The SmartSite® RPO Process

by

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SAICSmartSite™ SYSTEMS OPTIMIZATION

SAICSmartSite®

Remedial Process Optimization (RPO) + Software Services SmartSite Technology Systems + Long Term Monitoring (LTM)

Using a Systems Engineering Approach to integrate new technologies with proven operating, maintenance and monitoring methods to reduce costs, simplify operations and accelerate to closure.

SmartSite® Overview

- A systems approach to operations, maintenance and monitoring
- Combines SAIC's domain knowledge with systems engineering/integration skills
- Results in:
  - >20% cost savings
  - Quick (<2 yr.) payback
  - An integrated RAO/LTM program
  - Empowered operators and managers
  - Documented QA/QC

SAICSmartSite® Systems Engineering Approach

- Technology Enhancement
- Equipment Upgrade
- Process Automation
- Information Management
- O&M Services

- Good Engineering Practices
- Proactive Regulatory Approach
- Performance-based Metrics

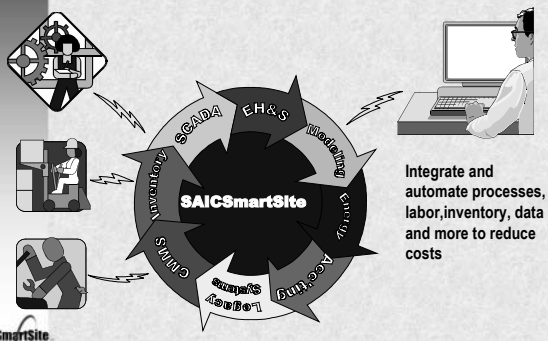
SmartSite

- Proactive Managers
- Innovative Engineers
- Empowered Operators

- Operating Systems
- Monitoring Programs

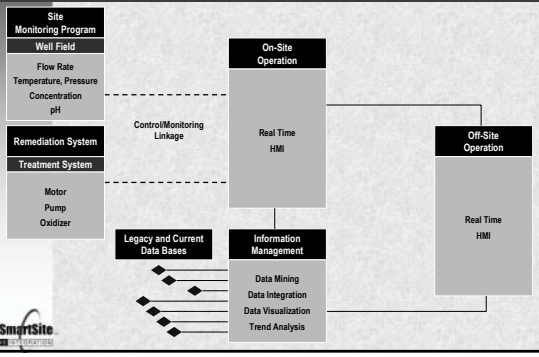
Optimize Performance
Minimize Costs
Mitigate Risk

Integration Tools and Techniques



Integrate and automate processes, labor,inventory, data and more to reduce costs

SAICSmartSite®Engineering Overview: An Integrated RAO/LTM Program



Key SmartSite® Success Features

SAICSmartSite™ SYSTEMS INTEGRATION

- Programmatic approach provides logical framework for complex analysis
- Systems engineering analysis evaluates interrelated cost and performance factors
- Integration of emerging and proven technologies yields high value at low cost
- Use of modern IT tools to integrate operations, maintenance, and monitoring data improves and simplifies management
- Fully documented, performance based results support continued improvements

Primary Goals – Typical Results

- **An integrated, more easily managed program.**
- **Empowered operators and managers.**
- **Improved communications and documentation.**
- **Improved systems performance and reliability.**
- **20% - 40 % cost savings from labor, utilities, materials, analytical, etc.**
- **2 - 3 yr. payback on optimization investments.**
- **Accelerated closure.**

SmartSite® Approach

- **Program Elements Approach**:
  - ✓ Treatment approach
  - ✓ Mechanical system components
  - ✓ Operations and maintenance
  - ✓ Environmental and treatment system monitoring
  - ✓ Administrative and regulatory

Olivetti Office *- Optimization of* ***all elements*** *of this complex groundwater and soil remediation program resulted in annual cost savings of approximately $110K, and reduced time to closure by up to 5 years.*

- **Systems Engineering Approach to Analysis:**
  - ✓ Interdisciplinary team approach
  - ✓ Evaluates all aspects of the program
  - ✓ Analysis of interrelated problems and solutions

O-FIELD Landfill *- Systems approach to analysis of performance and costs of packed tower supported elimination of the tower and associated GAC, O&M, and monitoring, yielding annual savings of $55K.*

SmartSite® Approach (cont.)

Industry's only formal documented systems engineering approach to optimization

- **Formal, Documented Approach:**
  - ✓ Structured program review process
  - ✓ *SmartSite®* Optimization Manual
  - ✓ Data collection modules
  - ✓ Formal QA/QC program
  - ✓ Standardized reporting

Loring Air Force Base*- Optimization results and recommendations used in CERCLA five-year review documents.*

- **Performance-Based Metrics:**
  - ✓ Mass removal efficiency
  - ✓ Program direct and indirect costs
  - ✓ Regulatory/QA/QC compliance
  - ✓ Environmental/Human exposures

SITE Program *- Achieving* ***performance-based metrics*** *including >95 % mass removal efficiency and assuring no off-site impacts was critical to optimizing this* ***innovative co-metabolic bioremediation*** *program.*

SAICSmartSite® Targets of Optimization A Systems Engineering Approach

TREATMENT APPROACH

- **Technology**
  - Is the existing technology still optimum with respect to current conditions and objectives?
  - Are there recent technology enhancements available?
  - Can remediation be accelerated?
  - Are design parameters still valid?
  - Are there system enhancements/changes to improve efficiency/effectiveness?
- **Regulatory Strategy**
  - Are ROD requirements still appropriate?
  - Do regulatory changes permit a different approach/technology?
  - What is the regulatory status of waste?
- **Cost/Benefit Decision**
  - What is the baseline cost of current performance?
  - How does current schedule affect long- and short-term costs?
  - Do changing environmental conditions require continuing optimization?

MECHANICAL SYSTEMS & SUPPLIES

- **Equipment**
  - Is system properly configured to efficiently meet treatment objectives?
  - Are life cycle costs of system hardware optimized?
  - Are systems over/under designed?
  - Is the system adequately or overly reliable?
- **Resource Utilization**
  - What are energy utilization issues?
  - Does system operate in peak versus nonpeak rate times?
  - Are alternate sources or types of energy or supplies available?
  - Are volume discounts possible from a program level basis?
  - Are there any opportunities for recycling?

MONITORING PROGRAM

- **Environmental (Soil and Groundwater)**
  - Are the number, frequency, and types of analyses sufficient/excessive to meet DQOs?
  - Can DQOs and QA/QC be refined based on current knowledge?
  - Are compliance and closure objectives supportable?
  - Can innovative analyses, automated data collection, etc., be applied at this site?
  - Are field procedures as efficient as possible?
- **Mechanical Equipment**
  - Is there opportunity for remote monitoring and control?
  - Can smart sensors and automated data collection reduce labor and reporting costs?
  - Are critical system reliability requirements defined and addressed?
- **Treatment Effectiveness and Residuals**
  - Are system treatment goals appropriate?
  - Are residuals such as sludge, spent carbon, etc., being handled appropriately?
  - Is the proper discharge monitoring technology being utilized?
  - Are off-gas and discharge water quality requirements appropriate?

SAICSmartSite® Targets of Optimization A Systems Engineering Approach (cont'd)

O&M ACTIVITIES

- **In-Ground/Environmental Components**
- **Mechanical Treatment Systems**
- **Labor and Resources**

- Is the use of labor supplies and materials efficient.
- Is system operating with preventive or predictive maintenance?
- Are there any liability/workers compensation issues?
- Has a reliability-based maintenance program been developed?
- Labor: Are utilization, scheduling, overtime management appropriate?
- Materials/Supplies: Inventory management, what is automated?
- System Reuse: Have closeout logistics and future utilization of parts and equipment been considered?

INFORMATION TECHNOLOGY

- **Process Control and Automation**
  - What system elements can be automated?
  - Can system be operated remotely? Multiple sites?
- **Data Collection**
  - How are data collected, processed, summarized?
  - Are data useful and necessary?
- **Information Management**
  - Are data bases user-friendly?
  - Are reports standardized and automated?
  - Are data transferred electronically?

SmartSite® Optimization Opportunity Examples

Project	Optimization Opportunity	Developed Alternative	Annual Savings
Environmental Systems Components			
Witco Petroleum	▫ Recovery of floating product beneath refinery limited by site access constraints and aquifer conditions	▫ Develop and install single caisson/angle well recovery systems to replace multiple vertical wells	$350K
Mound DOE	▫ Low soil oxygen concentrations due to soil saturation, and low soil nitrogen concentrations are limiting biodegradation rates which extends required remediation time associated with landfill leachate.	▫ Use existing dewatering trenches to decrease saturation. ▫ Install dual soil vacuum extraction/air injections system beneath landfill using angle drilling technique to enhance biodegradation rates coupled with mass removal by SVE.	$60K
CBS	▫ Solution weathering and geologic conditions limit capture and mass removal rates of P&T system	▫ Installation of angle drilled wells at strategic locations to intercept conduits of contaminant flow which eliminates the need for 2 wells	$45K
Olivetti Supplies	▫ Decline in groundwater concentrations and characterization of surface water receptors altered remedial requirements	▫ Perform fate and transport analysis along with human health and environmental risk assessment. Gain regulatory approval for NFA based on risk assessment results.	N/A– Accelerated Closure
Site Operating System Components			
Aberdeen Proving Ground	▫ Iron fouling of groundwater extraction system ▫ High pump repair and maintenance costs ▫ Clogging and intensive maintenance of well discharge lines	▫ Replace down-hole Clean Environment pumps with surface mounted double diaphragm pumps ▫ Replace bubbler level controls with electrical transducers	$31K
Olivetti Supplies, Inc., Harrisburg, PA	▫ Multiple contamination areas require multiple treatment systems	▫ Upsize treatment system to handle most significant area ▫ Manifold multiple areas to single treatment system ▫ Develop sequential treatment approach for multiple areas using a single treatment system	$42K
Loring Air Force Base	▫ Emulsification of recovered product prevents separation by oil water separator.	▫ Install second tank in sump. ▫ Install positive displacement pump at grade level. ▫ Upsize the oil water separator.	$24K
SouthDiv NIROP	▫ Piping configuration requires additional pump, resulting in unnecessary electrical power costs	▫ Reroute and resize piping to provide for gravity discharge	$16K

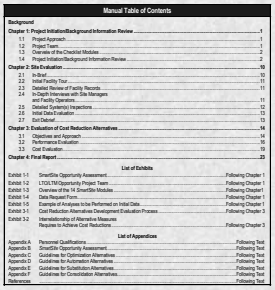
SmartSite® Optimization Opportunity Examples (cont'd)

Project	Optimization Opportunity	Developed Alternative	Annual Savings
Equipment Operations, Maintenance, and Monitoring Component			
Kodak Corporation	▫ Management/off-site disposal of acid wash water is labor-intensive and high cost	▫ Treat water on-site and manage with treated effluent.	$21K
Harley Davidson	▫ On-site operational problems associated with complex treatment train required frequent site visits by off-site personnel	▫ Configure treatment system SCADA to facilitate off-site problem analysis and resolution by on-site O&M staff	$24K
S. Jersey Clothing Site	▫ System shut down requires on-site acknowledgment of system faults, and manual startup involving over 40 individual system control switches	▫ Configure SCADA for off-site alarm recognition and acknowledgement, and automated sequence up of multiple system controls as one action	$23K
Higgins Farm	▫ Improper set point programming of pH sensors and feed control caused high fluctuations in effluent pH, resulting in frequent system alarms	▫ Reprogram set points and sensor delay functions ▫ Reprogram SCADA to allow for off-site alarm recognition	$23K
Management and Administrative Function's Component			
Aberdeen Proving Ground	▫ Manual collection of data is labor intensive and increases monitoring costs.	▫ Upgrade existing human-machine-interface (HMI) and RF communications linkage. ▫ Install PLC panel modifications and instrumentation. ▫ Configure system for automated data collection into Microsoft Access database.	$11K
Northampton Co. Water Authority	▫ Management of fourteen separate remote pumping centers made performance tracking, monitoring, and management extremely labor intensive	▫ Developed remote SCADA linkage with each facility, coupled with automated linkage to centralized database to facilitate data management and generation of streamlined reports.	$40K
Harley Davidson, York, PA	▫ Multiple remediation programs at single site resulted in intensive data management and reporting	▫ Develop GIS system for management of spatial and numeric information ▫ Develop automated data input and standardized reporting functions.	$18K

Formal and Documented Approach

- LTO/LTM and SmartSite® Manual
- Data Modules
- Dedicated Data Bases
- Structured Review Process
- Documented QA/QC Program
- Formal and Documented LTO/LTM SOPs

Optimization Approach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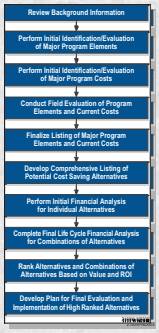


SAIC's optimization approach is thorough and well documented

Optimization Approach (cont'd)

- Team approach
- Standardized data collection modules
- Identification of cost-saving opportunities
- Rigorous financial analyses
- Phased implementation

SmartSite® Optimization Team

- O&M Field Technician
- Remediation Scientist
- Process Engineer
- Automation and SCADA Engineer
- Information Management Integrator
- Cost Estimator

Phased Approach - Minimize Costs/Maximize Return

STEP 1: Conduct Needs Assessment to Baseline Current Program
- Reality Check - Redefine program strategies and objectives
- Review existing program information
- Perform site visit
- Evaluate engineering systems, procedures, organization, information management/reporting, compliance issues, cost drivers…
- Identify opportunities for improvement
- Evaluate optimization alternatives
- Perform cost/benefit analysis
- Develop optimization recommendations

STEP 2: Develop Long-Term Optimization and Management Plan
STEP 3: Begin Implementation of Highest Ranked Alternatives
STEP 4: Evaluate Results Against Performance Metrics
STEP 5: Adjust Program and Implement Additional Alternatives

SAIC SmartSite SYSTEMS OPTIMIZATION

Standardized Data Collection Modules

- Background Information
- System Summary
- Labor
- Maintenance and Repair Management
- Transfer Equipment (pumps, blowers, etc.)
- Instrumentation (inputs)
- Control System
- Controlling Devices (outputs)
- SCADA and Operator Interface
- Management Systems
- Detailed Cost Data
- Monitoring
- Well and Trench Systems
- Specific Problems/Desired Improvements

SAIC SmartSite SYSTEMS OPTIMIZATION

Example Data Collection Module

Module 1—BACKGROUND INFORMATION Page _1_ of _2_

Facility / Site Name: Vineland Chemical Co. Superfund Site

Inspector: R. Cronce

A. Facility	B. Location
Vineland Chemical Co. Superfund Site	1405 N. Mill Rd. Vineland, NJ 08360 Cumberland Co.

C. Key Contacts:

Name and Title	Address	Contact Information
Dave Herwig Program Manager	Vineland Chemical 1405 N. Mill Rd. Vineland, NJ 08360	Phone: 856-690-1758 Fax: 856-690-1759 E-Mail: daherwig@voicenet.com
Steve Gillespie Site Manager	Vineland Chemical 1405 N. Mill Rd. Vineland, NJ 08360	Phone: 856-690-1758 Fax: 856-690-1759 E-Mail: vinelandi@voicenet.com
Chuck Van Winkle - Plant Superintendent/Head Operator	Vineland Chemical 1405 N. Mill Rd. Vineland, NJ 08360	Phone: 856-690-1758 Fax: 856-690-1759 E-Mail:
Bill Stappenfenne Maintenance Supervisor	Vineland Chemical 1405 N. Mill Rd. Vineland, NJ 08360	Phone: Fax: E-Mail:
Matthew Westgate Geologist/Project Manager	U.S. EPA, Region II Emergency/Remedial Response Div. 290 Broadway - 19th Floor New York, NY 10007-1866	Phone: (212) 637-4422 Fax: (212) 637-4422 E-Mail: westgate.matthew@epamail.epa.gov
Martin Connolly, Project Engineer	USACE Philadelphia District Vineland Project Office 1509 North Mill Rd. Vineland, NJ 08360	Phone: (856) 794-9925 Fax: (856) 794-9828 E-Mail: Martin.J.Connolly@nap02.us

D. General Notes (Facility mission, history, risk issues, land use, political issues, etc.):

Site soil and groundwater impacted by arsenic related to historical production of organic arcenical herbicides and fungicides since 1949. No. 42 on NPL list. RI/FS completed in 1988. Contaminants of concern are primarily organic (mono and di-methyl arsenic) and inorganic arsenic. Approximately 1 M gpd of groundwater is captured by 13 groundwater extraction wells. Treatment consists of chemical treatment by oxidation, coagulation, sedimentation, filtration, and precipitation. Treated water is discharged to Blackwater Branch under a NPDES permit.

Example Life Cycle Cost Analysis Backup Table

Col #	Current Labor Costs Category	Crew	Description of Work	Rate ($/hr)	total hours	Unit Cost	Units per year	Annual Cost
1	Operations	1	Pumping of well vaults - 2 persons, 1 day per week	35.00	16	$ 560.00	52	$ 29,120.00
	Operations	1	Note: Cost savings related to more efficient repair of flow meters are accounted	35.00		$ -		$ -
	Monitoring		for in Section 3.11, and savings due to reduced cleaning of discharge lines	35.00		$ -		$ -
	Admin.		are included in section 3.4	65.00		$ -		$ -
	Engineering			65.00		$ -		$ -
			SubTotal		16.0	$ 560.00		$ 29,120.00

Col #	Current Cost of Operations - Equipment and Subcontracts Category			Unit Cost	Units per year	Annual Cost
1	Analytical					$ -
	Subcontracts		Sludge disposal - 3 ft/wk X 52 wks X 8.14lb	$ 22.00	1	$ 22.00
	Utilities					$ -
	Chemicals					$ -
	Equipment					$ -
	Materials					$ -
	Supplies		Misc - Sump pump, truck, etc.	$ 10.00	52	$ 520.00
			SubTotal	$ 32.00		$ 542.00

Col #	Proposed Operations Labor Costs Category	Crew	Description of Work	Rate ($/hr)	total hours	Unit Cost	Units per year	Annual Cost
3	Operations	1	Periodic pumping of well vaults - 2 persons, 1 day per month	35.00	16	$ 560.00	12	$ 6,720.00
	Maintenance			35.00		$ -		$ -
	Monitoring			35.00		$ -		$ -
	Admin.			65.00		$ -		$ -
	Engineering			65.00		$ -		$ -
			SubTotal		16.0	$ 560.00		$ 6,720.00

Example Life Cycle Costing Analysis Summary Table

Life of the facility in years =	**30**	Date Prepared:	02-Aug-01
Discount Factor in percent =	**6%**	Prepared by:	R. Cronce

Project: Vineland Chemical
Alternative Name: Evaluation of Well Vault Monitoring and Maintenance
Description of Alternative: Site grading for surface water control.
Sealing of interior vault seams.
Replacement of concrete covers with lighter doors.

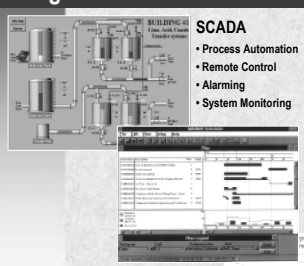
Cost Category	Column 1 Est. Cost of Current Operations (Annual) Note 1	Column 2 PW of Current Operations Note 2	Column 3 Est. Cost of Proposed Operations (Annual)	Column 4 Capital Cost of Proposed Alternative	Column 5 PW of Proposed Operations Note 3	Column 6 Annual Operating Cost Savings (Col. 1 - Col. 3)	Column 7 Potential R O I (Years) (Col.4 / Col.1)	Column 8 Potential Life Cycle Savings (Col. 2 - Col. 5)
Labor Operations	$ 29,120.00	$ 400,831.88	$ 6,720.00	$ 11,200.00	$ 103,699.67	$ 22,400.00		$ 297,132.22
Maintenance	$ -	$ -	$ -	$ -	$ -	$ -		$ -
Monitoring	$ -	$ -	$ -	$ -	$ -	$ -		$ -
Administration	$ -	$ -	$ -	$ -	$ -	$ -		$ -
Engineering	$ -	$ -	$ -	$ 520.00	$ 520.00	$ -		$ (520.00)
Analytical	$	$	$ -	$ -	$ -	$		$
Subcontract	$ 22.00	$ 302.83	$ -	$ -	$ -	$ 22.00		$ 302.83
Utility	$ -	$ -	$ -	$ -	$ -	$ -		$ -
Chemicals	$ -	$ -	$ -	$ -	$ -	$ -		$ -
Equipment	$ -	$ -	$ -	$ -	$	$ -		$
Materials	$ -	$ -	$ -	$ 20,000.00	$ 20,000.00	$ -		$ (20,000.00)
Supplies	$ 520.00	$ 7,157.71	$ 120.00	$ 500.00	$ 2,151.78	$ 400.00		$ 5,005.93
		$ -			$ -	$ -		$ -
Totals	$ 29,662.00	$ 408,292.42	$ 6,840.00	$ 32,220.00	$ 126,371.45	$ 22,822.00	1.41	$ 281,920.98

Note 1: Based on present estimated annual costs impacted by this alternative only.
Note 2: The present worth of annual costs are based on a facility life and discount factor listed above. PW Factor = 13.76483115

Example Summary of Alternatives Cost Analysis

Program Element	Alternative Evaluated	Initial Cost	Annual Cost Savings	Life-Cycle Savings[1]	Return on Investment (years)
Well Field Management for Flow Maximization	Redevelop 14 RW's, reconstruct RW-9, and hydrogeologic testing of two RW's	$173,000	N/A	$1,765,950	N/A
Fouling of Groundwater Extraction Pumps	Addition of automated sequestering agent system.	$36,000	($43,538)	($635,293)	(0.8)
Performance of Groundwater Influent Lines	New transfer main	$288,360	$19,360	$69,000	15
Well Vault Monitoring and Maintenance	Replace covers, seal vaults, and grade area.	$32,200	$22,822	$281,920	1.4
Hydraulic Capacity of the Treatment Plant	Add level control for coagulation tanks	$7,040	$550	$500	12.9
Performance Enhancement Through Flow Equalization	Addition of equalization tank system	$156,500	$51,300	$549,635	3.0
Chemical Usage Rates	Optimization of current protocols, eliminate second organic train, chemical elimination, and addition of polishing unit.	$296,093	$337,068	$4,343,585	0.9
Performance of DAF Units	Modify discharge pipe weir and add internal sludge collection pipes.	$25,660	$24,500	$311,647	1
Performance of Chemical and Polymer Feed Pumps	Replace existing pumps and add two new chemical dilution stations.	$25,000	$4,300	$34,200	5.8
Performance of Flow Meters	Replace well flow meters with magnetic	$27,300	$10,920	$123,012	2.5
Compressed Air System	Add third compressor.	$15,600	$1,875	$10,195	8.3
Sludge Dewatering and Management	Replace centrifuges with filter presses	$280,500	$96,300	$1,045,400	2.9
Installation of MOVs in Chemical Storage Facility	Install motor operators on valves	$64,175	$315	$0	>30
SCADA System – Well Field Control and Operations Monitoring	Implement SCADA well field control and monitoring	$45,660	$6,370	$42,022	7.2
SCADA System – Treatment Plant Control and Operations Monitoring	Implement integrated plant control and monitoring	$104,200	$28,600	$289,474	3.6
SCADA System – Operator SCADA Control of Chemical Feed Rates	Integrate chemical feed rate control into PLC	$50,000	$25,662	$303,233	2.0
PLC and VFD Maintenance and Obsolescence	Perform VFD survey and substitution design	$6,200	$0	$0	N/A
Environmental Monitoring – Well Field Monitoring	Optimize sampling frequency and install dedicated sampling pumps	$124,500	$63,440	$748,741	2.0
Environmental Monitoring – Treatment Plant Monitoring	Reduce frequency of two off-site sampling parameters.	$19,500	$11,720	$141,824	1.7
Data Management and Reporting	No opportunities for improvement identified	N/A	N/A	N/A	N/A
TOTAL		**$1,296,873**	**$657,778**	**$9,696,354**	**1.05**

Representative Automation and Information Management Tools



SCADA
- Process Automation
- Remote Control
- Alarming
- System Monitoring

CMMS
- Work Scheduling
- Maintenance Management
- Materials Purchasing
- Other Resource Management

EHS Data Management
- Site Information
- Chemical Data Base
- Waste Management
- Tracking and Reporting

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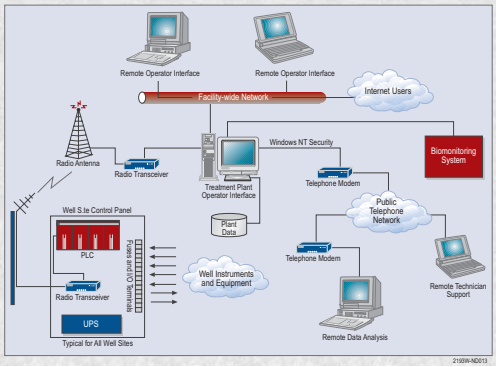
Integrated SCADA-HMI-Data Management Systems



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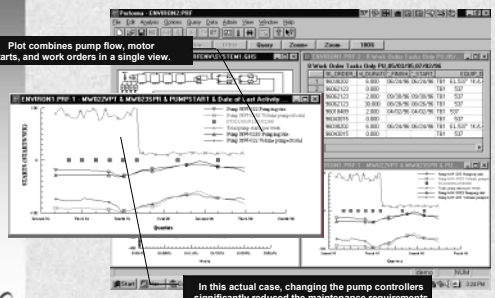
Performa™–Graphical Presentation of Multiple Data Bases in a Single Window



Plot combines pump flow, motor starts, and work orders in a single view.

In this actual case, changing the pump controllers significantly reduced the maintenance requirements without affecting flow rate performance.

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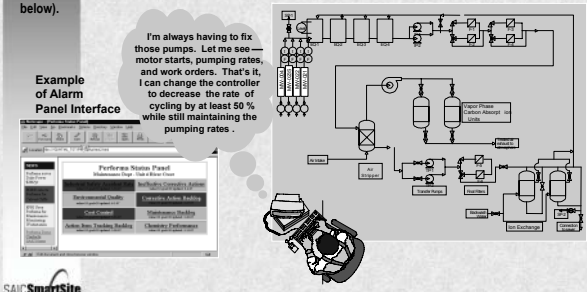
Performa™ Example: Reducing Pump Maintenance

Performa™ allows managers, engineers, and operators to have a single viewpoint for all data. The user can start with a process flow diagram (shown below) or an alarm panel (example below) to display pre-formatted reports or to generate *ad hoc* queries and reports. A browser interface is also possible (see below).

Example of Alarm Panel Interface



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SAICSmartSite® Supported Reliability Management

Identify the Problem →	Alarming Trend Analyses Statistical Analyses Observation
Quantify Causal Factors →	Root Cause Failure Analyses Failure Mode and Effects Analyses
Evaluate Consequence →	Risk Analyses Forensics Event Probability Modeling Reliability Assessment
Develop Avoidance Mechanism →	Alternatives Analyses Assignment of Costs Assignment of Value Consider Return on Investment (ROI)
Execute Change →	Operational Program Hardware/Software Training Management

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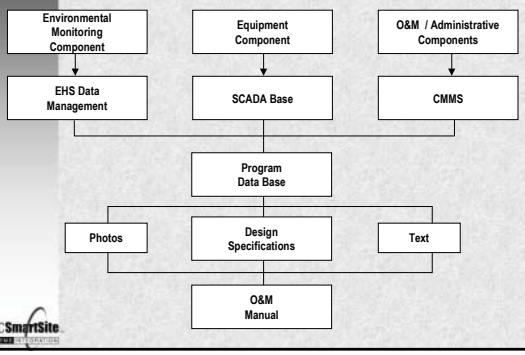
Interactive Optimization and Management Manual



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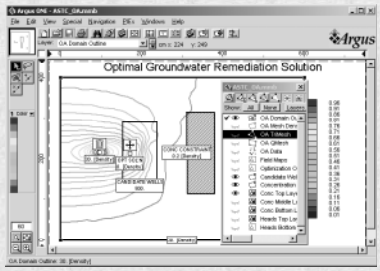
SAIC's PLUMECLEANER



PlumeCleaner links with subsurface simulators to auto-design the least cost, risk-based remediation

Summary

- **RAO/LTM Optimization Requirements Are Highly Variable and Technology and Site-Specific**
- **Systematic and Comprehensive Approach Fully Documents Baseline Conditions**
- **Multidisciplinary Team Provides Quality Evaluation**
- **Wide Range in Opportunities for Cost-Saving**
- **A Systems Analyses of Interdependent Problems and Solutions Yields Optimum Cost Savings**
- **A Systems Engineering Approach Maximizes Total, Long-Term Cost Savings**
- **Savings Generally Exceed 20%**