Attachment A

Monitoring and Sensors Working Group
Results and Homework

Facilitator: Mark Gladstone, The Gladstone Group

Monitoring and Sensors Workgroup:
Orlando Workshop

Technical Approaches (Form A)

Capability to be improved: Monitoring Multimedia

Associated Target: Verify conceptual model and adapt monitoring system

Technique/technology: Groundwater monitoring
Current maturity level: mature
Range of applicability: problems in highly heterogeneous porous media and fractured media; lack of knowledge of flow architecture
Needed R&D: incorporation of effects of GHBC framework on groundwater monitoring systems; identification of parameters that can predict failure; remote telemetry of groundwater monitoring network data.

Technique/technology: Remote sensing
Current maturity level: mature
Range of applicability: air and surface; calibration and ground-truthing issues; difficult to invert and limited spatial resolution.
Needed R&D: Increased spatial resolution, improved techniques for ground-truthing and calibration, improved inversion techniques using additional constraints

Technique/technology: Vadose zone monitoring
Current maturity level: immature
Range of applicability: mostly point data, often intrusive, generally not robust, measurements often have high uncertainty, difficult to monitor heterogenous and fractured systems
Needed R&D: volume integrating sensors; noninvasive technologies; improved techniques for monitoring heterogenous and fractured media; more robust technologies for long-term monitoring.

Technical Approaches (Form A)

Capability to be improved: Design and Emplace Monitoring Systems

Associated Target: Review and compare design of current monitoring systems and emplacement strategies to identify gaps and areas for improvements in cost and performance

Technique/technology: Statistical Sampling Methodology for all Media
Current maturity level: somewhat mature
Range of applicability: Can be utilized to optimize design of all monitoring networks, including sampling locations, frequencies, and analytical parameters
Needed R&D: Demonstration and validation of various approaches is needed to ensure stakeholder acceptance; some development of statistical approaches may also be desired.

Technique/technology: Direct-Push Technology Emplacement
Current maturity level: somewhat immature
Range of applicability: This technology offers an inexpensive alternative to emplacement of sensors in monitoring wells
Needed R&D: System integration of sensors with direct-push technologies that have been enhanced to allow placement of sensors for long-term monitoring

Technique/technology: Standard Drilling Technologies
Current maturity level: mature
Range of applicability: Applicable to all sites requiring subsurface monitoring systems where current drilling costs are high (especially true for difficult drilling conditions and great depths)
Needed R&D: New lower-cost methods for drilling and emplacement of sensors could be applied at sites where drilling costs are high

Associated Target: Identify and test five surrogates that could be used to track high-risk contaminants.

Technique/technology: Analytical Surrogates
Current maturity level: immature
Range of applicability: Can be used for optimization of all monitoring systems to meet LTS needs.
Needed R&D: Identification and testing of surrogates to reduce the number of sampling parameters is highly desirable. The performance of the surrogates as trackers of the high-risk contaminants must be validated and stakeholder acceptance must be obtained.

Technical Approaches (Form A)

Capability to be improved: Optimizing monitoring systems_____

Associated Target(s): 80% of LTS sites use optimization strategy_____

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Technique/technology # _1_____

Title: Groundwater monitoring networks_____

Current maturity level: Mature_____

Range of applicability: Conceptual model needed to describe flowpaths, knowledge of contaminant behavior (DNAPLs) needed, and vadose zone is included in this technology_____

Needed RD&D: Subgrid variability impacts on parameter scaling, uncertainty analyses that includes both model and data errors, Bayesian approaches to optimal network design, coherent design with other pathways_____

Technique/technology # __2_____

Title: Surface water monitoring_____

Current maturity level: Mature_____

Range of applicability: Information needed for water balance and erosion of surface cover, pedogenesis effects on long-term behavior_____

Needed RD&D: The effects of uncertainty on network design, scale dependency of parameters, coherent network design with other pathways_____

Technique/technology # __3_____

Title: Atmospheric monitoring network_____

Current maturity level: Mature_____

Range of applicability: _Information on particulate, vapor and aerosols at a site, applications in complex terrain_____

Needed RD&D: Local high-resolution models for network design, coherent network design with other pathways, approaches for manmade structures_____

Capability to be improved: Optimizing monitoring systems

Associated Target(s): 80% of LTS sites use optimization strategy

Technique/technology # 4

Title: Biological monitoring system

Current maturity level: Mature

Range of applicability: Primarily field sampling and inspection

Needed RD&D: Develop remote sensing techniques, coherent network design with other pathways

Technique/technology # 5

Title: Adaptive sampling

Current maturity level: Immature

Range of applicability: All sites using available information to change sampling to measure locations or frequencies that are most critical

Needed RD&D: Data assimilation techniques that provide information to make sampling adjustments, real time data visualization and analysis capabilities

Target Technical Approaches (Form A)

Activity 5: Information Management and Communication

Target: To have a mature, functional, web-based Information Management and Communication Systems in place at all Long-Term Stewardship sites across the DOE complex. Each system is to consist of two principle parts: 1) an **internal** communications system designed to accommodate data storage, data validation, user access, information dissemination, and visualization to be used primarily by site personnel and facilitate their communication with Headquarters and Regulators; and 2) an **external** communications system designed to facilitate Public Outreach and Education.

What is the final result of the RD&D? At this point in time, no additional research or development is considered necessary to implement a functional Information Management and Communication System at the Long-Term Stewardship sites. Existing technologies (computer hardware and software packages) are considered sufficient to develop the systems, and it is assumed that future advances in these areas will be readily incorporated into the communications system as the advances become available.

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Is there more than one technical approach identified?

Yes - Complete this section.

No - Fill out a "Technical Approach Summary" (Form B) for the single identified approach - Done

List the Technical Approaches	Relative Rank
A) Develop and implement the **internal** communications system (mature)	____1____
B) Develop and implement the **external** communications system (mature)	____2____

Note: The Information Management and Communication System is conceptualized as a two-part system in which the internal and external parts are of equal importance. The relative ranking provided above is intended to convey that the external communications portion (Public Outreach and Education) will be built upon the data storage, validation, and visualization capabilities of the internal system, and therefore must be developed subsequent to the development of the internal system.

Technical Approaches (Form A)

Capability to be improved _____

Associated Target(s) Hardware development

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Technique/technology # 1

Title Microchromatigraphs (Chem lab on a chip)

Current maturity level Research and development stage

Range of applicability Applicable to hydro-carbons, needs miniaturization, development of prototype, illustrate range of applicability and sensitivity

Needed RD&D _Develop prototypes, test prototypes, evaluation, and commercialization.

Technique/technology # 2

Title Fiber optic-laser techniques

Current maturity level ___research and development

Range of applicability ____real time monitoring, quantifying heavy metals, characterizing hydraulic properties, use in CPT

Needed RD&D ___Evaluate sensitivity of reading, temperature affects, longevity_____

Technique/technology # 3

Title Spectral Analysis of surface waves

Current maturity level _ Mature, need validation

Range of applicability _Used with tomography, interprets shear wave better than refraction, non-invasive, location of voids, earthquake geologic properties, and soil properties

Needed RD&D _improve resolution, applicability in contaminated soil, sediment and rock_

Technical Approaches (Form A)

Capability to be improved Monitoring and Sensors

Associated Target(s) Hardware development

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Technique/technology #_____4

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Title Flame photometer on chi

Current maturity level _____R and D for miniaturization

Range of applicability _Measuring the concentration of certain metals and transition elements in a sample solution, detection limits, sensitivity

Needed RD&D ____Miniaturization, increasing number of analytes, broadening detection limits, increasing sensitivity__

Technique/technology #_____5

Title Nanotechnology

Current maturity level Research Stage

Range of applicability ___ __ sensors capable of detecting pollutants at the molecular level. Major improvement in process control, compliance monitoring, and environmental decision making could be achieved if more accurate, less costly, more sensitive techniques were available.

Needed RD&D ____ development of nanosensors for efficient and rapid *in situ* biochemical detection of pollutants and specific pathogens in the environment; sensors capable of continuous measurement over large areas, including those connected to nanochips for real-time continuous monitoring; and sensors that utilize lab-on-a-chip technology. Research in this topic area may also involve sensors that can be used in monitoring or process control to detect or minimize pollutants or their impact on the environment.

From Jody Waugh's writeup in Jim Clarks group

Activity 4. Predict, Monitor, and Evaluate System Performance

Technical Approaches (Form A)

Capability to be improved: 4.1 Conceptualize and predict system performance and potential failure modes / levels of failure.

Associated Target(s): 4.1 Deploy a "toolbox" of techniques and technologies (e.g., models, natural analogues, guidance, performance indicators, failure criteria, etc.) to improve planning, decision making, design, monitoring, maintenance, and interpretation of monitoring data.

Technique/technology # 1

Title: Catalog of Analogs (Natural and Archeological)

Current maturity level: Analog characterization methods – mature / Incorporating analog data in PA – immature.

Range of Applicability: All covers.

Needed R&D: Integrate analog data with modeling and field tests in PA process.

Sources:

Technique/technology # 2

Title: Evaluate Existing Field Tests (e.g., lysimeters)

Current maturity level: Evaluation methods – very mature.

Range of Applicability: All existing caps and field tests of conventional (RDRA C) and alternative (ER) caps.

Needed R&D: Begin (deploy) evaluations.

Sources:

Technique/technology # 3

Title: Couples Models (performance/risk, ecosysystem/water balance, event probability)

Current maturity level: Conceptual to deployable

Range of Applicability: All caps.

Needed R&D: Couple existing models, model verification.

Sources:

Technique/technology # 4

Title: Indicators of Performance / Failure

Current maturity level: Low to high.

Range of Applicability: Wide range of contaminants.

Needed R&D: Compilation of case histories (good and bad), identification of potential indicators or surrogates.

Sources:

Technique/technology # 5

Title: Monitoring inputs – range of parameters.

Current maturity level: Medium.

Range of Applicability: Wide range of contaminants.

Needed R&D: Compiliation of current monitoring data, evaluation of potential ranges.

Sources:

Technique/technology # 6

Title: Plug & Play monitoring.

Current maturity level: Low.

Range of Applicability: Wide range of contaminants.

Needed R&D: Development of simple, robust monitoring systems.

Sources:

Technique/technology # 7

Title: Long-term performance of treatment, co???etion, and barrier systems.

Current maturity level: Low to medium.

Range of Applicability: Wide range of sites involving these types of systems.

Needed R&D: Forensic studies of existing systems. Accelerated testing, where applicable.

Sources:

Technique/technology # 8

Title: Top 10 Preventative Maintenance Items.

Current maturity level: Low to medium.

Range of Applicability: All facilities.

Needed R&D: Evaluation of case histories (good and bad). Review of previous O&M plans.

Sources:

Technology Pathway Summary (Form B) -- Jody Waugh

Capability to be improved: 4.1 Conceptualize and predict system performance and potential failure modes / levels of failure.

Associated Target(s): 4.1 Deploy a "toolbox" of techniques and technologies (e.g., models, natural analogues, guidance, performance indicators, failure criteria, etc.) to improve planning, decision making, design, monitoring, maintenance, and interpretation of monitoring data.

To achieve target 4.1, the LTS CC&C working group consolidated the traditional waterfall model into the following technology development pathway:

1. *Identify Performance Requirements.* (6 – 12 months)

    a. Characterize baseline (current) environmental settings.
    b. Identify release/exposure processes and pathways
    c. Parameterize CC&C performance requirements (e.g., drainage flux, soil loss, gas release, biointrusion, etc.)

2. *Find Analogs for Alternative Designs (Rocky Flats) and Long-term Environmental Change (Fernald).* (6 – 9 months)

    a. Review projected global/regional climate change scenarios and range of future states (e.g., temp., precip., seasonality, extremes).
    b. Match projected and past (proxy) climates.
    c. Map climate analog areas.
    d. Find analog sites for reasonable ranges of geomorphology, pedogenesis, and ecological succession.

3. *Design CC&C Systems that Mimic Favorable Natual Settings (Design Analogs).* Link to Capability #2.

    a. Characterize design analogs (stable slopes, target vegetation, capillary barriers, etc.)
    b. Develop engineering methodology to mimic settings that are favorable for long-term containment.

4. *Characterize Long-term Performacne Analogs.* (1 – 2 years).

    a. Characterize analogs of ecological responses to climate change and secondary perturbations.
    b. Characterize analogs of pedogenic (soil structural development, horizonation, bioturbation, etc.) effects on soil physical and hydraulic properties.
    c. Characterize geomorphological analogs of slope stability, soil loss, and drainage patterns.

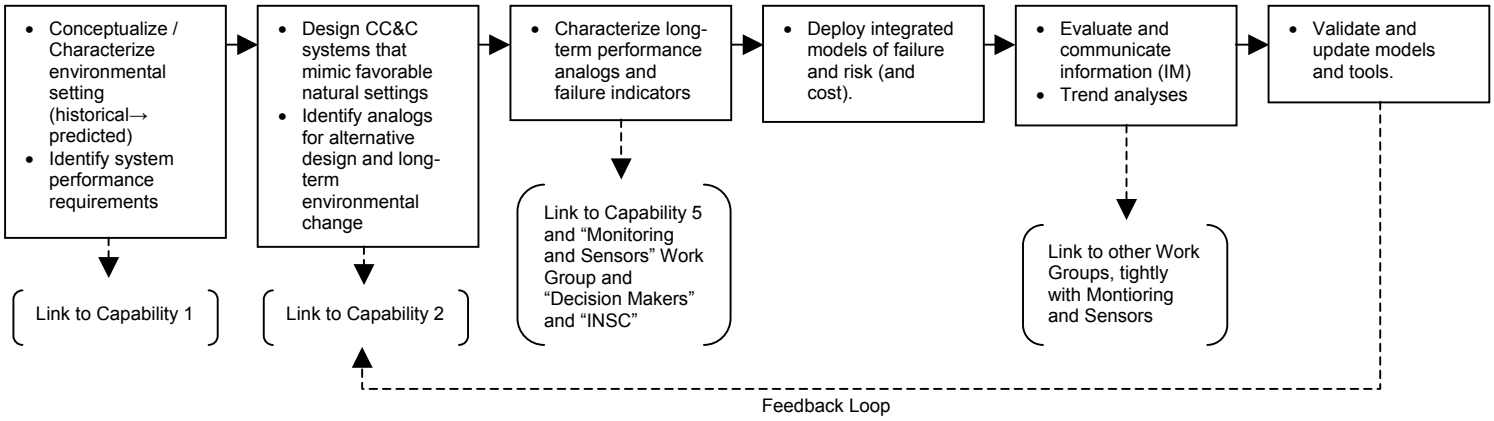
5. *Update and Deploy Integrated Models for Performance and Risk.* (1 – 2 years).

    a. Select appropriate performance (e.g., HELP, ECODYN, RAECON, etc.), risk, and cost models.

b. Select software tools (e.g., FRAMES) to integrate relevant models.
c. Identify future environmental setting scenarios and estimate parameter ranges and uncertainty.
d. Perform calculations and interpret results.

6. ***Evaluate Performance of Existing Tests.*** Link to Capability #2 (1 – 3 years).

a. Review existing field test designs.
b. Select alternative designs for range of environmental settings.
c. Monitor and evaluate design performance.



Technology Pathway Summary (Form B) – Margaret MacDonell

Capability to be improved: 4.1 Conceptualize and predict system performance and potential failure modes / levels of failure.

Associated Target(s): 4.1 Deploy a "toolbox" of techniques and technologies (e.g., models, natural analogues, guidance, performance indicators, failure criteria, etc.) to improve planning, decision making, design, monitoring, maintenance, and interpretation of monitoring data.

To achieve target 4.1, the LTS CC&C working group consolidated the traditional waterfall model into the following technology development pathway:

7. *Indicators.* Apply / update models to asses systems performance, failure event probabilities and consequences. Identify precursors to failure and develop site-specific indicators and criteria/trigger levels for key parameters to trigger response, retrofit, or replacement. (6 – 9 months)

    - *Prerequisites*—Performance requirement, system design specs, environmental conditions over time, event/failure probability and consequence analysis, monitor parameters, analogs.
    - *Expected Products / Results*—Catalog of performance indicators, catalog of failure and prefailure indicators, catalog of response criteria (per system element, setting, significance to integrity) and trigger levels (e.g., evaluation warranted). – watch list (precursor to failure). – Active measure (response: minimal to extensive).

8. *Preventative Maintenance.* Model maintenance options per system / setting, evaluate performance date of analogs (include natural systems) (6 – 9 months)

    - *Prerequisites*—Systems design specs, environmental settings, event/failure probability and consequence analysis, PFMC requirements, monitor parameters, analogs.
    - *Expected Products / Results*—Checklist/guidance for "top 10" items. Guidance/protocols for how to address them.

9. *Monitored Parameters.* Develop protocol/guidance for site-specific monitoring; conceptualize and calculate/model/predict expected design values and ranges of acceptable deviation for monitorable (emphasis on risk-drivign) parpameters, such as leachate inflow, cap moisture, outflows from reactive barriers, etc.; identification/predictive modeling of surrogates; guidance/protocol for plub & play monitoring capability.

    - *Prerequisites*—System specs – PFMC requirements, environmental conditions over time, event probability/consequence analysis.
    - *Expected Products / Results*—Science-based protocol/guidance for site-specific monitoring.

Technology Pathway Summary (Form Bs)
For Monitoring and Sensors Workgroup

Activity 1: Develop Framework for Multimedia

Related Capability 1.1: Monitoring Multimedia
Related Target: Develop technology to fill 30% of identified gaps

Task #1: Inventory of monitoring methods and techniques for all pathways

R&D Phase: N/A

Description: Collection and study of existing lists and descriptions of monitoring methods and techniques for air, surface water, vadose zone, groundwater, and manmade structures. Examples of existing lists include EPA, DOE EM; joint EPA, DOE and DoD in ITRD (Integrated Technology Research and Deployment); CMST (Characterization, Monitoring and Sensor Technologies). In addition, many of the sites have compiled lists of monitoring methods being used. These lists will be used to determine costs, detection levels, long-term performance, and constraints on deployment.

Prerequisites: Existing lists of monitoring methods

Expected Products/Results: Report detailing existing technologies, costs, detection levels, long-term performance, and constraints on deployment.

Cost: $65,000 Time: 3 mos

Task #2: Identify Gaps

R&D Phase: N/A

Description: Based on site and regulatory input identify critical high priority parameters that need to be monitored. Determine how well these parameters can be monitored with existing technologies or with modifications of existing technologies, and identify parameters that cannot be monitored with existing techniques.

Prerequisites: Inventory of monitoring technologies; high priority parameters from site input and regulatory input; performance of existing monitoring technologies

Expected Products/Results: Gaps that will be identified include upgrades in existing technologies and new technologies that can be developed to measure the high priority parameters.

Cost: $65,000 Time: 3 mos

Task #3: Prioritize technologies by cost/risk/uncertainty for different sites and time frames

R&D Phase: N/A

Description: Use cost and application data from task #1 with the priority lists from task 2 to rank selected technologies for development or upgrading. The prioritization will be based on reduction of cost, risk, and uncertainty for different sites and time frames (e.g. long-term stewardship for early closure sites starting in 2008 and for following closure sites that start in 2030).

Prerequisites: Cost results from task #1, priority parameters from task #2; information on risk and uncertainty related to these parameters for the different sites.

Expected Products/Results: List of prioritized technologies by cost/risk/uncertainty for different sites and time

Task #4 Identify performance requirements

R&D Phase: N/A

Description: Define the metrics and capabilities that are the targets for specific sensor development. Ensure that the upgraded or newly developed technology can meet the performance requirements.

Prerequisites: Results from tasks #1, 2, and 3.

Expected Products/Results: Performance criteria for upgraded or newly developed technologies

Cost: $40,000 Time: 2 mos

Task #5: Develop compelling document for technology development

R&D Phase: N/A

Description: Produce a white paper describing the inventory of existing techniques, the gap analysis, the prioritization, the performance requirements for upgraded and newly developed technology. These technologies address high priority needs of the end users and regulators. Initial analysis of the costs, uncertainty, and risk benefits will be included. In addition, a short succinct presentation will be developed and disseminated that portrays the important aspects of all these components.

Prerequisites: Results from tasks #1, 2, 3, and 4.

Expected Products/Results: White paper and short presentation

Cost: $40,000 Time: 2 mos

Related Capability 1.2: Cnceptual Model for Multimedia
Related Target: Verify conceptual model and adapt monitoring system

Task #1: Examine existing conceptual models at selected sites

R&D Phase: development

Description: Collect information on conceptual models for selected sites that represent a range of GHBC conditions and multimedia pathways. Such information includes the understanding of fate and transport, the predicted performance of the remediation system, and the GHBC framework. Essential are identification of the performance parameters related to the remediation system based on the conceptual model and their predicted values in time if the conceptual model applies. Information on historical changes in the conceptual model will also be collected and performance data in time that may exist.

Prerequisites: Information on current conceptual models, stages, and bases for their development for the selected sites.

Expected Products/Results: Report detailing existing conceptual models and stages and bases.

Cost: $250,000 Time: 1 yr

Task #2: Identify knowledge gaps

R&D Phase: N/A

Description: Based on knowledge of current conceptual models identify gaps in the conceptual model. Examine conceptual models developed by other industries to determine gaps in conceptual models at the sites. For example the petroleum industry has been very successful in incorporating soft geologic information on depositional systems into conceptual models of oil fields to enhance production.

Expected Products/Results: Gaps in conceptual models will be identified for sites that represent different GHBC and media.

Cost: $125,000 Time: 6 mos

Task #3: Apply sensitivity analyses to conceptual models

R&D Phase: development

Description: Conduct sensitivity analyses on conceptual models relative to risk and uncertainty. Sensitivity analyses will use existing numerical models developed for the selected sites. Parameters and processes will be evaluated on the basis of the greatest reduction in risk and uncertainty due to better understanding of process or better measurement of parameters. In addition, examine how new advances in technology can affect high impact parameters and processes. Determine how detailed conceptual models developed under basic and applied science in DOE programs or other programs (e.g NABIR program, Nuclear Regulatory Commission natural analog studies, Petroleum Industry studies) can be applied to DOE sites under remediation or being closed.

Prerequisites: Understanding of risk and uncertainty, knowledge of detailed conceptual models from basic and applied science programs and other relevant programs.

Expected Products/Results: Identification of parameters and processes with highest impact on uncertainty and risk.

Task #4 Validate the conceptual model

R&D Phase: development

Description: Use existing monitoring data to evaluate the performance of the conceptual models. Additional monitoring data may be required to monitor critical parameters and processes identified in the sensitivity studies.

Prerequisites: Results from tasks #1, 2, and 3. Existing monitoring data collected to date and possibly additional monitoring of parameters and processes identified in sensitivity analyses.

Expected Products/Results: Comparison of monitoring data to predicted performance using current conceptual model

Cost: $500,000 Time: 2 yr

Task #5: Modify/upgrade current conceptual model

R&D Phase: development

Description: Identify sites where current conceptual models do not predict the performance of the remediation system. Modify or upgrade these conceptual models based on results of the sensitivity analyses and the existing monitoring data. Modifications should also incorporate knowledge on conceptual models from research sites.

Prerequisites: Results from tasks #1, 2, 3, and 4.

Expected Products/Results: Modified or upgraded conceptual model.

Cost: $375,000 Time: 1.5 yr

Task #5: Cost/Benefit Analysis

R&D Phase: development

Description: Conduct cost/benefit analysis of modified or upgraded conceptual model relative to reduction of risk and uncertainty. This cost/benefit analysis will include complete life-cycle costs (incorporating closure and long-term stewardship).

Prerequisites: Cost/benefit data related to modified or upgraded conceptual models; predicted closure and long-term stewardship costs.

Expected Products/Results: Cost/Benefit analysis for modified or upgraded conceptual models

Cost: $125,000 Time: 0.5 yr

Task #6: Produce Guidance Document

R&D Phase: development

Description: Develop guidance document outlining how to modify or upgrade existing conceptual models based on monitoring data and results from research sites. Case studies should be described for different GHBC sites and different exposure pathways. Direct design of long-term monitoring systems to allow adaptation to changes in conceptual models. The guidance document should also include regulatory input to long-term stewardship monitoring systems and outline regular review of such systems.

Prerequisites: Regulatory input, regulatory acceptance, information for case studies.

Expected Products/Results: Guidance document

Cost: $250,000 Time: 1 yr

Activity 2: Design and Emplace Monitoring Systems

Related Capability 2.x:

Related Target: Review and compare design of current monitoring systems and emplacement strategies to identify gaps and areas for improvements in cost and performance

Task #1: Inventory current monitoring-system design and emplacement methods for all pathways

R&D Phase: N/A

Description: Collection and study of existing approaches for design and emplacement of monitoring systems for air, surface water, vadose zone, groundwater, and manmade structures. Information can likely be initially obtained from (1) web pages of the EPA Technology Innovation Office, DOE EM Office of Science and Technology and others. Information also can be collected from the peer-reviewed literature. This information will be analyzed to determine costs, performance, and constraints on deployment for the various approaches currently being utilized.

Prerequisites: Access to peer-reviewed literature and internet to perform information searches

Expected Products/Results: Report detailing current approaches, including an analysis of performance and costs for each method.

Cost: $60,000 Time: 4 mos

Task #2: Identify Gaps

R&D Phase: N/A

Description: Based on site and regulatory input, identify critical gaps where new approaches could add significant value to the performance and cost of the monitoring systems. These gaps can then be evaluated to identify R&D opportunities.

Prerequisites: Inventory of current methods for design and emplacement of monitoring systems. Access to DOE sites and regulators to obtain feedback on gaps.

Expected Products/Results: Report identifying R&D opportunities based upon gap analysis

Cost: $70,000 Time: 5 mos

Task #3: Prioritize opportunities by cost/risk/uncertainty for different sites and time frames

R&D Phase: N/A

Description: Use cost and application data from task #1 with the opportunities identified in task 2 to rank opportunities for development or upgrading. The prioritization will be based on reduction of cost, risk, and uncertainty for different sites and time frames (e.g. long-term stewardship for early closure sites starting in 2008 and for following closure sites that start in 2030).

Prerequisites: Cost results from task #1, opportunities from task #2, information on risk and uncertainty related to these parameters for the different sites.

Expected Products/Results: List of prioritized R&D opportunities by cost/risk/uncertainty for different sites and time

Cost: $20,000 Time: 1 month

Task #4 Identify performance requirements

R&D Phase: N/A

Description: Define the metrics and capabilities that are the targets for monitoring system design and emplacement advances. Ensure that the upgraded or newly developed capability can meet the performance requirements.

Prerequisites: Results from tasks #1, 2, and 3.

Expected Products/Results: Performance criteria for upgraded or newly developed methods or approaches

Cost: $20,000 Time: 1 mos

Task #5: Develop compelling document for technology development

R&D Phase: N/A

Description: Produce a white paper describing the inventory of existing techniques, the gap analysis, the prioritization, performance requirements for upgraded and newly developed methods. Initial analysis of the costs, uncertainty, and risk benefits will be included. In addition, a short succinct presentation that portrays the important aspects of all these components will be developed and disseminated.

Prerequisites: Results from tasks #1, 2, 3, and 4.

Expected Products/Results: White paper and short presentation

Cost: $40,000 Time: 2 mos

Task #6: Support R&D for Optimization of System Design and Emplacement

R&D Phase: N/A

Description: Prepare request for proposals. Review and select proposals for funded R&D projects that target optimization of design and emplacement for monitoring systems.

Prerequisites: Task 5 white paper

Expected Products/Results: New approaches and technologies for design and emplacement of monitoring systems

Cost: $5M Time: 5 years

Related Capability 2.X:
Related Target: Identify and test five surrogates that could be used to track high-risk contaminants

Task #1: Inventory current approaches to the use of surrogates for all pathways

R&D Phase: N/A

Description: Collection and study of existing approaches utilizing surrogates for monitoring air, surface water, vadose zone, groundwater, and manmade structures. Information can likely be initially obtained by performing research on the Internet and looking at the peer-reviewed literature. This information will be analyzed to determine costs, performance, and constraints on deployment for the various approaches currently being utilized.

Prerequisites: Access to the Internet and peer-reviewed literature

Expected Products/Results: Report detailing current approaches, including an analysis of performance and costs for each method.

Cost: $55,000 Time: 2 mos

Task #2: Identify Opportunities

R&D Phase: N/A

Description: Based on site and regulatory input, identify opportunities for research and demonstration of new surrogates.

Prerequisites: Inventory of current methods for surrogate analyses and access to DOE sites and regulators to obtain feedback

Expected Products/Results: Report identifying R&D opportunities for surrogate parameters

Cost: $65,000 Time: 4 mos

Task #3: Prioritize opportunities by cost/risk/uncertainty

R&D Phase: N/A

Description: Use cost and application data from task #1 with the opportunities identified in task 2 to rank opportunities for development or upgrading. The prioritization will be based on reduction of cost, risk, and uncertainty

Prerequisites: Cost results from task #1, opportunities from task #2, information on risk and uncertainty related to these parameters for the different sites.

Expected Products/Results: List of prioritized R&D opportunities by cost/risk/uncertainty for different sites and time

Cost: $20,000 Time: 1 month

Task #4 Identify performance requirements

R&D Phase: N/A

Description: Define the metrics and capabilities that are the targets for the surrogate analyses. Critical input from regulatory staff will be required to ensure that they are comfortable with the demonstration of new approaches and have provided input as to performance requirements.

Prerequisites: Results from tasks #1, 2, and 3.

Expected Products/Results: Performance criteria for upgraded or newly developed methods or approaches

Cost: $30,000 Time: 2 mos

Task #5: Develop compelling document for surrogate technology development

R&D Phase: N/A

Description: Produce a white paper describing the inventory of existing techniques, the gap analysis, the prioritization, performance requirements for newly developed methods. Initial analysis of the costs, uncertainty, and risk benefits will be included. In addition, a short succinct presentation that portrays the important aspects of all these components will be developed and disseminated.

Prerequisites: Results from tasks #1, 2, 3, and 4

Expected Products/Results: White paper and short presentation

Cost: $40,000 Time: 2 mos

Task #6: Conduct surrogate research and development

R&D Phase: N/A

Description: Prepare a targeted call for proposals and select projects focused on identification and testing of a minimum of five new surrogates that meet the requirements of Tasks 4 and 5. Review and select proposals for funding. Track R&D.

Prerequisites: Results from tasks #1, 2, 3, and 4

Expected Products/Results: Proven surrogates that can be proposed to the regulators for long-term stewardship of a site

Cost: $4.0 M Time: 5 years

Related Capability 2.X:
Related Target: Design state-of-the-art monitoring system that incorporates accessibility, repairability, and upgradeability for a facility/operable unit at Rocky Flats or an Ohio site.

Task #1: Identify facility/operable unit at Rocky Flats or Ohio for design of state-of-the-art monitoring system

R&D Phase: N/A

Description: Review long-term monitoring needs and schedules for facilities/operable units at Rocky Flats and Ohio sites and work with sites to identify one facility for design of state-of-the-art system

Prerequisites: Access to Rocky Flats and Ohio site information

Expected Products/Results: Selected facility for design of state-of-the-art system

Cost: $25K Time: 2 months

Task #2: Define monitoring needs for the state-of-the-art monitoring system and current approaches

R&D Phase: N/A

Description: Work with the particular site personnel to define the monitoring needs for the system. Collect information on existing approaches for monitoring the media required for the specific facility for which the system is being designed. Information on current approaches can likely be initially obtained on the Internet and in the peer-reviewed literature. This information will be analyzed to determine opportunities for optimization.

Prerequisites: Access to the Internet and peer-reviewed literature
Expected Products/Results: Report detailing current approaches, including an analysis of performance and costs for each method.

Cost: $25,000 Time: 2 mos

Task #2: Design, emplace, and test state-of-the-art monitoring system

R&D Phase: N/A

Description: Working closely with site personnel and associated regulators design and emplace a state-of-the-art monitoring system

Prerequisites: Inventory of current methods and documents detailing opportunities for optimization

Expected Products/Results: In-the-field, operable monitoring system

Cost: $200,000 Time: 8 mos

Related Capability 2.X:
Related Target: Develop guidance document on design and emplacement of monitoring systems for a broad spectrum of sites where waste is left in place

Task #1: Gather information from inventory and gap analysis of current monitoring-system design and emplacement methods for all pathways

R&D Phase: N/A

Description: Analysis of existing approaches and gaps for design and emplacement of monitoring systems for all pathways in terms of costs, performance, and constraints on deployment will be conducted to begin preparation of guidance document.

Prerequisites: Inventory and gap analysis of current monitoring system design and emplacement methods for all pathways

Expected Products/Results: Letter report detailing types of information available to utilize for preparation of guidance document

Cost: $30,000 Time: 2 mos

Task #2: Develop guidance based on lessons learned

R&D Phase: N/A

Description: Lessons learned will be obtained and analyzed from information identified in task 1.

Prerequisites: Inventory of current methods and gap analysis for design and emplacement of monitoring systems.

Expected Products/Results: Guidance Document on Design and Emplacement of Monitoring Systems

Cost: $125,000 Time: 12 mos

Task #3: Obtain approvals and endorsements

R&D Phase: N/A

Description: During preparation of guidance document, work closely with all stakeholders to ensure their acceptance of the proposed guidance. After document is completed, obtain their approvals and endorsements for the finished product.

Prerequisites: Access to all stakeholders

Expected Products/Results: Endorsement of guidance document

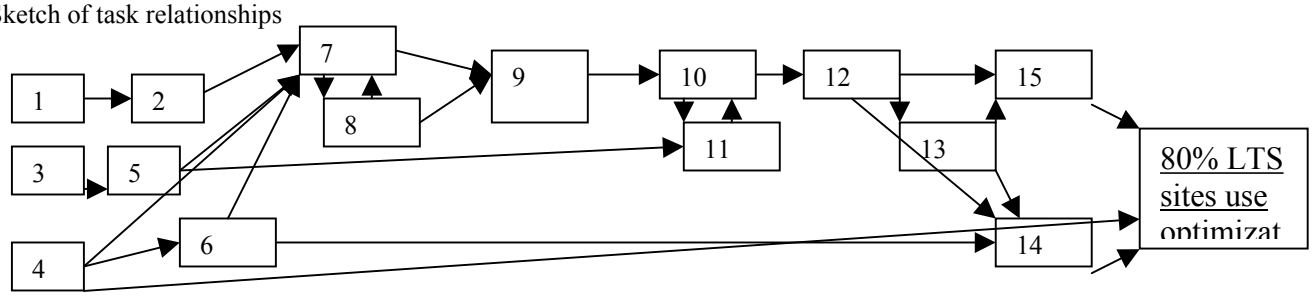
Cost: $40,000 Time: 8 months

Activity 3 :Optimizing sampling networks

Related Capability: 3.1: Design and Emplace Monitoring System

Related Target(s): 80% of LTS sites use optimization strategies

Sketch of task relationships



Task # 1 Review and inventory existing approaches and perform gap analysis for all pathways

RD&D Phase __N/A_____
Est. duration (months) 9____
Est. Cost ($K) 200___

Description: Review literature on approaches to design of optimal monitoring systems for each pathway. This includes EPA, DOE and DOD reports and lists. Identify gaps

Prerequisites: None

Expected Products/Results: Report that describes current approaches for various pathways and gap analysis to focus R&D efforts.

Task # 2 Identify media that require monitoring at LTS sites

RD&D Phase __N/A_____
Est. duration (months) ___6____
Est. Cost ($K) ___150_____

Description: For each LTS site, identify various pathways that will require monitoring system. This will include building and other man-made structures. The process will use both interview of site personnel and review of existing documentation.

Prerequisites: None

Expected Products/Results: Report providing important pathways for each site. This report will focus R&D activities

Task # 3 Examine existing long-term monitoring data

RD&D Phase __RD_____
Est. duration (months) __18_____
Est. Cost ($K) ___1000_____

Description: Data are available for most DOE sites from environmental surveillance and field experiments that can support monitoring system design. These data will be reviewed and analyzed to provide an initial basis for designing optimal monitoring systems.

Prerequisites: None

Expected Products/Results: A database and report with results of data analysis to support optimal monitoring system design and guide R&D efforts for future work.

Task # 4 Build support for optimal monitoring systems among sites and stakeholders

RD&D Phase __N/A_____
Est. duration (months) _114_____
Est. Cost ($K) _1000_

Description: This task will present and explain the optimizing approach to users, the public and regulators so that its approach and assumptions are understood. This task will last the duration of the project, as interactions are necessary at times when information is available.

Prerequisites: Optimized system is under development

Expected Products/Results: _Reports on results of interactions and needed changes to protocols or research

Task # 5 Obtain site input

RD&D Phase RD_____
Est. duration (months) 6_____
Est. Cost ($K) _100_____

Description: As optimized systems are developed then input from site operators is needed on approaches, assumptions, and models.

Prerequisites: Information on site pathways (Task 2) and optimization approaches

Expected Products/Results: Report with feedback from sites on approaches that will direct further R&D.

Task # 6 Invite regulator comment

RD&D Phase ___RD_____
Est. duration (months) _6_____
Est. Cost ($K) 100/site_____

Description: Regulators, both state and federal, will need to be informed of the optimal monitoring system approach and they can provide regulatory requirements in addition to expressing their concerns about the approach.

Prerequisites: Identify media at sites and optimal sampling approaches.

Expected Products/Results: Reports with regulator feedback so that R&D can be focused.

Task # 7 Perform research based on gap analysis by media

RD&D Phase _____RD_____

Est. duration (months) ___36__
Est. Cost ($K) __4000___

Description: _This task will perform research to address gaps. New or modified approaches will be developed for each pathway including building and other infrastructure. Bayesian methods will be developed to allow for updating of sampling scheme and conceptual model.

Prerequisites: Review of existing approaches and gap analysis (Task 1) site information (Task 2)

Expected Products/Results: Technologies including software will be developed to support design of optimized monitoring networks by media.

Task # 8 Modeling studies

RD&D Phase __RD_____
Est. duration (months) __18_____
Est. Cost ($K) _1125_____

Description: Initial studies of effectiveness of optimized monitoring systems will be performed using modeling or synthetic studies. Various cases will be used to test the optimization algorithm by providing a subset or sampled data component and evaluate the performance of the optimization approach. Comparisons with an actual model generated field will provide the basis for the tests.
Prerequisites: _R&D to develop optimization algorithm (Task 7)

Expected Products/Results: Report on effectiveness of optimization approach with feedback to R&D tasks on improvements in performance needed. Initial; demonstration of cost effectiveness and regulatory acceptance.

Task # 9 Develop Standard Protocols and Tools

RD&D Phase _D_____
Est. duration (months) _12_____
Est. Cost ($K) __1000_____

Description: For each optimization algorithm, a tool will be developed for filed application. The tool will have a user interface and be checked for quality assurance. A guide or manual to apply the code will be developed.

Prerequisites: Optimization tools that have been developed, tested and are ready for field application.
Expected Products/Results: A set of computer codes, procedures and user's manuals will be generated.

Task # 10 Design site specific strategies for optimization

RD&D Phase __D_____
Est. duration (months) __12_____
Est. Cost ($K) __250/site_____

Description: Work with sites to implement optimization tools. Identify requirements and media. Interact with site personnel and regulators.

Prerequisites: Complete optimization tools tests. Site conceptual model.

Expected Products/Results: An optimized monitoring network for a given LTS will be generated.

Task # 11 Consider site conceptual model

RD&D Phase D_____
Est. duration (months) ____6___
Est. Cost ($K) ___50/site_____

Description: The design of an optimized monitoring network will require a conceptual model for the sampled pathways. This task will work with site personnel to obtain the most recent conceptual model.

Prerequisites: Optimized monitoring network protocol. Selected site.

Expected Products/Results: Report defining site conceptual model and parameter values to support design of optimized network.

Task # 12 Demonstrate optimized monitoring network

RD&D Phase __D_____
Est. duration (months) __24_____
Est. Cost ($K) __250/site_____

Description: Implement the selected design at LTS sites. Site personnel will do data collection and management. Analysis of monitoring system performance and tests of monitoring system using tracers will be performed. Calibrate monitoring system, as data are available.

Prerequisites: Monitoring system installed.

Expected Products/Results: Report providing results of test and monitoring system performance.

Task # 13 Present data and beneficial impacts

RD&D Phase ___D_____
Est. duration (months) _6_____
Est. Cost ($K) _125/site_____

Description: Analyze performance of optimized system by comparing to other designs such as grid or judgment based approaches. Present results of analysis to site operators, regulators and public by providing cost figures, technical effectiveness and regulatory requirements.

Prerequisites: Demonstration data set and regulatory requirements.

Expected Products/Results: Report and presentations providing details on how systems performs and meets requirements.

Task # 14 Regulator review and acceptance

RD&D Phase __D_____
Est. duration (months) _12_____
Est. Cost ($K) __100/site_____

Description: Review with regulator the performance of optimized monitoring system to insure that requirements are met and system is acceptable.

Prerequisites: Data from demonstration.

Expected Products/Results: Letter from regulator or administrative authority accepting optimized system and approach for site monitoring.

Task # 15 Market, educate and train sites

RD&D Phase __D_____
Est. duration (months) __18_____
Est. Cost ($K) _250/site_____

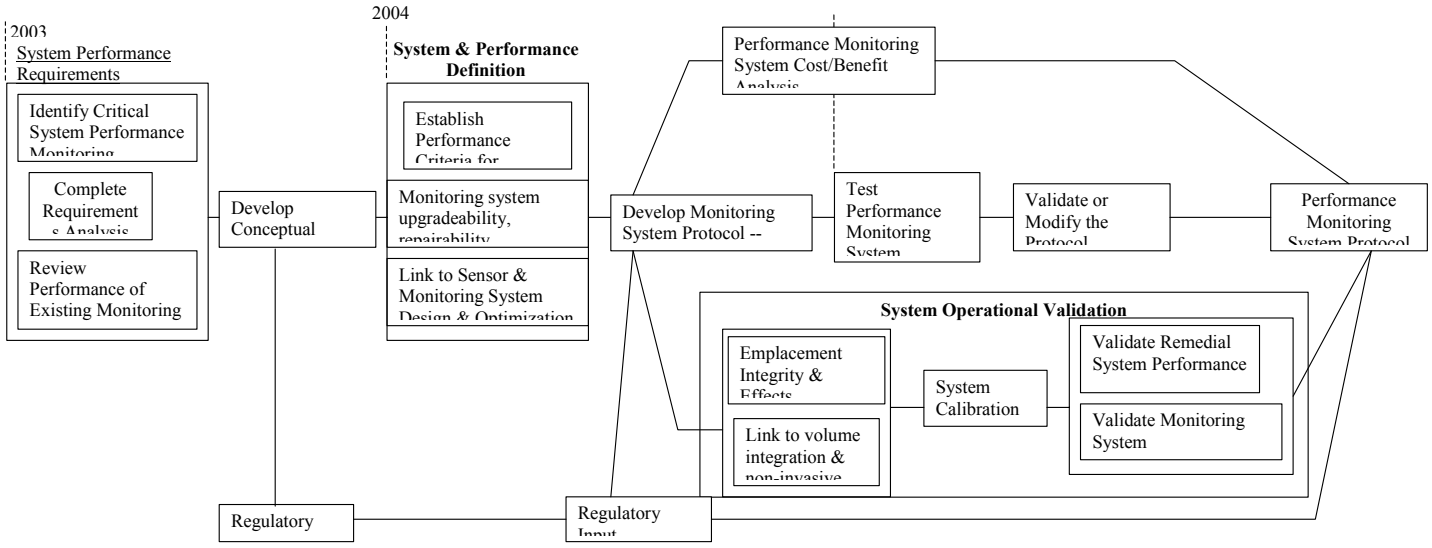
Description: Provide information on cost savings and technical effectiveness of optimized monitoring network for marketing purposes. Train site personnel on approach and tools. Educate public and stakeholders on advantages and disadvantages of system.

Prerequisites: Completed tools and regulatory acceptance. Results of cost analyses.

Expected Products/Results: Software and manuals for use, training records, and site acceptance and implementation of approach.

Activity 4: Operations and Systems Performance

Related Capability Validate System Performance
Related Targets Issue first draft of Guidance for System Performance Validation by 2005 and Field Performance Monitoring System Validation Protocol by 2008.



System Performance Requirements Assessment

Task #1: Complete Requirements Analysis

R&D Phase: N/A
Description: Collect information on remedial system performance impacting compliance to remedial goal and objectives. Information should span the following categories; regulatory – stakeholder requirements and expectations, remedial system life-cycle processes, contaminant – waste layer interaction cycle with the remedial system, multimedia interfaces, and performance monitoring system deployment objectives and transition to stewardship. Assess the information collected to bound system performance requirements.
Prerequisites: Information on remedial system designs and formulation, and regulatory – stakeholder requirements and expectations.
Expected Product/Result: Report detailing the information category assessment results, identify supporting information categories and technical requirements, highlight information/requirement gaps, and formulate bounded system performance requirements to transition to stewardship.
Cost: $75K Task Duration: 0.5 yr.

Task #2: Review Performance Existing Monitoring Systems and Sensors

R&D Phase: N/A
Description: Collect information on existing remedial monitoring systems configurations and performance, and deployed sensor arrays. The information should address the following -- sensor performance and sensitivity, sensor data interface and quality, sensor durability and hardening, monitoring system integration process into the remedial design, and monitoring system deployment and installation sequence. Supporting information as to selection of monitoring parameters and media interface, performance monitoring data processing and evaluation, and operational cost and lesson learned will be collected.
Prerequisites: N/A

Expected Product/Result: Report benchmarking current performance monitoring system applications and formulating a monitoring system matrix depicting monitoring parameters cross referencing to applicable existing sensors, operational cost, data output quality and evaluation process, monitoring system & sensor bounding conditions, and identify monitoring system integration considerations/inputs to the remedial system design.
Cost: $200K Task Duration: 1 yr.

Task #3 Identify Critical Performance Monitoring System Parameters

R&D Phase: Development
Description: In parallel with Tasks #1 & 2, categorize monitoring parameters regarding remedial system life-cycle short-term and long-term consideration, identify parametric bounding conditions regarding media and media interface, system/component failure events, and assess monitoring parametric value influencing risk management decision process.
Expected Product/Result: Report detailing the methodology of determining critical performance monitoring parameters and formulate a matrix of common performance monitoring parameters cross-referenced to media and bounding conditions based on remedial system application/configuration.
Cost: $75K Task Duration: 0.5 yr.

Task #4 Develop Conceptual Model/Monitoring System

R&D Phase: Development
Description: Based on the information collected, develop conceptual monitoring system configurations based on remedial system applications. The conceptual monitoring system configuration will incorporate remedial system life-cycle processes and data evaluation methodologies to validate overall remedial system performance.
Expected Product/Result: Conceptual model depicting performance monitoring system configurations based on remedial system applications.
Cost: $75K Task Duration: 0.5 yr.

Task #5 Regulatory Input for Conceptual Model

R&D Phase: N/A
Description: Regulatory input and review of the task development and supporting task in formulating the conceptual model depicting performance monitoring system configurations based on remedial system applications.
Expected Product/Result: Regulatory concurrence with conceptual model for performance monitoring system configurations based on remedial system applications.
Cost: $10K Task Duration: 0.25 yr.

System & Performance Definition

Task #6 Establish Performance Criteria for Success for Sensors

R&D Phase: Development
Description: Utilizing the Conceptual Model results (Task #4) and results from System Performance Requirements Assessment (Tasks # 1 – 3), develop criteria for success methodology for selecting appropriate sensor to address monitoring system requirements and bounding conditions based on the remedial system application. Attributes for sensor selection should touch the following areas – operability, deployment sequence and QC measures, data out-put and quality, reparability, upgradability, retreviability, and performance sustainability.
Expected Product/Result: Develop criteria for success methodology for selecting appropriate sensor.
Cost: $50K Task Duration: 0.5 yr.

Task #7 Establish Performance Criteria for Success for Monitoring System

R&D Phase: Development
Description: Utilizing the Conceptual Model results (Task #4) and results from System Performance Requirements Assessment (Tasks # 1 – 3), develop criteria for success methodology for selecting an appropriate performance monitoring system. Attributes for monitoring system composition should touch the following areas – operability, deployment sequence and QC measures, sensor mix, data out-put and quality, reparability, upgradability, retreviability, and performance sustainability.
Expected Product/Result: Develop criteria for success methodology for selecting an appropriate performance monitoring system.
Cost: $50K Task Duration: 0.5 yr.

Task #8 Linking Sensor & Monitoring System Design and Performance Optimization

R&D Phase: N/A
Description: Utilizing the information complied in Tasks 6 & 7, identify system optimization points based on the remedial system life-cycle processes.
Expected Product/Result: Identify performance monitoring system optimization points.
Cost: $20K Task Duration: 0.25 yr.

Task #9 Develop Performance Monitoring System Protocol – Framework

R&D Phase: Development
Description: Utilizing the information complied in Tasks 1 -- 8, formulate the performance monitoring system protocol. This protocol provides the methodology to validate and the quality assurance means for the overall remedial system performance.
Expected Product/Result: Performance monitoring system protocol.
Cost: $200K Task Duration: 1 yr.

Task #10 Regulatory Input for Performance Monitoring System Protocol

R&D Phase: N/A
Description: Regulatory input and review of the task development and supporting tasks in formulating the Performance Monitoring System Protocol.
Expected Product/Result: Regulatory concurrence with Performance Monitoring System Protocol.
Cost: $10K Task Duration: 0.5 yr.

Task #11 Test Performance Monitoring System Protocol at a Closure Site

R&D Phase: Deployment
Description: Field Performance Monitoring System Protocol at a Closure Site – Rocky Flats, Fernald, Mound, or Astubula.
Expected Product/Result: Field Performance Monitoring System Protocol at a Closure Site by 2005. Optimal fielding scenario is to have at least two fielding in different regional climate settings. This effort would help bracket protocol results.
Cost: $200K Task Duration: 0.5 yr.

Task #12 Performance Monitoring System Cost/Benefit Analysis

R&D Phase: Development

Description: Evaluate benefits and cost impacts for applying a performance monitoring system and validation sequence into a remedial design. The validation sequence is focused on providing the quality assurance measure of the overall remedial system in-place.
Expected Product/Result: Develop Performance Monitoring Cost Model
Cost: $50K Task Duration: 0.75 yr.

System Operational Validation

Task #13 Sensor and Monitoring System Emplacement Integrity & Effects

R&D Phase Development
Description: Develop evaluation methodology to assess sensor/system emplacement and start-up sequencing for remedial system configurations and duration. The start-up sequencing provides the broadening factors to link point source measurement to aerial & volume measurements of the system. The evaluation methodology will incorporate non-invasive methods to discriminate sensor/system effects due to installation verses overall remedial system performance.
Expected Product/Result: Develop evaluation methodology to assess sensor/system emplacement and start-up sequencing.
Cost: $50K Task Duration: 0.75 yr.

Task #14 Monitoring System Calibration

R&D Phase Development
Description: Develop evaluation methodology to assess sensor/system emplacement and start-up calibration for performance monitoring system configurations. These affects are coupled to Task #13 results.
Expected Product/Result: Develop evaluation methodology to assess sensor/system emplacement and start-up calibration.
Cost: $50K Task Duration: 0.75 yr.

Task #15 Validate Performance Monitoring System Operation & Remedial System Performance

R&D Phase Development
Description: Operational fielding of the methodology developed in Tasks #13 & #14. Results from these effects are linked to Task #16 and system optimization activities.
Expected Product/Result: Operational fielding of the methodology developed in Tasks #13 & #14.
Cost: $50K Task Duration: 0.75 yr.

Task #16 Validate/Modify the Protocol

R&D Phase Development
Description: Operational fielding of the methodology developed in Tasks #12 - #15. Operational fielding should be focused on at least seasonal cycle and preferably two cycles to validate results. Regulatory input/interactions to concur with conclusions and/or modification based on field performance data (Tasks #11 - #15).
Expected Product/Result: Performance monitoring system data set to validate performance monitoring system application.
Cost: $400K Task Duration: 3 yrs.

Task #17 Performance Monitoring System Validation Protocol Fielding

R&D Phase Development

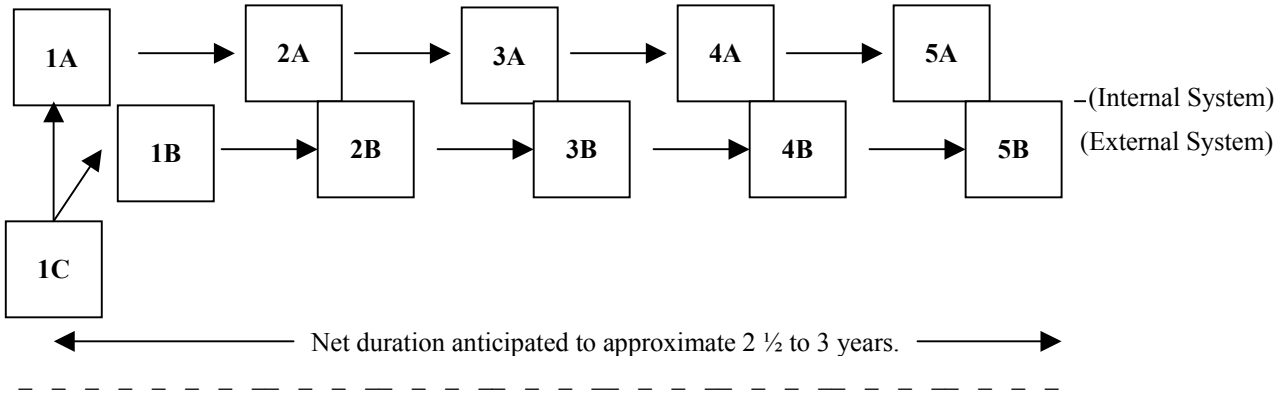
Description: Consolidation from the results developed in Tasks #1 - #15 to establish boundary conditions and scaling factors for monitoring system application. Protocol framework provides the methodology for the remedial system designer to incorporate system validation measures. Regulatory review and approval/acceptance of the protocol is key to fielding.
Expected Product/Result: Performance monitoring system validation protocol for monitoring system application.
Cost: $75K Task Duration: 0.5 yrs.

Activity 5: Information Management and Communication

Related Target: To have a mature, functional, web-based Information Management and Communication Systems in place at all Long-Term Stewardship sites across the DOE complex. Each system is to consist of two principle parts: 1) an internal communications system designed to accommodate data storage, data validation, user access, information dissemination, and visualization to be used primarily by site personnel and facilitate their communication with Headquarters and Regulators; and 2) an external communications system designed to facilitate Public Outreach and Education.

Current Maturity Level: Mature (Green). No additional RD&D is considered necessary to implement the proposed system at Long-Term Stewardship sites.

Sketch of task relationships



Task # 1A

Maturity Level: Mature (Green)
Est. duration (months) ___6_
Est. Cost ($K) _____

Description: COMPLETE A REQUIREMENTS ANALYSIS to guide the design of the Information Management and Communications System (internal). It is anticipated that establishing the Information Management and Communication System will be primarily a DOE Headquarters function, in that the systems established at all Long-Term Stewardship sites should be of comparable quality, layout, design, and performance. Communication with each of the involved sites, their regulatory agencies, and public advisory boards (1C), should be conducted to ensure that site-specific needs can be accommodated.

Prerequisites: No prerequisites are considered necessary.

Expected Products/Results: Completion of a Requirements Analysis will identify the entire suite of site-specific issues that will need to be incorporated into the design of the complex-wide Information Management and Communication System.

Task # 2A

Maturity Level: Mature (Green)
Est. duration (months) __12
Est. Cost ($K) _____

Description: DESIGN AND DEVELOP AN IDEALIZED, GENERIC, COMPLEX-WIDE INFORMATION MANAGEMENT AND COMMUNICATION SYSTEM, fully capable of storing and displaying environmental data and interpretations (raw field data, calculations, maps, conclusions, and projections).

Prerequisites: Completion of the Requirements Analysis (1A).

Expected Products/Results: An Information Management and Communication System that is ready to be implemented at all Long-Term Stewardship sites across the complex.

Task # 3A

Maturity Level: Mature (Green)
Est. duration (months) ___6___
Est. Cost ($K) _____

Description: ESTABLISH PROTOCOLS regarding data entry, usage, and user access.

Prerequisites: Completion of the generic Information Management and Communication System (2A).

Expected Products/Results: Following completion of the generic system design, protocols will need to be established that control and/or limit access to the data and other information contained in the system. It is assumed that site personnel and or program managers will have access to input and/or modify data, while others will be able to access information in a "read-only" format.

Task # 4A

Maturity Level: Mature (Green)
Est. duration (months) ___12____
Est. Cost ($K) _____

Description: TAILOR GENERIC INFORMATION MANAGEMENT AND COMMUNICATION SYSTEM to accommodate site-specific needs.

Prerequisites: Completion of the generic Information Management and Communication System (2A). It is also felt that, to some extent, Tasks 3A and 4A can be and should be completed at the same time, thereby minimizing the total amount of time necessary to develop and implement the system.

Expected Products/Results: An Information Management and Communications System that is both compatible with the complex-wide DOE system and tailored to accommodate site-specific needs.

Task # 5A

Maturity Level: Mature (Green)
Est. duration (months) ___6___
Est. Cost ($K) _____

Description: Implement the Information Management and Communication System at all Long-Term Stewardship sites.

Prerequisites: Completion of the Information Management and Communication System tailored to meet site-specific needs (4A).

Expected Products/Results: A functioning, web-based, upgradeable, complex-wide Information Management and Communication System, fully capable of storing and displaying environmental data and interpretations, that will facilitate effective management of the Long-Term Stewardship Program.

The following sequence of tasks applies to development of the external portion of the Information Management and Communication System, which will consist primarily of Public Outreach and Education. The steps required to develop the Public Outreach and Education portion of the system will of necessity parallel the development of the internal portion of the system. Moreover, it is envisioned that the Information Management and Communication System developed for use by program managers at the sites will form the basis of the system to be used for Public Outreach and Education programs.

Task # 1B

Maturity Level: Mature (Green)
Est. duration (months) ___6____
Est. Cost ($K) _____

Description: COMPLETE A REQUIREMENTS ANALYSIS to guide the design of the Public Outreach and Education portions of the Information Management and Communications System (external). It is anticipated that establishing the Information Management and Communication System will be primarily a DOE Headquarters function, in that the systems established at all Long-Term Stewardship sites should be of comparable quality, layout, design, and performance. Communication with each of the involved sites, their regulatory agencies, and public advisory boards (1C), should be conducted to ensure that site-specific needs can be accommodated.

Prerequisites: No prerequisites are considered necessary.

Expected Products/Results: Completion of a Requirements Analysis will identify the entire suite of site-specific issues that will need to be incorporated into the design of the complex-wide Information Management and Communication System and facilitate development of Public Outreach and Education programs.

Task # 2B

Maturity Level: Mature (Green)
Est. duration (months) __12___
Est. Cost ($K) _____

Description: Design and develop an idealized, generic, complex-wide Information Management and Communication System, fully capable of displaying environmental data and interpretations and supporting a Public Outreach and Education Program.

Prerequisites: Completion of the Requirements Analysis (1B).

Expected Products/Results: A Public Outreach and Education Program that is ready to be implemented at all Long-Term Stewardship sites across the complex.

Task # 3B

Maturity Level: Mature (Green)
Est. duration (months) ___6___
Est. Cost ($K) _____

Description: Establish protocols regarding data entry, usage, and user access.

Prerequisites: Completion of the generic Information Management and Communication System (2B).

Expected Products/Results: Following completion of the generic system design, protocols will need to be established that control and/or limit access to the data and other information contained in the system. It is assumed that, for the purpose of Public Outreach and Education, users will be able to access and manipulate information in a "read-only" format.

Task # 4B

Maturity Level: Mature (Green)
Est. duration (months) ___12____
Est. Cost ($K) _____

Description: Tailor generic Public Outreach and Education Program to accommodate site-specific needs.

Prerequisites: Completion of the generic Information Management and Communication System (2B). It is also felt that, to some extent, Tasks 3B and 4B can be and should be completed at the same time, thereby minimizing the total amount of time necessary to develop and implement the system.

Expected Products/Results: A Public Outreach and Education Program that is both compatible with the complex-wide DOE system and tailored to accommodate site-specific needs.

Task # 5B

Maturity Level: Mature (Green)
Est. duration (months) ___6___
Est. Cost ($K) _____

Description: Implement the Public Outreach and Education Program at all Long-Term Stewardship sites.

Prerequisites: Completion of the Information Management and Communication System tailored to meet site-specific needs (4B).

Expected Products/Results: A functioning, web-based, upgradeable, complex-wide Public Outreach and Education Program, fully capable of storing and displaying environmental data and interpretations, that will facilitate effective communication of the Long-Term Stewardship Program to the public.

Task # 1C

Maturity Level: Mature (Green)
Est. duration (months) ___6____
Est. Cost ($K) _____

Description: Solicit Site and Regulatory input into the design of the system.

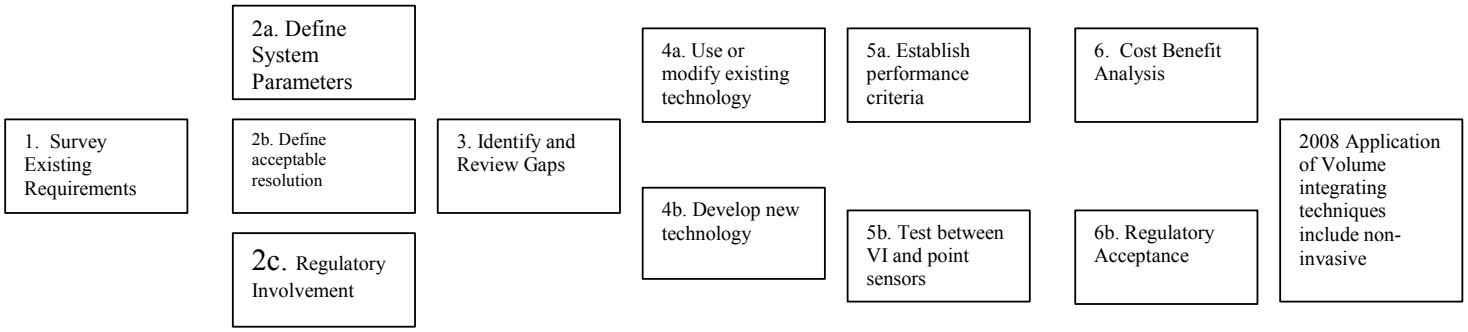
Prerequisites: No prerequisites are considered necessary.

Expected Products/Results: Input from all Long-Term Stewardship sites and their regulators should be used to facilitate the development of the Information Management and Communications System.

Hardware

Related Capability __ Hardware
Related Target(s) __2008 Application of volume integrating (VI) techniques include non-invasive

Sketch of task relationships



Task # 1 Survey existing requirements

RD&D Phase _____
Est. duration (months) ___2____
Est. Cost ($K) _____20 K

Description The goal of task one is to survey the existing requirements that would allow for the utilization of volume integrating techniques that include non-invasive. Existing requirements would include federal, state and local requirements for long term monitoring where sensors can be utilized. In addition, a survey will be conducted of existing DOE facilities to gain an understanding of what types of monitoring technologies are currently utilized to establish the current use of point versus volume integrating techniques and technologies.

Prerequisites
none_____

Expected Products/Results The expected product will be a report which catalogues the type of sensors utilized at current DOE facilities.

Task # 2 Define regulatory involvement, system parameters, and resolution

RD&D Phase _____
Est. duration (months) ____6___
Est. Cost ($K) _____60K_

Description Task 2 aims to define the regulatory involvement, system parameters and resolution for the application of volume integrating techniques. First, a review must be conducted of state and federal regulations that will govern the design of the monitoring approach. Upon reviewing the regulatory requirements, system parameters will be established which can utilize volume integrating techniques. Next, the resolution of the parameters will be established to define how the sensors will measure changes in the parameter in contrast to point sensors that measure absolute values.

Prerequisites

Expected Products/Results ___This task will produce a report on the potential application of volume integrating techniques at DOE facilities.

Task # 3 Identify and Review Gaps

RD&D Phase _____
Est. duration (months) __4_____
Est. Cost ($K) _____40 K

Description Task 3 aims to identify and review gaps in the design, development, implementation, and assessment of volume integrated sensors. This task will analyze the current use of volume integrating techniques, determine the state of art in volume integrating techniques, and determine where and how it can be incorporated. In addition, this task will outline the research needs.

Prerequisites ___Task 1 and 2.

Expected Products/Results A report will be generated that outlines the state of the art for existing technologies, current uses, and research needs for volume integrating techniques and technologies. In addition, an RFP will be developed for task 4.

Task # 4 Use existing, modify existing or develop new technologies

RD&D Phase _____
Est. duration (months) _24-36_____
Est. Cost ($K) 5,000-6,000 K

Description __The goal of task 4 is to utilize existing, modify existing or develop new technologies that utilize volume integrating techniques. Applied research will be conducted to implement existing technologies and to modify existing technologies to utilize volume integrating techniques. In addition, basic research will be conducted to develop new volume integrating techniques for application. (Note: modification and implementation of existing sensors should take two years where the development on new technologies will take 3 years).

Prerequisites ___The request for proposals and Task 1-3 must be developed.

Expected Products/Results __The expected results include the development of new technologies, application of existing technologies, and modification of existing techniques.

Task # 5 Establish performance criteria and test difference between VI and Point sensors

RD&D Phase _____
Est. duration (months) __12_____
Est. Cost ($K) ____2000K_____

Description __Task 5 aims to establish performance criteria and test the difference between VI and point sensors. VI sensors will be implemented at DOE sites in conjunction with point sensors. DOE will initiate a field implementation and testing program at various sites to determine the short-term performance of the sensors. Sensors will be monitored for long term (10 years or greater) performance. For existing sensors, at the conclusion of task 5, there will be three years of performance data.

Prerequisites ___The R and D phase in task 4 must be accomplished.

Expected Products/Results Page: The results of this task will include the implementation of existing sensors, modification of existing sensors, and development of new VI sensors.

Task # 6 Cost Benefit and Regulatory Acceptance

RD&D Phase _____
Est. duration (months) _12_____
Est. Cost ($K) _____200K

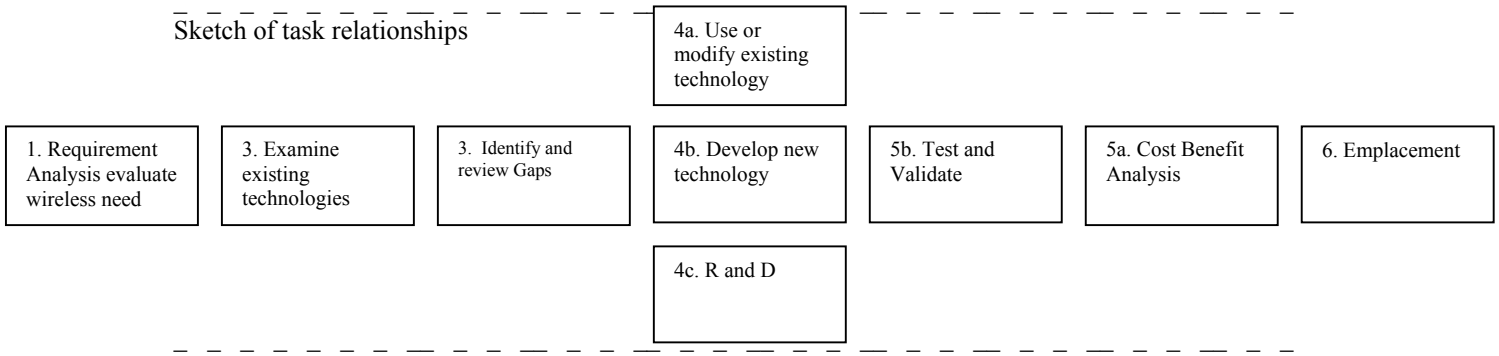
Description ___Task 6 involves developing a cost benefit analysis of the sensor techniques that were developed. CBA will categories the pros and cons of each technique based on performance, applicability, and cost. In addition, regulatory acceptance will be sought. To steward regulatory acceptance, the regulatory community must be involved in the developmental process. To foster regulatory acceptance, members of the regulatory community should be involved in development of Task 1-3.

Prerequisites ___Task 1-5.

Expected Products/Results ____An interagency guidance document will be produced that quantifies the cost-benefits of the different volume integrating techniques and technologies.

Related Capability 10% of the sensor arrays in the field will be delivered wirelessly
Related Target(s) _____

Sketch of task relationships



Task # 1 Requirement Analysis

RD&D Phase _____
Est. duration (months) _3_____
Est. Cost ($K) _____30K____

Description ____Task 1 aims to determine the requirement that will be needed for applying wireless technologies. Task 1 will review the regulatory framework for monitoring by state, local and federal regulators. In addition, task 1 will develop the framework for conducting a technology assessment in task 2.

Prerequisites none

Expected Products/Results __The expected result from task 1 is an outline of the regulatory framework for monitoring techniques.

Task # 2 Examine existing technologies

RD&D Phase _____
Est. duration (months) _6_____
Est. Cost ($K) _____90K____

Description ___Task 2 will examine the state of the art and science for wireless technologies. Task 2 aims to define what technologies are currently available and how have they been utilized. Technologies will be categories according to application, description, developmental state, cost, and feasibility.

Prerequisites: Task 1 framework

Expected Products/Results The expected result is a report that documents wireless technologies.

Task # 3 Identify and review gaps

RD&D Phase _____
Est. duration (months) __3_____
Est. Cost ($K) _____40K_

Description ___Task 3 aims to identify and review gaps in the current state of the art and science in wireless technologies. Wireless technologies will be prioritized with respect to R and D needs. Technologies will be categories with regards to existing, modifications, or developmental.

Prerequisites Task 2

Expected Products/Results _An rfp will be developed from the gap analysis that focuses on applied and basic research.

Task # 4 Use existing, modify existing or develop new technologies

RD&D Phase _____
Est. duration (months) __36_____
Est. Cost ($K) __4000-5000K__

Description __Task 4 aims to utilized existing technology, modify existing technology or develop new technology that use wireless technology. Implementation of existing technology and modification of existing technology will encompass applied research which will be aimed at immediately impacted existing DOE sites. In addition, basic research will be conducted to develop new wireless technologies developed. (Note: modification and implementation of existing sensors should take two years where the development on new technologies will take 3 years). to

Prerequisites ____Task 1-3

Expected Products/Results ___The results of task 4 include the implementation of existing wireless technologies and the development of new wireless sensors.

Task # 5 Test and validate

RD&D Phase _____
Est. duration (months) _12_____

Est. Cost ($K) ___1000K_____

Description _Task 5 aims to test and validate wireless sensors. This task will involve the implementation of wireless sensors into DOE facilities. DOE will initiate a field implementation and testing program at various sites to determine the short-term performance of the sensors. Sensors will be monitored for long term (10 years or greater) performance. For existing sensors, at the conclusion of task 5, there will be three years of performance data.

Prerequisites _____Task 4

Expected Products/Results ____ The results of this task will include the implementation of existing sensors, modification of existing sensors, and development of new sensors.

Task #__6 Cost benefit analysis

RD&D Phase _____
Est. duration (months) ___6____
Est. Cost ($K) ___60_____

Description ___Task 6 aims to develop a cost-benefit analysis of wireless sensors and compare it to existing techniques for transferring data. Cost benefit analysis will compare and contrast wireless sensors to non wireless sensors with regards to cost, performance, and ease of utilization.

Prerequisites _____Task 1-5_____

Expected Products/Results __A document will be developed on the CBA of wireless techniques.

Task #_____6 Emplacement

RD&D Phase _____
Est. duration (months) __12_____
Est. Cost ($K) ____200K_____

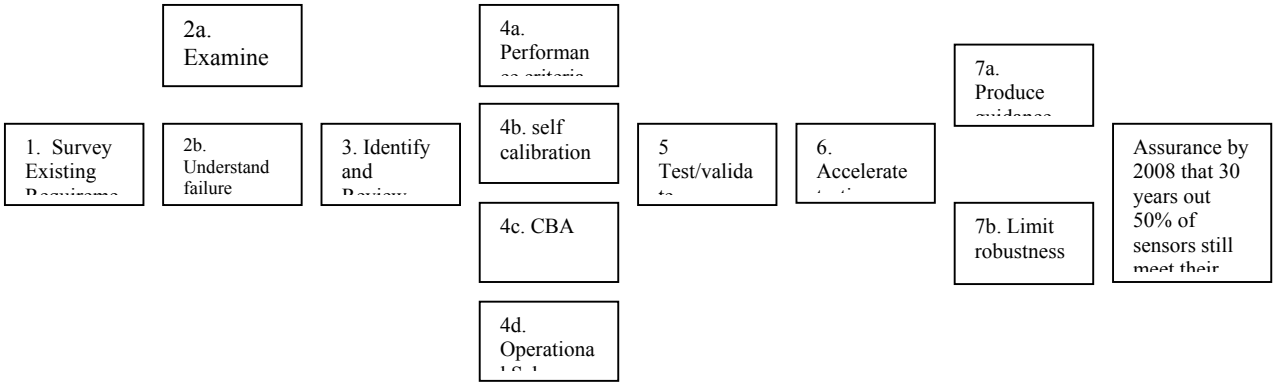
Description _____Task 6 will establish an emplacement guideline and protocol for wireless technologies.

Prerequisites ___Task 1-5

Expected Products/Results _____Guideline

Related Capability Hardware
Related Target(s) Assurance that by 2008 that 30 years out 50% of sensors meet original goal

Sketch of task relationships



Task # 1 Survey existing requirements

RD&D Phase _____
Est. duration (months) __3_____
Est. Cost ($K) ___30K_____

Description The goal of task one is to survey the existing requirements that would assure that 30 years out 50% of the sensors are still meet their original goal. Existing requirements would include federal, state and local requirements for long term monitoring where sensors can be utilized. In addition, a survey will be conducted of existing DOE facilities to gain an understanding of what types of monitoring technologies are currently utilized to establish the current use of techniques and technologies. A framework for assessing failure will be developed.

Prerequisites _____none_

Expected Products/Results _A survey will be developed of existing requirements and currently used techniques and technologies.

Task # 2 Examine existing technologies and establish failure modes

RD&D Phase _____
Est. duration (months) _6_____
Est. Cost ($K) ___100K_____

Description ____ Task 2 will examine the state of the art and science for monitoring technologies. Task 2 aims to define what technologies are currently available and how have they been utilized. Technologies will be categories according to application, description, developmental state, cost, and feasibility. The failure modes, advantages and disadvantages will also be established.

Prerequisites ____task 1

Expected Products/Results __The expected result from task 2 is a document that outlines the failure modes for various monitoring technologies.

Task # _3 Identify and review gaps

RD&D Phase _____
Est. duration (months) 3_____
Est. Cost ($K) ___30_____

Description __ Task 3 aims to identify and review gaps in the current state of the art and science in technologies. Failure modes will be prioritized with respect to R and D needs. Technologies will be categories with regards to existing, modifications, or developmental to reduce long term failure.

Prerequisites

Expected Products/Results ____A document will be developed that outlines the failure modes of monitoring technologies.

Task # 4 Performance, calibration, operational schemes, and CBA

RD&D Phase _____
Est. duration (months) ___18____
Est. Cost ($K) __500K_____

Description __Task 4 aims to develop performance criteria, calibration requirements, operational schemes, and cost benefit analysis for reducing failure of sensor arrays. Performance criteria will be developed by reviewing regulatory requirements, establishing performance goals, and quantifying existing technologies performance data. Calibration requirements for the sensor arrays will also be established where sensor arrays will aim to incorporate self calibrating sensors. Operational schemes and approaches will also be reviewed. Cost benefit analysis will compare and contrast wireless sensors with regards to cost, performance, failure potential, longevity and ease of utilization.

Prerequisites __Task 1-3

Expected Products/Results __A performance assessment document on sensor technology will be developed. A protocol on sensor array configuration and implementation to reduce the risk of sensor failure will also be developed.

Task # 5 Test and validate

RD&D Phase _____
Est. duration (months) _12-36_____
Est. Cost 1000 K

Description __Task 5 will test and validate the implementation of the guidance on reducing failures in sensors. The protocol developed in task 4 will be tested at various DOE facilities.

Prerequisites ____Task 4

Expected Products/Results _____Performance data will be obtained.

Task # 6 Accelerate testing

RD&D Phase _____
Est. duration (months) _12_____
Est. Cost ($K) ___1000K_

Description ____Task 6 will perform accelerated testing on the sensor configurations. Accelerated testing may include increased temperature, gravitational acceleration, or pressure.

Prerequisites ____task 1-5

Expected Products/Results __Predictions of long term performance

Task # 7 Guidance Document

RD&D Phase _____
Est. duration (months) _12_____
Est. Cost ($K) ___200K_____

Description ____ Task 7 will produce a guidance document that outlines performance criteria, the protocol for designing sensor arrays to reduce failure, performance data on sensor array configurations, and cost benefit analysis.

Prerequisites ____

Expected Products/Results __guidance document