure routes; human, ecological, and environmental receptors; protection of groundwater resources; and potential future land use.
PBEM – Conceptual Site Model

CSM

Problem Statement & Objectives

PBC

Exit Strategy

ARARs

RPO

Land Use Risk Strategy

CSM

Decision Logic

Systematic PBEM Expert Team Planning
PBM – Conceptual Site Model

- Updated conceptual site model (CSM)
  - Comprehensive description of all available site conditions that influence
    - Design
    - Selection
    - Performance of remedies

- Streamlined, timely characterization
Conceptual Site Models (CSM)

- Site contaminants
- Possible receptors including future land use
- Contaminant
  - Fate
  - Transport
  - Paths to receptors
- Incorporate recently collected data
- Consistent with potential land use
PBEM – Decision Logic

Decision Logic
Using Decision Logic in PBEM

- **Decision logic levels include**
  - Program
  - Project
  - Field

- **Decision logic development**

- **Decision logic documenting**
  - Decision trees
  - Flow charts
  - Other tools
PBEM – Decision Trees

**QUALITATIVE REVIEW**

Is monitoring point used to monitor a point of regulatory compliance?
- NO
- YES: Retain well in monitoring program

Are neighboring monitoring points hydrologically proximal (less than 1/4 th of the greatest plane dimension apart)?
- NO
- YES

Are chemicals of concern always less than maximum concentration limits in well?
- NO
- YES

Is monitoring point isolated hydrologically from the contaminant plume?
- NO
- YES

Is monitoring point hydrologically distant from the contaminant source?
- NO
- YES

Is monitoring point providing redundant information with a neighboring well?
- NO
- YES

Is sampling frequency greater than the time it would take groundwater to travel from the closest upgradient well to the monitoring point?
- NO
- YES

Has the monitoring point been dry for more than two years?
- NO
- YES

Retain well in monitoring program

**TEMPORAL ANALYSIS**

Non-Detect or No Trend
- YES
- NO

Increasing Trend
- YES
- NO

Decreasing Trend
- YES
- NO

Is monitoring point located upgradient or downgradient from the contaminant source?
- YES: Retain well in monitoring program
- NO: Consider well for removal from monitoring program, or for modification of sampling schedule. Perform Spatial Analysis.

**SPATIAL ANALYSIS**

Does removal of well result in a change of the log10 standard deviation of less than approximately 1 percent?
- NO
- YES

Remove well from monitoring program or modify sampling schedule

Retain well in monitoring program

Consider well for removal from monitoring program, or for modification of sampling schedule. Perform Temporal Analysis.
PBEM – RPO

- Remediation Process Optimization
  - External look at optimizing current remediation
  - Goal to save time and resources
  - Enhance protection
  - More common in practice

- Recommendation:
  - Before embarking on a PBEM/PBC
Elements of RPO

- Site selection
- Building the RPO team
- Evaluating the exit strategy
- Evaluating performance
- Evaluating cost efficiency
- Remedy optimization
- Monitoring optimization
- Cost benefit analysis
- Implementation and tracking
PBEM – ARARs

ARARs
PBM – ARARs

▶ What are ARARs
  • Soil screening levels
  • Maximum contaminant levels
  • Risk-based cleanup levels
  • Site-specific target levels
PBM – ARARs

Regulatory requirements assessment

• Applicable, or relevant and appropriate federal and state requirements (ARARs) must be considered initially during remedy selection and periodically revised

N.J.A.C. 7:26E Technical Requirements for Site Remediation ("Tech Rule")
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PBEM – Exit Strategy

- Definition
- Overview
- Benefits
- Components
- Obstacles
- Example
Exit Strategy: Definition

- Detailed and dynamic cleanup plan to reach site closeout within a defined period of time
- Describes how progress toward performance expectations and goals will be pursued and measured
- Documents the pathway leading to no further action status
- Identifies alternative actions

A multi-site facility should develop an exit strategy for each site and a comprehensive exit strategy for the facility
Exit Strategy: Overview

- The purpose of the exit strategy is to clearly document the pathway leading to closure/response-complete status including consideration of contingency measures to be implemented should the progress vary from the plan.
- Preparation of a written exit strategy is an important component of PBEM practices.
- Based on sound scientific and technical understanding of site conditions and remediation technologies.
- Iteratively validated and updated through routine review to take advantage of lessons learned.

“...and if you don't know where you're going; any road will take you there”
Exit Strategy: Benefits

- Promotes concurrence among all stakeholders on the final goal and contingency measures
- Provides basis for effective decisions
- Accelerates risk reduction while maximizing restoration resources
- Promotes dynamic system optimization through performance tracking thus minimizing restoration time
Exit Strategy: Components

- Summary of the technical and regulatory basis for the selected action
- Description of the remedial components and actions that are planned
- Remediation and monitoring schedule
- List of metrics to be used to measure progress
- Description of potential contingency measures
- Description of conditions required for site closure
- Written or graphical summary of the decision logic
Exit Strategy : Examples

Site with groundwater affected by VOCs

► Protect human receptors from exposures to VOCs in drinking water and indoor air

► Existing monitoring program and remedial action (GW extraction with air stripping) in place

► Flexibility to deal with changes at the site
  • Site may require fewer monitoring and extraction wells as remediation progresses, or additional wells if plume unexpectedly gets larger
  • Air stripping may be replaced with activated carbon as extracted groundwater flow volume and mass is reduced

► Regulator buy-in to shut down pump and treat is already in place once the site reaches the planned clean-up goals (groundwater reaches MCLs)
Exit Strategy: Examples

Example Site-Specific Exit Strategy
Exit Strategy: Obstacles

Obstacles to executing an exit strategy generally can be traced to deficiencies in the strategy elements themselves (e.g. the exit strategy did not incorporate decision logic for dealing with unexpected conditions)

- An inadequate CSM may require modification of exit strategy as additional data become available
- If the RAOs are not necessary to protect human health and the environment, cost will be incurred on unnecessary actions
- If the RAOs are not achievable, the exit strategy cannot be successful
Exit Strategy: Obstacles

... contd.

- If the remedy is impracticable or infeasible, the RAOs are unlikely to be achieved in a reasonable timeframe.

- If performance metrics are unclear or the performance monitoring plan is inadequate, the effectiveness of the exit strategy cannot be assessed and optimization needs may go unrecognized—resulting in wasted resources and delayed protective measures.

- If decision logic is not well-defined, stakeholders may be disappointed in the outcome of the remedy and the time and cost to achieve terminating a response action.
PBEM – Performance-based Contracting

- Overview
- Contracting Vehicles
- Development Steps
- Environmental Insurance
- Pros and Cons
PBC: Overview

- **Performance-based contracting (PBC)**
  - Achieves clearly defined cleanup goals and milestones
  - Incentives for performance
  - Allowances for flexibility

- **Caution:** PBCs do not fit all cases

- **A typical PBC involves:**
  - Definition of the scope of the work to be done under PBC - Well defined conceptual site model and exit strategy are musts
  - Selection criteria for the PBC contractor - Qualifications (company and individuals), capabilities, financial ability, etc.
  - PBC implementation schedule - Must anticipate regulator approval and stakeholder acceptance process
PBC: Contracting Vehicles

- **Fixed Fee**
  - For services that can be objectively defined in the solicitation
  - Risk of performance is manageable
  - For such acquisitions, performance-based statements of work, measurable performance standards and surveillance plans are ideally suited

- **Cost-reimbursement**
  - For services that can only be defined in general terms or for which the risk of performance is not reasonably manageable.
  - Different variations include cost-plus-fixed fee, fixed-price incentive or cost-reimbursement incentive contracts

- **Time and Materials**
  - When the use of time and material/labor hour contracts is appropriate
  - Employed when site conditions are not well defined
  - All risk is on the agency
PBC: Development Steps

1. Establish the team.
2. Decide what problem needs solving.
4. Develop a PWS or SOO.
5. Decide how to measure and manage performance.
6. Select the right contractor.
7. Manage performance.
PBC: Development Steps

- Establish an Integrated Project Team
- Describe and Develop the Problem that Needs to Be Solved and the Link to the Department’s Strategic Plan and Objectives
- Contractor Selection Solutions from Both Private and Public Sectors
- Develop Performance Work Statements for the Work to Be Accomplished
- Decide How to Measure and Manage Performance
- Select the Right Contractor(s)
- Manage Performance
PBC: Environmental Insurance

- Though costly, environmental insurance can benefit a project by avoiding project failure due to cost overruns
- Regulators may require insurance
PBC: Pros and Cons

Pros

• reduced, or pre-established, reporting points with pre-established turn around times agreed to up front
• PBCs can result in better managed, faster executed and more cost effective cleanups

Cons

• perceived loss of control by regulators
• The PBC process requires significant up front time on the part of the regulator

Key is how well the problem is defined

Need to learn from successes and failures
Performance-based Environmental Management (PBEM)

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PBEM – When to use it?
PBEM – When to use it?

- Only during the beginning of a project?  
  All phases

- Only at huge – superfund like sites?  
  All sites

- Sites where we know we will be successful?  
  No, but …

- Do we have to do all components?  
  No

- Sites with no controversies and limited public interest?  
  Not always
PBEM – Regulatory Concerns

- Unknown process with limited assurances
- Government staff shortages to provide rapid responses
- Loss of government oversight
- Lack of consensus on exit strategy
- Perception issue – sidelines for regulators
- Ineffective communications
- Need for PBEM Memorandum of Agreement (MOA) with regulators
PBEM – Case Studies

▶ Programmatic
▶ Project-specific
  • Federal
  • State
▶ Lessons Learned
  • Early Completion Incentives
PBEM – Case Studies

- Federal Programs
- State Programs
- EPA Office of UST Programs PFP

Still building the database
PBEM – Case Studies  

Guaranteed Fixed Price with Insurance

Award Period: 5 years from 2004

Site Information:
  • TCE Plume
  • Fine-grained glacial till with limited sands
  • Ground water and soil impacted

What went right:
  • Expedited progress
  • Time-critical removal

What went wrong:
  • Presupposed remedy – inadequate input from stakeholders
  • Pilot testing not conclusive
Advantages of PBC
• Strong motivation to make progress at the site

Disadvantage of PBC:
• Potential to circumvent public participation required by CERCLA
• Contractor pursuing technology that was not quite unequivocal in producing results
• Potential for residual risk for responsible parties

Lessons learned:
• Include pilot testing in the process and for bid
• Include room for public participation
PBEM – Case Studies

Several Sites being managed through PBCs

A Variety of Goals
- Property Divestment
- Remedy in Place
- Response Complete
- Long-Term Monitoring
- 5-Year Reviews

A Variety of PBCs
- Fixed price Remediation with SOB
- Fixed price with incentives
- Fixed price with insurance
Charleston Naval Complex

- Closed in 1996 – BRAC site
- 1500 acres prime real estate
- FPRI contract in April 2000
- Over 400 soil samples and 1500 wells
- >170 RCRA and >70 UST sites
- Variety of chemicals – solvents, metals, PCBs, lead-acid, fuel/POL sites, landfills, etc.

Goals

- Divest property quickly
- Cap environmental liabilities
- Fund liabilities within current budgets – BRAC, ER
Challenges

- Sites not fully characterized
- Extensive RFI documents to be reviewed
- Remedies not selected or approved
- Long-term liabilities > 20 years

Keys to Expediting Process

- High performance team concept
- Use of organizational tools to expedite decision-making process
- Implemented public relations plan
- GIS/EVS system to manage and visualize massive data
- Developed decision-making flow charts with stakeholders input
Use of Innovative Technologies

- Vertical profiling in characterization
- Membrane interface probe for site screening
- Electrical resistive heating
- Hydrogen release compound to enhance *in situ* bioremediation of solvents

Schematic Diagram for ERH
Lessons learned

- Involve regulators early
- Plan enough time for regulatory processes
- Engage in open discussions with contractors and insurers
- Flexible solicitations for bids
- Allow sufficient time for data transfer to new management system
Program-wide
- All UST program sites follow this process

Overview
- about 9000 releases
- > 3300 active
- nearly 400 in active corrective action
- Fund: $12-15 Million
- Risk-based corrective action
Tiered approach to remedial investigations

- Tier I (standard plan)
- Tier II (site-specific)
- Tier III (detailed, if needed)

Risk-based Corrective Action

- Vapor, Soil, Groundwater
- Risk based on the receptors
- Complete vertical and horizontal characterization
- Modeling
- Verification
- Conditional NFA
Pay for performance
- Award is Low Bid (in most cases)
- Award price – firm fixed price

Highlights
- Pay contractors in a timely manner
- Avoid cost change orders
- Assist environmental consultants/contractors
  - With streamlined permitting process
  - Offsite access issues, etc.

Unless the Department Agrees
- A new petroleum release has occurred
- The assessment had major errors or omissions
- Initial concentrations have dramatically increased
## Remediations Bids Awarded at SC UST Sites

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<thead>
<tr>
<th>Year</th>
<th>Number of Cleanups</th>
<th>Average Bid Cost</th>
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<tr>
<td>1997</td>
<td>16</td>
<td>$128,396</td>
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<tr>
<td>1998</td>
<td>68</td>
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<tr>
<td>2005</td>
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<td>~$120,000</td>
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<tr>
<td>2006</td>
<td>23</td>
<td>$229,607</td>
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PBEM – Case Studies

Progress of Remediations at SC UST Sites
Early completion incentive

- A bonus of 10% of the contract money if they finish cleanup within an established time period
- Based on the risk priority ranking of the release, a site incentive period is set by the Department and is included in the bid solicitation.
Involve all regulators early in the process
Plan enough time for regulatory process
Engage in open discussions with contractors and insurers
Flexible solicitations for bids
Allow sufficient time for data transfer to a new management system
Case Studies – Lessons Learned

- Be flexible
- Provide incentives
- Insurance
- Contingencies
  - What if…
  - How to pay for failure
Performance-based Environmental Management

• Who uses PBEM? Federal, state and other agencies
• Regulators will receive some form of PBEM proposals
• Concepts of PBEM – systematic planning, exit strategy, CSM, etc.
• A better management practice for site remediation
Thank You for Participating

► Other resources:
  • ITRC website: www.itrcweb.org
  • CLU-IN Website: www.clu-in.org

► Your feedback is welcome and encouraged!
Questions and Answers