Sandia National Laboratories
Yucca Mountain Site Characterization Project

TECHNICAL PROCEDURE

TP-239

Installation of Extensometers

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Revision History

Rev.	Change Summary
01	Major revision to Sections 7.1 and 7.2 to better reflect processes used; small change to Sec.8.0 re documentation of manual measurements; editorial changes throughout
02	Minor clarification added per PR YMP-97-P-011; deleted reference to cancelled QAIP 7-1; updated cover page, and identified QA records as lifetime records and added training log as a record.

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1.0 SCOPE

Sandia National Laboratories (SNL) is responsible for field experiments to monitor and characterize activities in the Exploratory Studies Facility (ESF) in support of the Yucca Mountain Project (YMP) Site Characterization Plan (SCP). These experiments consist of installing and monitoring instrumentation that measures the long term in situ stability of rock units penetrated by ESF excavations. Deformation of rock in the excavation is one of the parameters used to monitor stability and is measured using single and multi-point borehole extensometers (SPBX and MPBX).

This Technical Procedure (TP) applies to all YMP SNL personnel and contractors who will be trained and qualified to install extensometers in the ESF.

2.0 ACTIVITY OBJECTIVE

The objective of the activity described in this TP is to define the methods used to control and document extensometer installations in ESF excavations.

3.0 RESPONSIBILITIES

The Principal Investigator (PI) has responsibility for ensuring that all information obtained in the ESF is in accordance with SNL's Quality Assurance Implementing Procedures (QAIPs) and that all individuals installing extensometers are properly trained.

Training will be conducted by the PI or PI designee for this particular procedure. A training log documenting all individuals working to this TP have met the qualification prerequisites will be maintained by the PI. The minimum TP training log requirements include printed name, signature and data read; and verification by (printed name), signature, and date verified.

4.0 QUALIFICATION PREREQUISITES

The PI verifies that the following prerequisites have been met:

- Training:
  1. Completed training to the applicable QAIPs as provided in Work Agreement (WA) WA-0065 and WA-0116, and future WAs controlling the work.
  2. Read the TP and meet the proficiency requirements by demonstration to the PI or a previously qualified technician.
- The most current version of this TP is being used.

5.0 DEFINITIONS

ESF	Exploratory Studies Facility
MPBX	Multi-Point Borehole Extensometer
PHA	Preliminary Hazard Assessment
PI	Principal Investigator
QA	Quality Assurance
QAIP	Quality Assurance Implementing Procedure
SCP	Site Characterization Plan
SNL	Sandia National Laboratories
SPBX	Single-Point Borehole Extensometer
TBM	Tunnel Boring Machine
TP	Technical Procedure
WA	Work Agreement
YMP	Yucca Mountain Project

6.0 SAFETY

The constructor has the primary responsibility for safety when working on the North Portal pad or in the ESF. SNL's safety assessment for the pad and the ESF is given in the SNL Preliminary Hazard Assessment (PHA) 474315. At no time should any work be performed that appears unsafe. The site safety plan authorizes work stoppages in the event of an immediate hazard. You are also authorized to issue a stop work order, per YMP AP-16.2Q, "Corrective Action and Stop Work," for QA reasons.

7.0 TECHNICAL INSTRUCTION

Borehole extensometers may consist of SPBX or MPBX instruments with expansion shell, hydraulic or grouted anchors. Procurement of equipment must meet the requirements of QAIP 4-1, "Procurement," Calibration requirements are specified during procurement. Calibration control must meet the requirements of SNL YMP TP-246, "Control of Measuring and Test Equipment Used in the Exploratory Studies Facility," and QAIP 12-1, "Measuring and Test Equipment Control."

7.1 Preparations for Installation

Instrument station arrangement layouts will be developed by the PI which specify the nominal location, orientation, and anchor depths for the extensometers. These arrangement layouts will form the basis of instructions to other YMP organizations responsible for instrument installation.

Station arrangement layouts may include the following:

- Location of station,
- Number and orientation of extensometer holes,
- Nominal depth of holes,
- Number and nominal depth of anchors,
- Specifications for accuracy of alignment and collar location,
- Specifications for hole diameter,
- Extensometer type, and
- Special instructions.

After drilling of the holes, the station arrangements will be reviewed by the PI or PI designee to verify compliance with the specifications. If some aspect of the constructed borehole is out of the design specifications, the PI must be notified. The PI may request revision of the station or may authorize deviation from the specifications and instruct SNL personnel to proceed with the installation. PI acceptance and instructions for any deviations will be logged on the station as-built documents.

The SPBX or MPBX should be withdrawn from the equipment inventory in the SNL equipment trailer at the ESF pad and logged into the station as-built records. Substitution of specified items require prior approval of the PI or PI designee. Other equipment and material required for extensometer installation may include:

Equipment

1. Calibrated digital multimeter
2. Instrument specific read-out (for example GK403)
3. Anchor setting equipment
4. Hydraulic hand pump with calibrated pressure gage
5. Hand tool set

Material

1. Calibrated extensometer head and transducers
2. Anchors or anchor materials
3. Measurement rods
4. Protective plastic tubing

Verify that all measurement and test instruments are calibrated and are on the YMP SNL Equipment Inventory and Calibration Schedule.

Pre-installation inspection of each borehole should be performed. This may consist of visual inspection from the hole collar with a light or a more detailed inspection of the entire length of the hole using a borehole stratascope or borehole video system. If the PI specifies detailed

inspection of the hole, a log of the hole depth and results will be compiled. Anchor locations may be adjusted based upon borehole inspection, if authorized by the PI or his designee. Holes should be blown out, if necessary.

7.2 Installation

Installation instructions from the vendor will be used to install or to assemble MPBX and SPBX. Unless space is very restricted, MPBX and SPBX can be preassembled outside the borehole and installed as a single unit into the borehole. Anchor depth will be measured from the midpoint of the collar anchor near the borehole to the midpoint of the respective anchor using a commercial grade steel tape with 1 mm or 0.01 ft subdivisions.

MPBX or SPBX with hydraulic anchors

1. Screw the female threaded end of the measurement rod into the hydraulic anchor.
2. Slide the protective PVC tubing over the measurement rod, then thread tubing into the position anchor. Continue adding lengths of measurement rod and PVC extension pipe to desired anchor length. For MPBX repeat this process for all position anchors.
3. The final section of PVC pipe should be cut and cemented into the tube attached to the hole collar hydraulic anchor.
4. Select a vibrating wire displacement transducer and record the serial number and the specified anchor position in the as-built documentation.
5. The transducer is connected to the measurement rod through the Swagelok fitting provided in the hole collar hydraulic anchor.
6. Connect a vibrating wire readout box (for example GK-403) to the gage leads according to the wiring diagram provided by the vendor.
7. While observing the readout box display, set the transducer until the desired reading (usually around the midrange of the transducer) is obtained.
8. Repeat steps 4 through 7 for remaining transducers.
9. Protective cap is placed and secured over the transducer(s).
10. Insert the extensometer assembly into the borehole.
11. Attach the anchor inflation line from the deepest anchor to a hydraulic pump with calibrated pressure gage. Set the anchor by applying hydraulic pressure between 900 to 1500 psi, depending on the manufacturer of the instrument. Repeat this procedure for remaining anchors.
12. Cut the hydraulic lines and push the lines into the borehole.
13. The space between the borehole and the collar anchor assembly can be filled with grout to prevent foreign object entering into the hole.
14. Verify zero reading of each extensometer by attaching the manual reading instrument or portable data logger. Record this baseline readings in the as-built documentation.

SPBX with mechanical anchors

1. Connect the extension rod onto the bottom anchor.
2. Tighten the adapter at the end of the extension rod.
3. Insert the bottom anchor and the extension rod into the borehole.
4. Set the bottom anchor by rotating the extension rod clockwise.
5. Remove the protective cap and housing from the surface transducer housing.
6. Unscrew the gage adapter from the tubing rod.
7. Insert the collar anchor into the borehole and set the collar anchor.
8. Install the gage adapter at the top of the tubing rod.
9. Insert the vibrating wire displacement transducer in the gage adapter and screw it into the adapter.
10. Connect a vibrating wire readout box (for example GK-403) to the gage leads according to the wiring diagram provided by the vendor.
11. While observing the readout box display, set the transducer until the desired reading (usually around the midrange of the transducer) is obtained.
12. Protective cap is placed and secured over the transducer(s).
13. The space between the borehole and the collar anchor assembly can be filled with grout to prevent foreign object entering into the hole.
14. Verify zero reading of each extensometer by attaching the manual reading instrument or portable data logger. Record this baseline readings in the as-built documentation.

8.0 RECORDS

Records and record packages, including corrections and changes thereto, generated as a result of implementing this procedure shall be prepared and submitted to the SNL YMP Department Records Center as lifetime QA records (QA:L) in accordance with QAIP 17-1, "Protecting, Preparing and Submitting YMP QA Records," and the "Nuclear Waste Management File Codes." QA records generated in following this TP include:

- Training Log records
- Instrumentation Station As-Built Layout
- Documentation of the extensometer installation is part of the station as-built documents and includes:
    - Station as-built layout with extensometer identification data, anchor depth details, as illustrated by the example in Figure 7.1
    - Vendor drawings of extensometer components and connector wiring configuration
    - As-built station wiring and junction box layout with verification notes annotated
    - Identification of installers, dates, initials, etc.
    - Manual measurements of anchor depths with respect to the collar anchor
    - Manual reading of transducers
    - Verification of transducer output through the datalogger
    - Identification of all M&TE used in the installation
- Survey Locations of Extensometers
- Initial Reading of Extensometers

MPBX / SPBX As-Built Documentation

Installation Information

Station ID: Installation Date:

Extensometer Serial #	Type	Orientation	Anchor #	VW Serial #	Anchor Depth(m)	Collar Coordinates (Survey Info)

General Specification (B-Station)

Vertical

- drill a hole - 2 1/4 inch nominal diameter, 25 ft nominal depth
- rim to 3 inch nominal diameter, 12-inch nominal depth
- offset from the tunnel centerline and verticality as determined by drilling equipment and vent location

Springline

- drill two holes - 2 1/4 inch nominal diameter, 10 ft nominal depth
- offset from the tunnel springline and inclination as determined by drilling equipment

General Layout

Initial Reading

Date	Time	Extensometer Serial #	Scale	Reading				Comments	Reader Initial
				Anchor 1	Anchor 2	Anchor 3	Temp		

MTE Type:GK403 SNL#:023 Recalibration Date:

Verification

Required specifications have been met: Yes ☐ No ☐
If no, describe deviations: _____

_____

Station is accepted as built: Yes ☐ No ☐
If No, describe action required: _____

_____

Signature: Date

Figure 7.1 Example of Station As-Built Layout and Documentation.

9.0 REFERENCES

Preliminary Hazard Assessment 747315 for the Exploratory Studies Facility, Sandia National Laboratories, Albuquerque, NM.

QAIP 4-1, "Procurement Document Requirements," Sandia National Laboratories, Albuquerque, NM.

QAIP 12-1, "Measuring and Test Equipment Control," Sandia National Laboratories, Albuquerque, NM.

QAIP 17-1, "Protecting, Preparing and Submitting YMP QA Records," Sandia National Laboratories, Albuquerque, NM.

Technical Procedure 246, "Control of Measuring and Test Equipment Used in the Exploratory Studies Facility," Sandia National Laboratories, Albuquerque, NM.

Work Agreement WA-0065, "Construction Monitoring Activities in the North Ramp Starter Tunnel."

Work Agreement WA-01116, "Design Verification Activities in the Alcove/NRST and North Ramp."

YMP AP-16.2Q, "Corrective Action and Stop Work," Office of Civilian Radioactive Waste Management, U.S. Department of Energy, Washington, D.C.