SECTION 31 09 13
GEOTECHNICAL INSTRUMENTATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section specifies the design, installation, maintenance, and removal of geotechnical instrumentation to monitor soil, rock, and structure movements during construction. This section also includes specifications for reading, analyzing, and reporting instrumentation monitoring results.

B. Design Criteria:

1. Provide a system of geotechnical instrumentation which will allow monitoring of soil, rock, and excavation support elements, as well as adjacent structures and utilities to ensure safety and stability, confirm design assumptions, and provide a basis for establishing compliance with Contract requirements.

C. Definitions:

1. Geotechnical Instrumentation - Any device designed to determine change in the position or state of stress of soil, rock, and structures.
2. Instrument Monitoring - The procurement of data obtained from the repeated optical, mechanical, or electronic observations of geotechnical instruments.
3. Frequency of Monitoring - The number of readings obtained from a geotechnical instrument with respect to time.
4. Initial reading- The first stable reading set obtained after instrument installation, but prior to excavation, to which all subsequent readings will be compared.
5. Threshold Limit Values Level 1 and Level 2 - Designer-specified limits for geotechnical instrumentation which if exceeded require (1) notification of the Authority and increased monitoring frequency and (2) implementation of the contingency plan.

1.02 QUALITY ASSURANCE:

A. Comply with codes and regulations of the jurisdictional authorities.

B. Permits - Prior to instrumentation installation obtain any permits from the responsible jurisdiction and pay permit costs and any associated fees at no additional cost to the Authority.

C. Qualifications of Personnel:

1. Instrumentation Selection, Design, Layout, and Data Analysis shall be performed by a registered Professional Engineer specializing in geotechnical engineering with 5 years experience in soil stability and geotechnical design
2. Instrumentation installation shall be performed under the supervision of qualified technicians with at least one year experience in the installation of instruments of the type specified.
3. Instrumentation monitoring shall be performed by qualified technicians with at least one year experience in the reading of instruments of the type specified.

D. Continuously maintain all geotechnical instrumentation in proper working condition and within manufacturer’s specifications. Immediately repair or replace malfunctioning equipment. All

instrumentation readout devices to be periodically tested and recalibrated within schedule as recommended by the instrument manufacturer or as approved by the Authority.

1.03 SUBMITTALS:

A. Submit the following for approval prior to proceeding with work:
   1. Type of instrumentation system proposed, showing arrangement, location and depths of proposed system.
   2. Manufacturer's literature including descriptions and installation recommendations for all instruments, software, and read-out devices proposed for use.
   3. Instrumentation installation schedule and monitoring schedule.
   4. Resumes listing the qualifications of the Professional Engineer and Technicians specified in 1.02.C.

B. Instrument Installation Data:
   1. Record of installation details including date and time of installation, general soil condition at instrument site, adjacent construction activities, and remarks of unusual conditions observed during installation.
   2. As-built location and elevation of installed instruments including coordinates and distance referenced to Outbound track centerline. Supply location data within 48 hours of instrument installation.

C. Instrumentation Monitoring Data:
   1. Analyzed data to be submitted on forms approved by the Authority within 48 hours after instrument monitoring. Supply copies of field notes if requested.
   2. Immediately report to the Authority movements exceeding Level 1 limits.
   3. Shift Reports of Construction Activities:
      a. For each shift in which work is taking place, submit a report within 24 hours containing the following:
         1) Detailed excavation and tunneling status at time of instrument reading.
         2) Excavation subgrade elevation and tunnel face station at time of instrument reading.
         3) Incidents of ground loss, groundwater flow, excavation support instability, or any other unusual event.
         4) General construction activity in the vicinity of the instruments.
         5) Duration and cause of delays to construction activities.
         6) Weather conditions.

D. Contingency Plans:
   1. Submit contingency plans to stabilize soil, rock, and structures affected by adverse movements detected by instrumentation. Submit contingency plans at least one month prior to start of excavation or tunneling. At a minimum, include the following:
      a. Names, telephone numbers, and locations of persons responsible for implementation of contingency plans.
      b. Materials and equipment required to implement contingency plans.
      c. Location onsite of all required materials and equipment to implement contingency plans.

d. Step-by-step procedure for performing work involved in implementation of the contingency plans.

e. Threshold limit Level 1 and Level 2 values for all instruments.

f. Clear identification of objectives of contingency plans and methods to measure plan success.

1.04 JOB CONDITIONS:

A. Do not disclose to third parties or publish monitoring data without the approval of the Authority.

B. The Authority may monitor any geotechnical instrument at any time. Provide and facilitate access to instruments for the Authority.

C. The instrumentation monitoring data shall be continuously reviewed and interpreted by the responsible instrumentation specialist.

D. During construction, additional instrumentation may be required beyond that proposed in the initial design. Modifications to the instrumentation plan, including proposed instrument locations, may be required due to site conditions and instrumentation results.

E. Ensure that all instrumentation installations are continuously protected and are not damaged by construction activities, including blasting. Replace or repair as necessary any instrument damaged by construction activities or adverse soil, rock, or structure movement.

PART 2 - PRODUCTS

2.01 INSTRUMENT TYPES:

A. Specify instrument types and locations in accordance with design criteria indicated in Section 1.01 B.1. and as approved by the Authority.

PART 3 - EXECUTION

3.01 INSTRUMENT INSTALLATION SCHEDULE:

A. Install and obtain initial readings for all surface instrumentation prior to excavation, chemical grout operations, or dewatering activities, in accordance with approved schedule. In areas to receive chemical grout, delay installation of instruments which might be damaged by chemical grout until completion of this activity.

B. For all instrumentation located within excavated areas, install and obtain initial reading as soon as practical after excavation or passage of tunnel heading in accordance with approved schedule.

3.02 INSTRUMENT LOCATIONS:

A. Install instruments as close as practical to locations submitted and approved. Actual conditions in field may require location adjustment. Obtain Authority approval for location adjustments.

B. After instrument installation, submit reports showing location and installation details of each instrument as specified in Section 1.03.B.

C. Ensure that all proposed instrument locations will not result in damage to utilities or other structures. Coordinate proposed instrument locations with Miss Utility and any other affected owners prior to instrument installation.

3.03 INSTRUMENTATION MONITORING:

A. Initial Reading:
   1. At time of initial reading, verify that instrument is functioning and has been installed in accordance with contract specifications and manufacturer's recommendations.
   2. Replace at no additional cost to the Authority any instrument which does not meet specification requirements.
   3. Obtain at least three separate and complete sets of initial readings on each instrument which yield consistent results.
   4. Should inconsistent initial readings be obtained on any instrument, reread until correct and repeatable readings are obtained.

B. Monitoring Frequency:
   1. Monitoring frequency to be in accordance with schedule submitted and approved as specified in Section 1.03 A.3.
   2. Instrument readings which show significant change from previous readings shall be reread immediately.

C. Instrumentation Monitoring Threshold Values:
   1. Instrumentation system design shall establish threshold limit values for each instrument.
      a. Level 1 Limit values if exceeded require notification of the Authority within 24 hours and notification of individuals listed within the contingency plan. Monitoring frequency of affected instruments which exceed Level 1 limit will be increased to frequency as approved within the contingency plan.
      b. Level 2 limit values if exceeded require immediate notification of the Authority and implementation of the contingency plan. Instruments which exceed Level II limits will be monitored continuously until stability is achieved.

3.04 INSTRUMENT PROTECTION, MAINTENANCE, AND REPLACEMENT:

A. Protect and maintain instruments. Divert surface water from instrument covers. Flush debris from instrument installations. Maintain access to all instruments.

B. Provide barriers as required to protect instrument.

C. Install and maintain instruments and instrument access covers in a manner which protects workers and ensures public safety.

D. Repair or replace damaged instruments within 5 days at no additional cost to the Authority.

3.05 REMOVAL OF INSTRUMENTS:

A. Prior to final acceptance of work and subject to Authority approval, remove and dispose of all instrumentation.
   1. Remove surface instrument installations to 2 feet below ground surface. Backfill voids and casing with cement grout.
   2. Restore ground surface to original condition.

B. Fill holes in masonry with portland cement mortar. Restore structure surfaces to original condition.

END OF SECTION