Pilot Demonstrations of Innovative Arsenic Treatment Technologies in the Arsenic Water Technology Partnership

New Mexico Environmental Health Conference

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Sandia National Laboratories

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Outline

1. Sandia National Laboratories' Water Initiative
2. Arsenic Treatment Technology Pilot Demonstration Program: objectives, concept, and plans
3. Technology selection criteria used at Vendors Forum
4. Examples of sites considered for initial Pilot Tests
5. Roles and responsibilities for Pilot Tests

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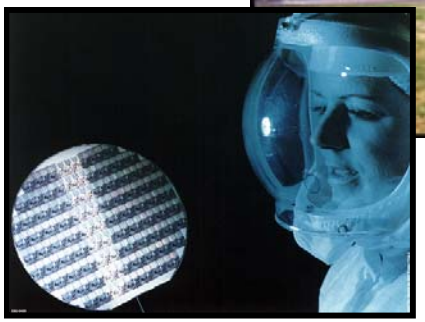
- **Four primary mission areas**

Safety, Security, & Reliability Of Nuclear Weapons

Reduction of Vulnerability to Weapons of Mass Destruction

Safety, Security, & Reliability of Critical Infrastructures

Enhancing National Security Measures



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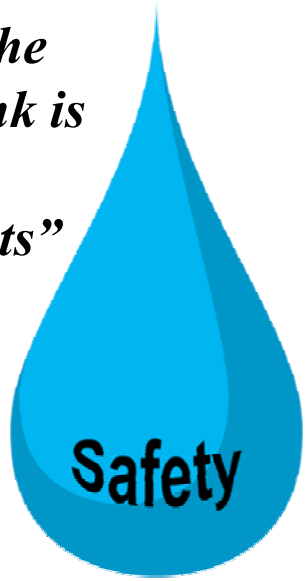
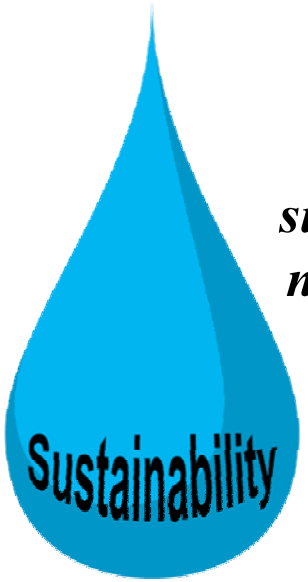
Sandia Water Initiative

"protecting water sources and water distribution systems"

"assuring the water we drink is free of contaminants"





"supplying sufficient water now and in the future"

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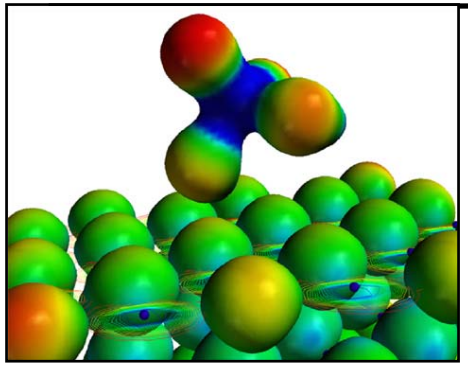
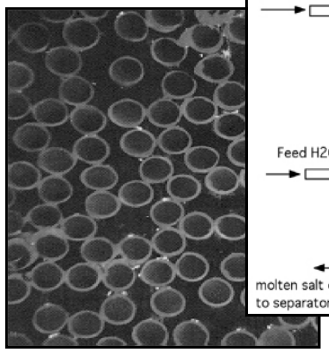
Sandia Water Initiative



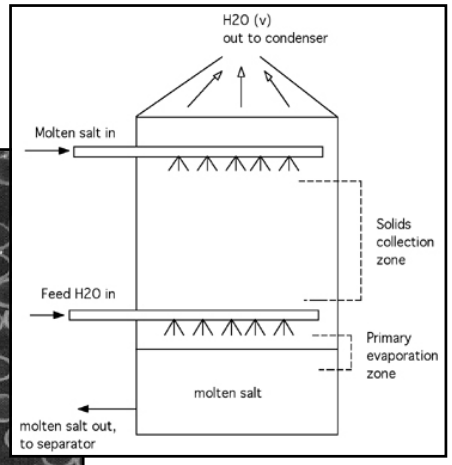
Design of arsenic-specific chemical filter materials

Safety:
Cost-effective contaminant removal technologies

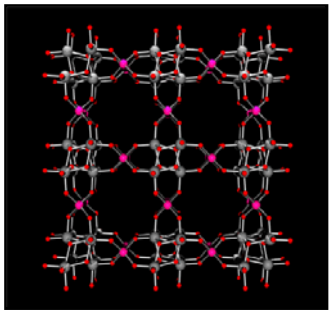
Sustainability:
Next-generation desalination technologies



Pervaporation



Direct contact distillation



In situ crystallization

Integrated chem/bio treatment technologies

Point of use (rather than centralized) treatment technologies

Security:
Future treatment strategies for reducing vulnerability of water infrastructure

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Arsenic Treatment Technology Pilot Demonstration Program Objectives

- **Primary Objective:**
  - Generate cost/performance data for innovative technologies selected through Vendor Forum, WERC contest or AwwaRF bench scale research program
- **Secondary Objectives**
  - Provide methods to reduce Arsenic for selected community
  - Evaluate impacts of treatment costs/facility on community
  - Improve other aspects of water quality where possible through integrated approach

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Pilot Test Concepts

- Side-by-side demonstrations of technologies tested by AwwaRF bench-scale program, WERC design contest or commercial technologies vetted through Vendor Forums
  - Test duration: 3 – 9 months
  - Test size: 0.3 – 10 gpm
  - Different technology classes: adsorptive media, C/F, membranes, softening
- Cooperative effort between Sandia, Technology Owner and Site Owner
- Test Protocols developed with help from NSF, ETV, academia, industry during 2003 - 2004

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Pilot Test Configurations

- Pump house
- Skid Mount or container
- Mobile unit

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Initial Activities (FY2003 – 2004)

- Sponsor activities at New Mexico Environ. Health Conference.
  - Theme session to introduce program
  - Vendors Forum to evaluate commercial technologies
  - Website: http://www.sandia.gov/water/arsenic.htm
- Evaluate sites in NM, CO, AZ, MA, NH, OK
  - Contacts through NM Rural Water Assoc., USGS, State agencies
  - AwwaRF projects that identified exposed sites
- Initial technology deployment at Kirtland AFB

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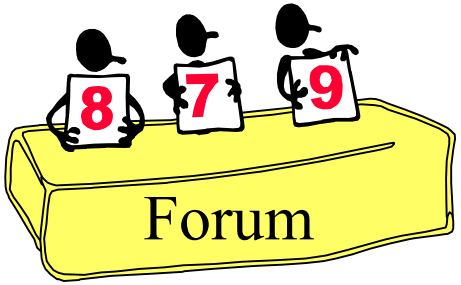
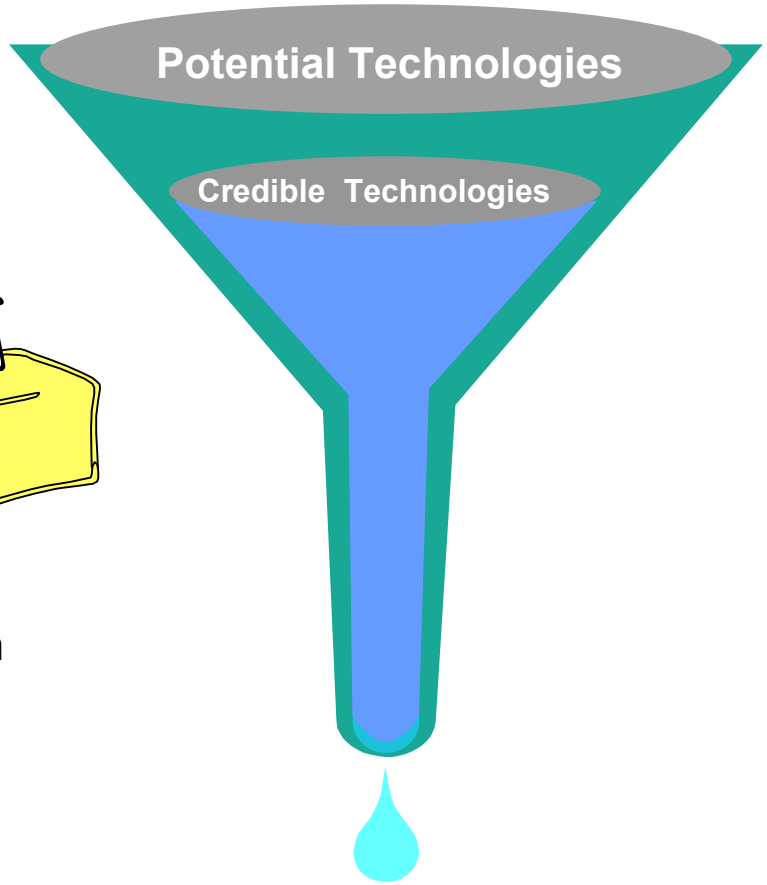
Pilot Technology Evaluation Process



Technical Evaluation Teams



Suggested Pilot Technologies

- Performance
- Cost
- Complexity
- Maturity

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Performance Criteria

- As levels in effluent
- Site-specific adsorptive capacity
- Robustness of performance with respect to possible changes
  - pH, TDS, foulants such as Fe, Mn, silica, and organics
  - competing ions
  - Other metals and radionuclides
- Sources of information:
  - Vendor tests, 3rd party evaluation, AwwaRF, WERC, SNL

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Cost Criteria

- Design/engineering costs
- Initial Capital Costs
- Construction/installation
- Operation & Maintenance
  - Energy requirements and chemical(s) usage
  - Predicted waste generation
  - Pre/post-treatment requirements

Costs will be compared to "baseline" technology.

Complexity and Maturity

- Operation & maintenance requirements
- Training level required by O & M personnel
- ES&H concerns: materials, other hazards
- Package system vs. new construction vs. add-on technology
- How many plants have been installed
- Equipment mass-produced or custom-designed
- Operational and performance record at different sites

Potential Initial Sites

- New Mexico
  - Kirtland AFB
  - Jemez Pueblo
  - Socorro
  - Chama
  - San Ysidro
  - Columbus
  - Placitas
- Other States
  - Norman, OK
  - Salem, NH
  - Alamosa, CO
  - Blackfalls, AZ

Jemez Pueblo, NM

- Single well serves rural mountain village with 3000 water connections
- As levels : 30-40 ppb
- Existing treatment: only chlorination
- Future treatment
    - Arsenic removal
    - High organics content
    - Fe and Mn hardness
    - Example of “piggyback” pilot

Soccoro, NM

- 100% groundwater source for drinking water
- Warm springs (90oF) provide 500 gpm, 20 – 40 ppb As by gravity flow.
- Formerly site of tap for bottled water company

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Chama, NM

- 100% surface water source
- Need GW source for growth (water rights issues)
- Emergency well has 200 ppb As
- Current treatment systems uses coag./filtration
- Opportunity to piggy back on existing system.

Roles and Responsibilities

- AwwaRF
  - Overall program integration
- WERC
  - Economic analysis and tech transfer
- Technology Owner
  - Provides material or technology
- Sandia National Laboratories
  - Funds and oversees test
- Site Owner
  - Assists with test

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Technology Owner

- Provide selected technology or materials
- Provide engineering design, fabrication, operation and follow-on consultation to Sandia National Laboratories and the Site Owner
- Work with Sandia National Laboratories and the site owner to fabricate and install the technology
- Assist with startup phase of pilot demonstration
- Provide guidance and training assistance to WERC and the Site Owner
- Provide O & M manual

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- Provide funding for demonstration including equipment, material and site support.
- Identify appropriate technology (owner) and match to applicable site (owner).
- Prepare specifications including design drawings for submission to regulatory authority for approval of prior to commencement of demonstration;
- Prepare site specific sampling and analysis plan/protocol (with QA & QC measures);
- Fabricate, and install technology in pilot facility with assistance from Technology and Site owners
- Supervise technology startup and conduct sampling.
- Take responsibility for disposal of residuals
- Ship samples to Sandia National Laboratories and EPA certified lab for analysis.

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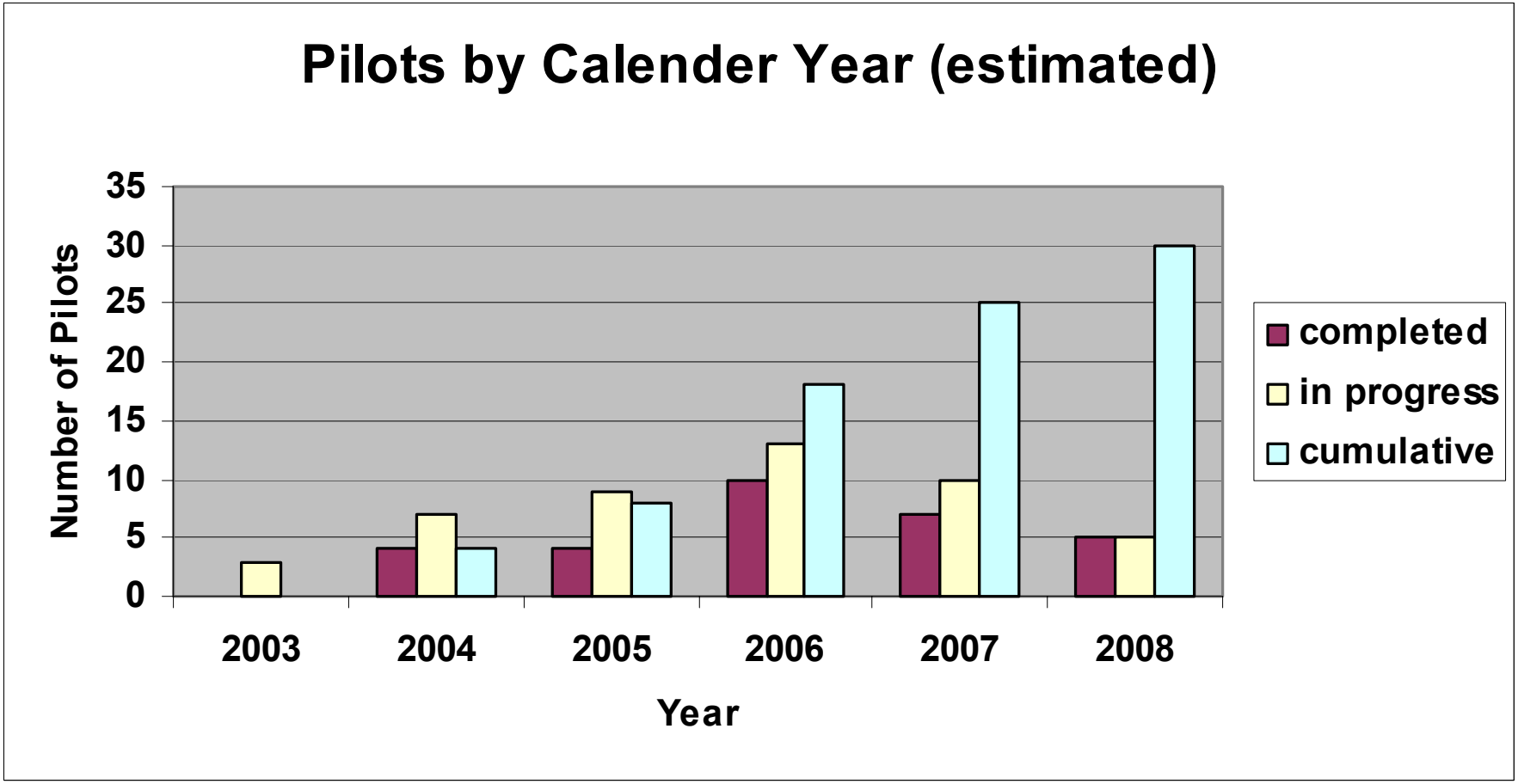
Site Owner

- Daily operation and maintenance per technology-specific O & M manual
- Documentation of operations and maintenance data per Sandia protocol
- Sample collection (Sandia National Laboratories may assist or take primary responsibility.)
- Temporary storage and handling of residuals.
- Disposal of treated effluent

Long Term Program Plan



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Summary

- Project Goal
  - Generate cost/performance data for innovative treatment technologies
  - Side-by-side demonstrations of technologies
- Short-term Activities
  - Vendors Forum to evaluate commercial technologies
  - Evaluate sites in NM, CO and AZ
- Long-term Plans
  - Up to 10 pilots /yr throughout US
  - Improved water quality through integrated approach

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Issues

- Perception that As not harmful at 10 – 50 ppb
- Communities don't have $ to pay for treatment
  - Focus on "punishment" and delays
- Low-level of training and technical expertise
  - Many communities out of compliance with training