REMEDY PERFORMANCE REPORTING

driving remediation system optimization and site progression

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Agenda

- A Programmatic Approach to OM&M
- Field Data and Optimization
- Key Performance Indicators (KPIs)

A PROGRAMMATIC APPROACH

establishing a framework

Types of OM&M Projects

Groundwater extraction
Vapor extraction
Air sparging, biosparging
Multi-phase extraction
NAPL recovery
Vapor mitigation
ISCO and ozone sparging
Storm/ surface water treatment
Leachate recovery and treatment
Landfill gas management

Soil cap
Barrier wall
(sheet piling)
Permeable reactive
barriers
Landfill cap
Phytoremediation
NAPL sorbent socks
MNA

ISCO
ISCR
Bioremediation
MNA
Surfactant
In-situ activated carbon
Dewatering
Vacuum truck programs

Active (Mechanical)

Passive (Non-mechanical)

Other (Short-term, temporary)

OM&M Program Benchmarking

Program Element	Major Oil	Major Oil	Major Oil	Divers. Mfg	Major Oil	Aero. Mfg	Chem. Mfg	Pipeline Co.	Power Utility
Defined OM&M Practices	■	■	■	■					
Defined Work Scopes / Units	■	■							
Defined MOC Processes	■		■					■	
Performance Scorecards	■	■	■	■					
MMS			■	■					
Defined Technical Reporting Requirements	■	■	■		■				
Defined Financial Reporting Requirements	■	■		■					
Formal Site Review / Audit Process	■	■	■	■		■	■		

OM&M Priority Benchmarking

Remediation introduces immediate risks that were not present prior to implementation.

Why is Management of Change Important?

Changes occur during OM&M

- Often less rigorously evaluated and reviewed
- May be “field determinations”
- Introduces new or different risks
  - > Injury to site workers
  - > Permit non-compliance
  - > Loss of treatment efficiency
  - > Exceed design flow rates
  - > Damage to equipment

Audits and Peer Reviews

Safety & Compliance Audits

- Internal and/or third party
- Avoid injury and related costs
- Avoid downtime
- Avoid regulatory and public scrutiny:
  - > Consent orders, permit non-compliance
  - > Re-work

Peer Reviews

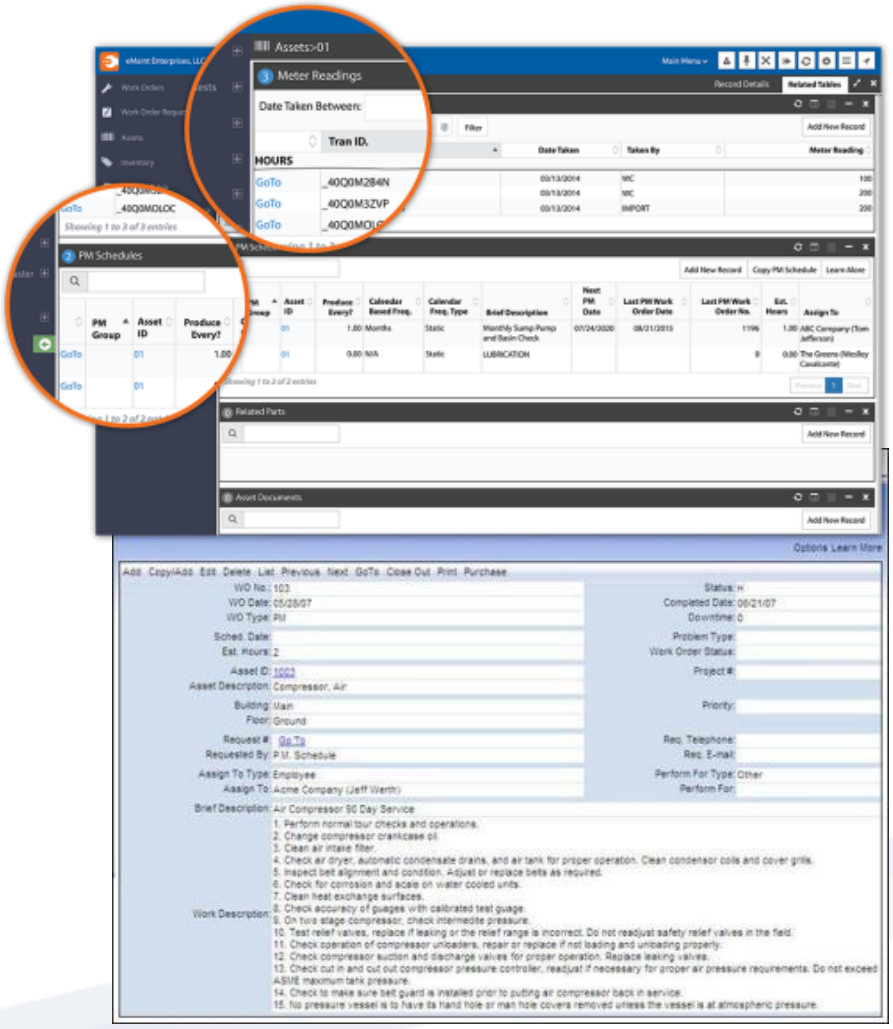
- Get new perspectives on languishing issues
- Break status quo for continuous improvement

Engage stakeholders in the process.
Assign action items and accountability for further vetting and/or implementation.

FIELD DATA AND OPTIMIZATION

working together

Workflow Proces



Select System Data

Flow rate	NAPL thickness	Operator hours	Process data (pressure, flow)
Mass flow rate	Mass recovered	Utility costs	
NAPL recovery rate	COC concentrations	Uptime	Chemical usage rate
Pore volumes recovered	PID and LEL	Sustainability factors	Equipment hour meter
Groundwater geochemistry	Groundwater elevation	Waste generation	Permit compliance data

Every piece of data collected should be used.

Timely review data and trends.

If data is not being used,

1. *Should it be used?*
2. *Is it valuable for later use?*
3. *Should it be collected?*

Remedial Process Optimization (RPO)

Remedy Optimization	Protective of human health and environment	
	Hydraulic control and plume capture	Subsurface barrier
		Groundwater extraction system
	Contaminant concentrations in soil and groundwater	Stabilization, reduction
	Vapor intrusion mitigation	
	Soil cap condition	
	Permit and regulatory compliance	
Process Optimization	Flow rates and pressure	
	Process stream chemistry	Contaminants, pH
	Equipment cycling rates, condition, life cycle	
	Treatment train effectiveness and necessity	
	Chemical/consumable usage	
	Waste generation volume and frequency	
	Data collection needs	Field
		Laboratory
	Control logic appropriateness	
	Process safety management	

Industry Optimization Approaches

- Traditionally viewed as separate from OM&M
  - > Defined process
  - > Holistic review of remedy success/progress
  - > Cost review
  - > Treatment train evaluation
  - > Safety review
- Increasingly considered part of OM&M
  - > Some have defined process
  - > Expectations often less clearly defined
    - "Reduce cost"
    - "Site progression"
  - > May be expected as "value-added" service

Ensure remedy performance is routinely monitored and continuously improved. Optimization almost always leads to the need to implement a management of change process.

KEY PERFORMANCE INDICATORS

selecting the right metrics

Performance Metrics: KPIs

defining objectives and measuring performance

Program KPIs

- Health and safety
- Regulatory compliance
- Schedule compliance
- Financial & cost savings
- Project progression
- Peer reviews
- System performance
- Optimization

Site-specific KPIs

- Operating as designed
- Mass removed / treated
- Uptime
- Carbon footprint
- Inspections

Select remedy performance KPIs that provide a quantitative measure of remedy performance toward remedial goals.

KPI Selection

- If met, site will reach remedial goals in the predicted time
- Evaluate the rate at which the site is remediated
- Benchmarked against established standards
- Specific to a site, system, and a remedy
- Defined prompt action plan for deficiencies

Uptime

- Good first look
- Identify problematic systems or trends
- Always tracked but minimal diagnostic value

Mass Recovery

- Track as total mass, rate, or $/lb
- Value dependent on initial mass estimate
- Tracking by well or area useful

Supplemental KPIs

- Specific to a given technology and site
- Targeted to evaluate rate at which system is achieving remedial goal or evaluate key operational parameters
- Monitor changes in regulations and site use

SVE Examples

- Pore volume exchange rate at maximum ROI
- O_2 and CO_2 concentrations
- Vadose zone temperature changes
- Respiration test data

LNAPL Recovery Examples

- Actual vs. predicted recovery rates
- Recovery per unit area
- Changes in transmissivity at recovery and monitoring wells
- Apparent thickness (often regulatory closure criteria)

Key Takeaways

- Build “fit for purpose” OM&M program
  - > Safety, cost, change management, and KPIs
- Use independent “fresh eyes” reviews to share best practices, highlight innovation, and continuous learning opportunities
- Select useful OM&M data to collect
- Optimization is change
- Standardize performance tracking, but allow flexibility in site-level implementation

Thank you.

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