WP 07-EU1301

Revision 6

Manually Acquired Geomechanical Instrument Data

Technical Procedure

EFFECTIVE DATE: 03/19/08

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APPROVED FOR USE

TABLE OF CONTENTS

INTRODUCTION [1]

This document provides the methods used for manually acquiring data from the Geomechanical Instrumentation System (GIS) in the Waste Isolation Pilot Plant (WIPP) repository. The methods described in this document involve manual collection of data from convergence points, multi-position borehole extensometers, piezometers, strain gages, earth pressure cells, and rockbolt load cells. The instruments are read to monitor changes due to deformation of the underground openings and shafts, as well as changes in the lithostatic and hydrostatic pressures within the rock around the underground openings.

Geomechanical monitoring of the drifts, rooms, and shafts is performed to provide *in situ* data on the behavior of the rock around these openings. Such monitoring provides early detection of conditions that could affect operational safety, monitors closure rates, and provides a better understanding of the *in situ* behavior of bedded salt by comparison of observed response with design calculations. Measurements of salt deformation and stresses are used to confirm or revise the opening configuration and parameters used in the facility design.

| This procedure is to be performed by geotechnical personnel. Training requirements for the performance of this procedure are identified in the Engineering Technical Personnel section of WP 09.

The following records are generated as a result of this procedure:

- Tape Extensometer Check Calibration Sheet (Attachment 1)
- GIS Field Data Sheet (Attachment 2)
- GIS Extensometer Reset Data Sheet (Attachment 3)
- GIS Field Data Sheet (Attachment 4)
- GIS Field Data Sheet (Attachment 5)

Attachment 5 is a sample of a form generated by a scheduling software application all references made to Attachment 5 refer to the actual form. If Attachment 5 is being used, and if either of the items listed below occur prior to the page being completed, the readings affected should be indicated in the comments section.

- A change in the personnel performing the readings.
- A reading device is replaced with one that performs the same function.

REFERENCES

BASELINE DOCUMENTS

- WP 07-1, WIPP Geotechnical Engineering Program Plan

- Instrument Document No. 2, Vibrating Wire Spot Welded Strain Gage, Geomechanical Instrumentation, Waste Isolation Pilot Plant, prepared for Cementation West, Inc., Tucson, Arizona by Soil & Rock Instrumentation Division, Goldberg-Zoino & Associates, Inc., Newton Upper Falls, Massachusetts, SRI Document No. F5-002, Rev. 000, SRI File No. B-3217-F5, February 1982.

- Instrument Document No. 3, Vibrating Wire Embedment Strain Gage, Geomechanical Instrumentation, Waste Isolation Pilot Plant, prepared for Cementation West, Inc., Tucson, Arizona by Soil & Rock Instrumentation Division, Goldberg-Zoino & Associates, Inc., Newton Upper Falls, Massachusetts, SRI Document No. F5-003, Rev. 001, SRI File No. B-3217-F5, March 1982.

- Instrument Document No. 4, Vibrating Wire Earth Pressure Cell, Geomechanical Instrumentation, Waste Isolation Pilot Plant, prepared for Cementation West, Inc., Tucson, Arizona by Soil & Rock Instrumentation Division, Goldberg-Zoino & Associates, Inc., Newton Upper Falls, Massachusetts, SRI Document No. F5-004, Rev. 001, SRI File No. B-3217-F5, March 1982.

- Instrument Document No. 5, H-300 Load Cells, Geomechanical Instrumentation, Waste Isolation Pilot Plant, prepared for Cementation West, Inc., Tucson, Arizona by Soil & Rock Instrumentation Division, Goldberg-Zoino & Associates, Inc., Newton Upper Falls, Massachusetts, SRI Document No. F5-005, Rev. 000, SRI File No. B-3217-F5, March 1982.

- Instrument Document No. 6, Vibrating Wire Piezometer, Geomechanical Instrumentation, Waste Isolation Pilot Plant, prepared for Cementation West, Inc., Tucson, Arizona by Soil & Rock Instrumentation Division, Goldberg-Zoino & Associates, Inc., Newton Upper Falls, Massachusetts, SRI Document No. F5-006, Rev. 000, SRI File No. B-3217-F6, March 1982.

- Instrument Document No. 8, Multi-position Borehole Extensometer, Geomechanical Instrumentation, Waste Isolation Pilot Plant, prepared for Cementation West, Inc., Tucson, Arizona by Soil & Rock Instrumentation Division, Goldberg-Zoino & Associates, Inc., Newton Upper Falls, Massachusetts, SRI Document No. F5-008, Rev. 000, SRI File No. B-3217-F5, March 1982.

- Instrument Document No. 11, Tape Extensometer, Geomechanical Instrumentation, Waste Isolation Pilot Plant, prepared for Cementation West, Inc., Tucson, Arizona by Soil & Rock Instrumentation Division, Goldberg-Zoino & Associates, Inc., Newton Upper Falls, Massachusetts, SRI Document No. 05-011, Rev. 000, SRI File No. B-3217-F5, April 1982.

- Displacement Transducer Model 4040 Instruction Manual, Publication No. KA069876-001, Research Inc., February 1988.

REFERENCED DOCUMENTS

- WP 07-EU1303, Geomechanical Instrument Data Processing

- WP 09, Engineering Conduct of Operations

EQUIPMENT

- Tape Extensometer

- Portable Sonic Probe Readout Unit - Irad Gage MB-7, Geokon GK-701

- Portable Vibrating Wire Readout Unit - Irad Gage MB-6, Geokon GK-401

- Strain Indicator - Vishay P350A and P3500

- Linear Potentiometer Readout Unit, Geokon RB-100

PERFORMANCE

NOTE

The Monitoring and Data Collection (M&DC) equipment used in gathering data shall be calibrated according to the calibration and maintenance schedule. Calibration methods and intervals are based on the manufacturer's recommendations.

The tape extensometers are checked once every three months by geotechnical personnel on a fixed calibrated frame, and records are kept by Geotechnical Engineering that document existing conditions (Attachment 1).

1.0 TAPE EXTENSOMETER

1.1 Check the reference point eyebolts for any signs of physical disturbance or damage.

1.2 Clean the eyebolt of all dirt and debris and attach the snaphook on the end of the tape to the eyebolt.

1.3 Unreel the tape while carrying the instrument to the opposite reference point.

1.4 At the opposite reference point, attach the hook on the end of the instrument to the eyebolt on the reference point.

1.5 Wind up the excess slack in the tape, running the measuring tape along the backside of the instrument through the slot in the head and attaching to the "Tape Locking Pin" in the nearest punched hole.

1.6 Holding the tape extensometer in one hand, turn the adjusting knob clockwise with your other hand to tension the tape.

1.7 Verify that the tape is securely anchored on the "Tape Locking Pin".

1.8 With the tape extensometer lightly supported, slowly turn the adjusting knob until properly aligned.

NOTE

The Sinco Model 1900 extensometer has scribed lines that line up to indicate proper tension. The Geokon Model 1610 extensometer has indicator lights that come on to indicate proper tension.

1.9 **IF** the extensometer cannot be aligned due to lack of travel adjustment, position the "Tape Locking Pin" in the next available punched hole, **THEN GO TO** Step 1.5.

NOTE

At this point, the extensometer has approximately 23 lbs of tension on the tape. All readings will be taken with the extensometer unsupported.

1.10 At the "Tape Locking Pin", add the tape measure reading and the dial/digital gage reading.

NOTE

The actual reading does not represent the true distance between convergence points. The true distance is not necessary, since the tape extensometer is only used to monitor relative deformations.

1.11 Record the tape reading at the TAPE LOCKING PIN, and the dial/digital gage reading on Attachment 2, or Attachment 5, as applicable.

NOTE

Section 2.0 provides operating instructions for use of the Irad Gage MB-6 Vibrating Wire Readout Unit to acquire manual readings for earth pressure cells, piezometers, and strain gages.

2.0 MB-6 VIBRATING WIRE READOUT UNIT

2.1 Connect the gage to the HI and LO terminal by the supplied jumper cable.

2.2 Connect the red jumper lead to the red instrument wire.

2.3 Connect the black jumper lead to the black instrument wire.

2.4 Set "GAGE TYPE" switch to the appropriate position:

"EPC" for earth pressure cell;
"VBS-1" for piezometers;
"EM5" for embedment strain gages; and
"SM2W" for spot welded strain gages.

2.5 Set "AUTO/MANUAL" switch to the "AUTO" position.

NOTE

A flashing dot should appear between the first and second digit. This dot indicates that the gage is being energized. It is not a decimal point.

If a colon appears between the second and third digit, then the readout unit gage has a low battery.

2.6 Set "NORMAL/LINEAR" switch to the "NORMAL" position.

2.7 Push "POWER" switch to momentary "ON"; the unit remains on for three to four minutes after release of switch.

2.8 If no reading appears or if the display is "0000" or "0001," set the "AUTO/MANUAL" switch to "MANUAL," and slowly rotate the "TUNE" control either clockwise or counterclockwise until a repeatable stable reading appears.

2.9 Record the reading on Attachment 2, or Attachment 5, as applicable.

NOTE

At least three excite-count-display cycles shall be observed to determine actual readings. The reading should not vary more than 10.

2.10 Manually turn off the unit, push the "POWER" switch to "OFF."

NOTE

The following provides operating instructions for normal use of the Irad Gage MB-7 Portable Sonic Probe Readout Unit.

There are slight differences in the readings of different sonic probes when utilized for the same borehole extensometer. Therefore, a sonic probe and borehole extensometer should function together continuously as a single unit for the lifetime of the instrument. If a sonic probe should require replacement, the new sonic probe should be read in the same borehole extensometer and the respective difference in their readings should be documented as a "RESET" value, per anchor rod and reference magnet and entered on Attachment 3.

3.0 MB-7 SONIC PROBE READOUT UNIT

3.1 Connect the supplied jumper cable to the amphenol connector on the MB-7 and to the connector on the sonic probe.

CAUTION

These connectors are a "one-way" fit. Forcing the mating of connectors will cause damage to connectors.

3.2 Push the "POWER" switch to the "ON" position; the unit remains on for approximately 30 seconds after release of the switch.

3.3 Set the position selector switch to "POSITION 1" and record the display on Attachment 2, or Attachment 5, as applicable.

3.4 Repeat Step 3.3 for all subsequent anchor positions.

NOTE

A Vishay P350A Strain Indicator is used to read the resistive strain gaged load cells. For convenience, a plug adapter has been fitted to the indicator to enable the load cells to be directly coupled to the unit in the correct (full-bridge) configuration.

4.0 ROCKBOLT LOAD CELLS (VISHAY P350A STRAIN INDICATOR)

4.1 Attach the supplied standard calibrator to the input socket.

4.2 Set GAGE FACTOR to "1.00."

4.3 Turn SENSITIVITY knob fully clockwise.

4.4 Switch BRIDGE to "FULL."

4.5 Turn BALANCE switch to "ON."

4.6 Turn CALIBRATOR switch to "OFF."

4.7 Switch on "POWER."

4.8 With STRAIN counter on +1000, zero meter with BALANCE knob, and lock.

4.9 Unplug calibrator, plug in load cell.

4.10 Re-zero meter with large knob and "RANGE EXTENDER."

4.11 Read counter and record reading on Attachment 2, or Attachment 5, as applicable.

NOTE

The steps in Section 5.0 provide operating instructions for normal use of the Geokon GK-401.

5.0 GK-401 VIBRATING WIRE READOUT UNIT

CAUTION

These connectors are a "one-way" fit. Forcing the mating of connectors will cause damage to the connectors.

5.1 Connect the supplied jumper cable to the connecter marked "TRANSDUCER" on the GK-401 and to the vibrating wire transducer.

NOTE

A table is provided on the lid of the readout unit. Six transducer options are available on the GK-401.

5.2 Set the display selector to correspond to the proper transducer type setting.

5.3 Push the "POWER" switch to the "ON" position; the unit will automatically turn off after approximately four minutes.

5.4 Record the display on Attachment 2, or Attachment 5, as applicable.

NOTE

The steps in Section 6.0 provide operating instructions for normal use of the Geokon GK-701 Sonic Probe Readout Unit.

6.0 GK-701 SONIC PROBE READOUT UNIT

CAUTION

These connectors are a "one-way" fit. Forcing the mating of connectors will cause damage to the connectors.

6.1 Connect the supplied jumper cable to the amphenol connector marked "PROBE" on the GK-701 and to the connector on the sonic probe.

6.2 Push the "POWER" switch to the "ON" position; the unit will automatically turn off after 15 seconds if no switch has been activated during this time.

6.3 Turn the position selector switch to "POSITION 1"; the GK-701 is capable of reading up to twenty anchor positions.

NOTE

In the normal ("N") position, the display shows the distance from the roof level anchor to each borehole anchor in turn. In the "D" position, the display shows the distance between each sequential set of anchors.

6.4 Switch the "N/D" selector to "N."

6.5 Record the reading on Attachment 2, or Attachment 5, as applicable, and switch to the next sequential position.

6.6 Repeat Step 6.5 for all subsequent anchor positions.

NOTE

The steps in Section 7.0 provide operating instruction for normal use of the Vishay P-3500 Digital Strain Indicator Readout Unit. The P-3500 is used to read resistive strain gages and transducers.

7.0 VISHAY P-3500 DIGITAL STRAIN INDICATOR READOUT UNIT

NOTE

When the "BRIDGE" button is depressed, yellow is displayed, indicating FULL-BRIDGE mode. Black is displayed in 1/4 - ½ BRIDGE mode.

7.1 Determine transducer bridge configuration by selecting for full-bridge configuration or by pushing the "BRIDGE" button for 1/4 - ½ for quarter-or half-bridge configuration.

NOTE

When the "MULT" button is depressed, yellow is displayed on the button panel, indicating "X10" mode. When the button panel is black in color, the unit is in "X1" mode.

7.2 Select "X1" position by pushing the "MULT" button.

7.3 Connect the strain gage(s) or transducer to the colored binding posts or "TRANSDUCER" connector.

NOTE

When the "AMP ZERO" button is depressed, the "POWER" button will pop up, causing the button panel to change to black. Steps 7.4 through 7.6 must be carried out while the "MULT" button is in "X1" mode.

7.4 Push in the "AMP ZERO" button, when the button is pushed in, the button panel should be orange in color and the readout display should come on.

7.5 Allow the unit to warm up for a minimum of two minutes.

7.6 Using the "AMP ZERO" control, set the readout display to (+/-)0000. This can be done by pressing lightly with the fingertip and rotating until the displayed reading is (+/-)0000.

NOTE

The button panel should turn orange in color when the "GAGE FACTOR" button is depressed.

7.7 Depress the "GAGE FACTOR" button.

NOTE

When the gage factor of approximately 2.0 is being used, the 1.7 to 2.5 range will result in the optimum setting capability.

7.8 Set the "GAGE FACTOR" range selector to the range under which the desired gage factor falls.

7.9 Unlock "GAGE FACTOR" control knob by pushing the locking mechanism counterclockwise.

7.10 Set the exact gage factor value by turning the "GAGE FACTOR" control knob.

NOTE

The locking mechanism provides a means to mechanically lock the knob in place.

7.11 Once the gage factor has been set, lock the "GAGE FACTOR" control knob by pushing the locking mechanism clockwise.

NOTE

The button panel should turn green in color when the "RUN" position button is depressed.

7.12 Depress the "RUN" push button.

NOTE

Steps 7.13 and 7.14 must be carried out while the "MULT" button is in "X1" mode.

7.13 Set the "BALANCE" selector to zero.

7.14 Unlock the "BALANCE" control knob by pushing the locking mechanism counterclockwise.

7.15 Set the "BALANCE" control knob to display reading (+/-)0000.

7.16 Depress the "CAL" push button and verify calibration of the instrument.

7.17 Select the "X1" or "X10" "MULT" position as required.

7.18 Depress the "RUN" push button and record the displayed reading on Attachment 2, or Attachment 5, as applicable.

NOTE

The steps in Section 8.0 give operating instruction for normal use of the Geokon RB-100 Linear Potentiometer Readout Unit. The RB-100 is used to read a single or multiple linear potentiometers.

8.0 RB-100 LINEAR POTENTIOMETER READOUT UNIT

8.1 Connect the potentiometer cable to either the single input or multiple input connector marked "PROBE" on the RB-100.

CAUTION

These connectors are a "one-way" fit. Forcing the mating of connectors will cause damage to the connectors.

8.2 Push the "POWER" switch to the "ON" position.

8.3 Set the "RANGE" selector to the appropriate range of the potentiometer.

8.4 Record the reading on Attachment 2, or Attachment 5, as applicable.

8.5 For a multi potentiometer transducer, move the "POSITION" selector to the desired potentiometer and record the reading on Attachment 2.

NOTE

The RB-100 does not have an automatic "SHUT OFF" power switch, therefore, the unit must be switched "OFF" when not in use.

8.6 Switch "POWER" to "OFF."

9.0 MANUALLY ACQUIRED ROTARY POTENTIOMETER READINGS

9.1 Connect the instrument to connector P1 on the potentiometer interface.

9.2 Connect the voltmeter to connector P2 on the potentiometer interface.

9.3 Ensure the voltmeter is set to read DC voltage.

NOTE

Initial instrument voltmeter readings should be recorded on Attachment 1, GIS Initial Field Data Sheet, of WP 07-EU1303.

Subsequent readings will be entered on Attachment 4, or Attachment 5, as applicable, of this procedure.

9.4 Read and record the voltage with the potentiometer interface selector switch set to the "V_{ex}" position.

9.5 Read and record the voltage with the potentiometer interface selector switch set to the "V_{in}" position.

9.6 Sequence the selector switch through any additional transducers while recording the output of each.

10.0 INSPECTIONS

NOTE

A visual inspection of geotechnical instrumentation for deterioration is limited to those parts of the instruments located on the strata surface of the underground facility.

10.1 Check for cracks, erosion, salt buildup, damage, corrosion, loose or missing parts, malfunctions, and structural deterioration.

10.2 **IF** a required inspection goes delinquent,
THEN immediately notify Site Environmental Compliance of the delinquent inspection.

10.3 Schedule and complete the inspection.

10.4 Document the following in a letter to Site Environmental Compliance within five working days:

- The schedule for the inspection.
- The reason(s) why the inspection was not performed.
- Any measures taken to offset negative impacts resulting from not performing the inspection.
- Actions taken to prevent further delinquencies.

Attachment 1 - Tape Extensometer Check Calibration Sheet

TAPE EXTENSOMETER

CHECK CALIBRATION SHEET

CALIBRATION RUN BY _____ DATE _____

CALIBRATION CHKD. BY _____ DATE _____

TAPE EXTENSOMETER MANUFACTURER _____

TAPE EXTENSOMETER S/N _____ WIPP CALIBRATION LAB ID. No. _____

CALIBRATION FIXTURE S/N _____ WIPP CALIBRATION LAB ID. No. _____

CALIBRATION FIXTURE TEMPERATURE _____ (°F)

TRIAL NUMBER	READINGS						SUM
	TAPE		DIAL (INCHES)				
	FEET	INCHES	INCHES	0.1	0.01	0.001	
1							
2							
3							
4							
5							
6							
7							
8							
						AVERAGE	
						AVERAGE FROM PREVIOUS CALIBRATION	
						CHANGE FROM PREVIOUS CALIBRATION	

ACCEPT ☐ REJECT ☐

COMMENTS AND CONCLUSIONS

@ LAST REPAIR

@ THIS CALIBRATION

CHANGE SINCE LAST REPAIR

Attachment 2 - GIS Field Data Sheet

GIS FIELD DATA SHEET

DATE ____/____/____ TIME _____ READINGS BY _____

FIELD TAG ENTITY	READING	GISID

SKETCH OF INSTALLATION

STATION: _____

INSTRUMENT TYPE: _____

READING DEVICE: _____

SERIAL NUMBER: _____

CHECK: _____

COMMENTS: _____

VIEW LOOKING _____

Check for cracks, erosion, salt buildup, damage, corrosion, loose or missing parts, malfunctions, and structural deterioration.

Attachment 3 - GIS Extensometer Reset Data Sheet

GIS EXTENSOMETER RESET DATA SHEET

FIELD TAG _____ RESET BY _____

LOCATION _____

READING DEVICE _____ SERIAL NUMBER _____

RESET ACTIVITY BEGUN: DATE ____/____/____ TIME _____

#	READING
1	
2	
3	
4	
5	
6	

RESET ACTIVITIES		
1		
2		
3		
4		
5		
6		
#	DEPTH OF ROD	LENGTH ADDED

COMMENTS _____

RESET ACTIVITY COMPLETED: DATE ____/____/____ TIME _____

#	READING
1	
2	
3	
4	
5	
6	

READINGS ALTERED MORE THAN ±0.010			
BEFORE	AFTER	CHANGE	GISID

DATA REDUCTION BY _____ DATE ____/____/____

CHECKED BY _____ DATE ____/____/____

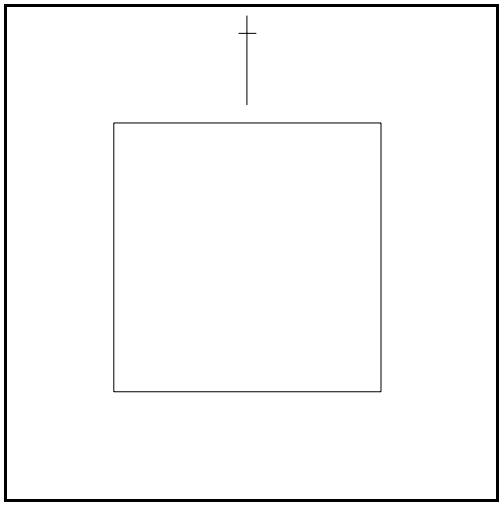
Attachment 4 - GIS Field Data Sheet

GIS FIELD DATA SHEET

DATE ____/____/____ TIME _____ READINGS BY _____

FIELD TAG ENTITY	READING	GISID
V_{ex}		
V_{in}		
A		
B		
C		
D		
E		

SKETCH OF INSTALLATION



STATION: _____

INSTRUMENT TYPE: _____ WEX: _____

READING DEVICE: _____

SERIAL NUMBER: _____

CALIBRATION DUE DATE: _____

COMMENTS: _____

VIEW LOOKING _____

Check for cracks, erosion, salt buildup, damage, corrosion, loose or missing parts, malfunctions, and structural deterioration.

Attachment 5 - Sample GIS Field Data Sheet

GIS FIELD DATA SHEET

GISID	LOCATION	TYPE	READING	DATE
18713	E0 DRIFT-N1100 A-C	CVPT	/	
18714	E0 DRIFT-N1266 A-C	CVPT	/	
18564	E0 DRIFT-N225 A-C	CVPT	/	
18541	E0 DRIFT-N225 B-D	CVPT	/	
18542	E0 DRIFT-N290	CVPT	/	
18565	E0 DRIFT-N460 A-C	CVPT	/	
18673	E0 DRIFT-N562 A-C	CVPT	/	
18674	E0 DRIFT-N562 B-D	CVPT	/	
18675	E0 DRIFT-N626 A-C	CVPT	/	
18676	E0 DRIFT-N686 A-C	CVPT	/	
18677	E0 DRIFT-N686 B-D	CVPT	/	
18711	E0 DRIFT-N780 A-C	CVPT	/	

Check for cracks, erosion, salt build-up, damage, corrosion, loose or missing parts, malfunctions and structural deterioration.

Comments: _____

Read/Inspected by: _____

Readings due date: 4/2/2004

Provide the information required below for the readout devices used in the collection of the readings recorded on this page:

Reading device: _____ Device ID: _____ Calibration due: _____

Reading device: _____ Device ID: _____ Calibration due: _____

Reading device: _____ Device ID: _____ Calibration due: _____

Reading device: _____ Device ID: _____ Calibration due: _____