EVALUATION OF ON-SITE INSPECTION ACTIVITIES FOR PLANNING AND IMPLEMENTATION

The views expressed here do not necessarily reflect the opinion of the United States Government, the United States Department of Energy, or the speaker's Laboratory.

Objective:
- Draw on expertise gained from previous UNE and treaty work (CTBT, PHE, TBT, IAEA, etc.) and involvement in new technology developments.
- Explore options for potential OSI technologies to develop and test.
- Provide an activity to aid with inspector training.

A Technology Evaluation Matrix is an effective mechanism to capture and apply technical expertise for a comprehensive review of monitoring technologies in support of policy considerations.

**Technology Evaluation Criteria**
- **Relevance:** A highly desirable technology provides information directly diagnostic of, or related to the monitoring objective.
- **Detection Sensitivity:** A highly desirable technology has a high signal-to-noise ratio (sensitivity dependent on proximity and frequency of measurements).
- **Measure Confidence:** A highly desirable technology provides information that is easily authenticated and documented for credibility.
- **Equipment Factors:** Highly desirable equipment is readily available, robust, transportable, and easy to install, operate, and maintain.
- **Personnel Factors:** Highly desirable technologies require minimal personnel, and are safe.
- **Overall:** Provides means for weighting other evaluation criteria to define the overall desirability.

**Example Evaluation Matrix**

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Intermediate yield</th>
<th>Dry desert environment with relatively level terrain</th>
<th>Alluvium overlying tuff, with basement Paleozoic Sedimentary rock</th>
<th>Area of industrial activities</th>
</tr>
</thead>
</table>

**Criteria**
- **Technology**
  - GEOPHYSICAL
    - Aftershock Monitoring
  - VISUAL
    - Mapping
  - OVERFLIGHT
    - Multispectral Imaging
  - RADIOLICAL
    - Noble Gases
    - Aerosols

<table>
<thead>
<tr>
<th>Technology</th>
<th>Relevance</th>
<th>Detection Sensitivity</th>
<th>Measure Confidence</th>
<th>Equipment Factor</th>
<th>Personnel Factor</th>
<th>Additional Criteria</th>
<th>Overall</th>
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<tbody>
<tr>
<td>Aftershock Monitoring</td>
<td>Score</td>
<td>Score</td>
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<td>Score</td>
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</table>

**Geographic Distribution of Example Technologies**

**Matrix Design, Technologies, and Criteria**
- Dependent on many variables including: location, environment, objectives, etc.
- The more detailed the scenario the more specific the results.
- Requires a diversity of expertise to identify potential technologies, develop effective evaluation criteria, and provide useful assessments and recommendations.
- Choose criteria of most utility based on past experience and potential monitoring applications.
- Evaluations will be scenario dependent.
- Choose metric for which higher value denotes more desirability.
- Evaluation results depend upon scenario detail, qualitative judgments (L, M, H), and the SME experience basis.

The Matrix identifies issues and assists in decision making.

**RESULTS**

Matrix Scoring and Application to Example Scenario
- Ratings are the considered judgment of a panel of Subject Matter Experts. The overall rating is not necessarily an average but a collective deformation. The product involves rigorous documentation and allows flexibility to adjust the scenario, the criteria, and the technologies.
- Ratings can be a simple scoring system like High (H), Medium (M), or Low (L), or a more complex numerical system of scoring.
- Results have been achieved using a simple H, M, L scoring system.
- The matrix evaluation method has been successfully applied to several real world scenarios in Test Site Transparency, and could be readily adapted for use in OSI.

**Criteria Justifications and Logic: An Example using Aftershock Monitoring Technology**
- **Measure Confidence:** Authentication is not typically used in general application of passive seismic methods, but procedures similar to those used by the IMS can be incorporated to obtain high credibility for the data. Data authentication for this technology is highly dependent on the extent of the deployment (number of instruments used, deployment arrangement, etc.), it is easier to authenticate a well-designed network that includes several small arrays.
- **Equipment Factors:** Passive seismic equipment, similar to that purchased by the PTS for use in on-site inspections under the CTBT, is ideal for use in this application. The equipment is a mature, commercially available technology used in a variety of applications.
- **Personnel Factors:** Equipment can be deployed and operated by a minimum crew of two to three people. After the equipment is installed and operating, the system will require a relatively small level of monitoring and maintenance. Most of the monitoring and data processing operations can be automated. Only the usual safety issues of field geophysics deployment apply.