Instrumentation Computer Based Training

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Why is Instrumentation Training Offered
Instrumentation Computer Based Training

- Transfer knowledge of TVA’s internal policies and procedures related to instrumentation.
- AECOM developed a web based training program for Instrumentation of ponds and landfills at TVA Fossil Plants.
- Includes piezometers, inclinometers and settlement monitoring systems.
- TVA trains all new and existing employees and requires annual recertification.
- Training provided through an internal instrumentation database system.
Course Objectives
Instrumentation Computer Based Training

• Roles and responsibilities.
• Instrumentation locations and monitoring.
• Manual data collection and response.
• Threshold/action levels.
• Instrumentation reporting.
Coal combustion products or coal combustion residuals (CCRs) are generated from the combustion of coal and emission control systems:

- Fly ash
- FGD (synthetic) gypsum
- Bottom ash and boiler slag
- Air emission control system residues (other FGD co-products)

Includes CCR’s stored in ponds and dry stacks.
## Fleet Involved

Instrumentation Computer Based Training

<table>
<thead>
<tr>
<th>Plant</th>
<th>State</th>
<th>Piezometers</th>
<th>Vibrating wire piezometers</th>
<th>Slope inclinometers</th>
<th>Settlement system</th>
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</thead>
<tbody>
<tr>
<td>Allen Fossil Plant</td>
<td>Tennessee</td>
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<tr>
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<td>6</td>
<td></td>
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<tr>
<td>Shawnee Fossil Plant</td>
<td>Kentucky</td>
<td>70 (E ); 10 (P)</td>
<td></td>
<td>6 (E ); 5 (P)</td>
<td></td>
</tr>
</tbody>
</table>
Roles and Responsibilities
Instrumentation Computer Based Training

01 Project Engineering
• Takes the lead for developing and deploying instrumentation and monitoring programs.

02 Responsible Manager
(Projects & Civil Construction Program Manager)
• Instrumentation and Monitoring Plan (IMP) consistency.

03 Routine Handling Operations and Maintenance
(RHO&M)
• Responsible for implementing corrective actions.

04 Project Management
• Maintain instruments.
• Support RHO&M in implementing corrective action.
Roles and Responsibilities (cont’d)
Instrumentation Computer Based Training

05 **Consultants** AECOM and Stantec
• Prepares and implements IMP.
• Collects instrumentation data.
• Supervises data collection process for adherence to QC procedures.
• Review data and prepare reporting.

06 **Dam Safety Officer**
• Provides technical oversight.
• Communicates the necessary requirements of the program to TVA staff.
• Reviews all submittals for compliance with TVA dam safety guidelines.
Instrumentation Overview
Instrumentation Computer Based Training

**Instrumentation includes:** piezometers, slope inclinometers and settlement stations.

**Piezometer types**

- Types include Slotted screen tips, Casagrande tips or vibrating wire transducers.
- Depth to water in slotted screen or Casagrande tip piezometers is measured using a water level indicator.

![Piezometer Installation using Auger Torque Earth Drills.mp4](image)
Vibrating Wire (VW) Piezometers
- Use a vibrating wire pressure transducer and signal cable to monitor water levels.

Slope Inclinometers
- Monitor subsurface horizontal movements.
- Reading probe detects minute horizontal movement of the casing.
- Slope Inclinometers installed in accordance with given details
Slope inclinometer casings

- Maintain access for the inclinometer probe.
- Control the orientation of the probe via internal grooves.
- Conform to movement of the surrounding ground.
The Sondex settlement system

- Monitors settlement and heave
- Readout probe
- Signal cable
- Cable real with a built-in voltmeter
- Number of sensing rings fixed inside a corrugated plastic pipe.
- An inclinometer casing is installed inside the corrugated pipe and the annulus is grouted.
Flow Chart for Manual Data Collection, Assessment and Reporting

- Identifies all decision nodes and steps to be taken.
- Details action steps based on the data results and evaluation.
- Identifies the responsible parties to be notified.
Data collection

- Occurs first two weeks of each month.
- Contact TPE prior to visit to review current conditions or instrument changes.
- Standardized Descriptors for Observations.
- Record field conditions using descriptors.
- Standardized Descriptors for observations.
- Record field conditions using descriptors.
### Manual Data Collection and Response (cont’d)
Instrumentation Computer Based Training

- Photograph obstructions or damaged instrument.
- Notify Responsible Manager if there is exceedance.
- For larger view see the link: [observations@tva.org](mailto:observations@tva.org).

<table>
<thead>
<tr>
<th>Standardized Descriptor</th>
<th>Observed Condition Category</th>
<th>Possible Observed Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Significant Change</strong></td>
<td>Significant Change in the Water Level</td>
<td>The current depth to water reading differs by two feet or more (greater than or less than) from the recorded depth for the previous reading.</td>
</tr>
<tr>
<td><strong>Dry</strong></td>
<td>No Water Level Indicated</td>
<td>Manual water level indicator probe was lowered to the full depth of the piezometer well and no water was indicated – no water level elevation has been recorded.</td>
</tr>
</tbody>
</table>
| **Damaged**             | Instrumentation Damaged     | 1. Piezometer is bent and a manual water level reading cannot be obtained – no reading has been recorded.  
2. Piezometer has been destroyed and a manual water level reading cannot be obtained – no reading has been recorded. |
| **Obstructed**          | Instrumentation Obstructed  | 1. Piezometer top opening is obstructed by [soil - ash - ice - submerged in water] and a manual water level reading cannot be obtained – no reading has been recorded.  
2. Piezometer is physically inaccessible due to [list condition] and a manual water level reading cannot be obtained – no reading has been recorded. |
| **Altered**             | Instrumentation Altered     | 1. Piezometer pipe has been [cut off - raised with additional pipe] requiring a revision to stick-up data in the data table – a manual water level reading has been recorded.  
2. A concrete collar and protective cover have been installed on the piezometer requiring a revision to surface elevation and stick-up data in the data table – a manual water level reading has been recorded. |
| **Abandoned**           | Instrumentation Abandoned   | Piezometer has been abandoned. |
| **Automated**           | Instrumentation Automated   | 1. Piezometer has been automated – a manual water level reading has been recorded. |
| **Automated - Data Not Provided** | Automated Instrumentation Data Not Provided | Automated data not provided for this location [piezometer – inclinometer – pond level – river level – rainfall]. |
• Threshold Level: Stability factor of safety has reached 1.50.

• Action Level: Corresponding factor of safety is greater than 1.50 and is based on historical readings and current stability conditions.
Manual Data Collection and Response (cont’d)
Instrumentation Computer Based Training

- For slope inclinometers, if movement is greater than 0.20 inches from the previous month’s readings and/or beginning of shear (as opposed to creep or gradual movement) is detected.
- For settlement stations, action levels are dictated by the Consultant Design Team based upon site specific conditions.

Action Level Values
Field interpretation-
Piezometers

• Compile data in spreadsheet.
• Compare values from the previous visit.
• Compare initial water surface elevations to threshold and/or action levels to determine if exceedance has occurred.
Piezometer Threshold/Action Levels Exceeded

- Obtain a second reading immediately to confirm the threshold / action level.
- Obtain a third reading after 60 minutes with a different indicator.
- Prior to leaving the facility, contact the TPE.
Threshold/Action Levels Exceeded

- If exceedance occurred, forward recorded data to the TPE within 24 hours of the reading event.
- Responsible Manager to be notified within 24 to 48 hours of an exceedance.
- TPE conducts a reanalysis of slope stability or seepage concerns within 24 – 48 hours.

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Step 4.0 Threshold Assessment
TPE Assess Data; Reanalyze Slope Stability/Seepage; If Evaluation Period Reaches 7 days, global FS<1.5, facility on Dam Inventory List – Responsible Manager Notify Dam Safety; Issue Resolved

Step 5.0 Increased Monitoring
Increase Monitoring; Notification and Response Following Plant Seepage/Emergency Action Plan (SAP); Responsible Manager Notify Dam Safety
Manual Data Collection and Response (cont’d)
Instrumentation Computer Based Training

Additional response steps may include:
• Temporary stability improvements (TSI)
• Assessment of TSIs
• Increased monitoring

Step 5.0 Increased Monitoring
Increase Monitoring; Notification and Response Following Plant Seepage/Emergency Action Plan (SAP); Responsible Manager Notify Dam Safety

Increased Monitoring Reveals Acceptable Threshold/Action Level

Yes
Continue increased monitoring; data evaluation

No

Step 6.0 Temporary Stability Improvements (TSI)
TPE Design Temporary Stability Improvements
• Piezometers are in the process of being converted from manual collection to automation.

• Allows continuous monitoring of phreatic surface through containment embankments.

• Monitoring of embankments on a continual basis is important to insure stability with changes in the phreatic surface.

• Threshold analyses have shown cross sections are sensitive to changes in piezometric level and should be monitored.
**Instrumentation and Monitoring Plan**

Instrumentation Computer Based Training

- Outlines the Instrumentation and Monitoring Program consistent with TVA's GC-SPP-27.5.1, Section 3.2.1.
- Outlines types and configuration of instruments.
- Establishes site specific programmatic procedures.
- Updates and supplements existing threshold/Action Levels.
- Documents Quality Assurance and Quality Control Procedures.
- Annual field audit to verify collection controls.
- Annual Updates Provided to TVA.
Quality Control and Reporting
Instrumentation Computer Based Training

Prescribed data tables and figures

- Piezometer data tables
- Graphical rainfall data
- Inclinometer plots
- Settlement plots
- Piezometer plots with Threshold/Action levels
- Summary of Threshold/Action Level Review
- Observed conditions for unreadable instruments

Stability – Baseline F.S. 1.687

Stability – Plus 3 Feet, F.S. 1.527
Graphical Rainfall Data

Rainfall records from 1/2011 to 2/2012 based on records collected by the National Weather Service for Oak Ridge, TN. Rainfall totals presented from 3/2012 to present are based on TVA site specific rain gauge readings.
<table>
<thead>
<tr>
<th>STN</th>
<th>PZ ID</th>
<th>Top of Hole Elev. (ft)</th>
<th>PZ Tip Depth (ft)</th>
<th>PZ Tip Elevation (ft)</th>
<th>Hz</th>
<th>T (degree C)</th>
<th>Barometric Pressure (in Hg)</th>
<th>Water Pressure (ft)</th>
<th>Water Depth (ft BGS)</th>
<th>Water Elev at (ft)</th>
<th>Date</th>
<th>Time ET</th>
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Quality Control and Reporting (cont’d)
Instrumentation Computer Based Training

Inclinometer Plot
Settlement Plots
Piezometer Plots with Thresholds
### Field Observed Conditions

<table>
<thead>
<tr>
<th>Facility</th>
<th>Instrument ID</th>
<th>Observed Condition</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ash Pond Complex</td>
<td>STN-64</td>
<td>Obstructed, soil/ash blockage in piezometer</td>
<td>Instrument replaced by STN-64A, piezometer to be abandoned</td>
</tr>
<tr>
<td>Gypsum Stack Stilling Pond</td>
<td>STN-42</td>
<td>Obstructed, cannot locate in the field, no reading obtained</td>
<td>Instrument to be abandoned</td>
</tr>
<tr>
<td></td>
<td>STN-48 (Obstructed)</td>
<td>Obstructed, water level probe lodged inside piezometer, no reading obtained</td>
<td>Instrument to be abandoned</td>
</tr>
<tr>
<td></td>
<td>STN-49</td>
<td>Obstructed, cannot locate in the field, no reading obtained</td>
<td>Instrument to be abandoned</td>
</tr>
</tbody>
</table>
Question 1
What are the required resampling periods for the piezometer following the threshold/action level exceedance?
Select all that apply by clicking on the blue squares

A. Second sample within 30 minutes of the first sample and third sample within 1 hour later.

B. Second sample immediately and third sample at least one hour later.

C. Second sample within 24 hours and determine those results before taking a third sample.

D. Second sample within 2 hours and third sample two hours later.
Training Results (cont’d)
Instrumentation Computer Based Training

Personnel trained since 2013
• 5 Engineering Managers
• 8 Field Supervisors
• 5 Technicians

Re-training required
• Annual

Training Results
• TVA conducts all field sampling and data recording starting FY 2015.
• Consultant Design Team reviews data and conducts analysis and reporting.
Lessons Learned
Instrumentation Computer Based Training

01
Multiple instrument reading devices should be presented during training to prepare users for equipment changes.

02
Site plans for each facility should be included to prepare technicians for field readings.

03
Discussion of types of non-instrumentation tools needed for field readings.
Benefits of Computer Based Training
Instrumentation Computer Based Training

• Consistent knowledge given to staff.

• Message of safety, stability and monitoring at Fossil plants.

• Provides cross-training for staff to cover vacation and sick time.

• Increases knowledge of the instruments and their purpose in providing up front indicators of potential stability issues.

• Flexibility for employees schedule.
Thank you
Contact us for more information

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