

## **SAMPLE SPECIFICATION for SPT ENERGY TESTING**

November 2015

The Drill Crew and SPT Contractor (Contractor) shall perform a series of SPT energy measurements on Standard Penetration Test (SPT) hammers. All SPT testing and sampling shall be performed in accordance with ASTM D1586 (or ASTM D6066 if the soil is cohesionless). SPT energy measurement shall be performed in accordance with ASTM D 4633.

Both strain and acceleration measurements are required to determine the energy transferred to the SPT sampling rods. The Contractor shall provide all SPT energy measurement equipment necessary, including an SPT Analyzer or a Pile Driving Analyzer® as manufactured by Pile Dynamics, Inc. (30725 Aurora Road, Cleveland, OH 44139, USA; <http://piledynamics.wpengine.com/>; email: sales@pile.com; phone: +1 216831-6131;), or equivalent to make the SPT energy measurements. The equipment shall be specifically designed for dynamic foundation testing or for SPT data acquisition; generic data acquisition systems are inadequate and are expressly prohibited. The SPT energy measurement equipment shall be capable of 1) displaying force, velocity and/or energy time histories transmitted to the drill string for each hammer blow in real time as blows are applied, 2) calculating and displaying the maximum transferred energy value in real time as blows are applied and 3) storing the complete time record of force and velocity for all SPT blows.

The Contractor shall provide an instrumented 2 ft (0.6 m) subassembly of \_\_\_\_\_ (exact designation of AW, NW or other type) drill rod which matches the drill rod type used by the Drill Crew in the drill string so that energy transmission represents the SPT operation without the subassembly. The instrumented subassembly shall have a minimum of 2 strain gage bridges glued directly to the rod ("strain transducers" are specifically prohibited) and 2 accelerometers mounted diametrically opposite to cancel bending. The subassembly shall be inserted at the top of the drill string between the hammer and the existing sampling rods. Calibrations for all sensors shall be current (within last 2 years as per ASTM D4945) and calibration certificates shall be included in the report.

The SPT energy test shall be performed in accordance with measurements as detailed in ASTM D4633 Standard Test Method for Energy Measurement for Dynamic Penetrometers, and ASTM D6066 Standard Practice for Determination for the Normalized Penetration Resistance of Sands for Evaluation of Liquefaction Potential (Method B with force and velocity measurements).

High strain energy measurements shall be performed at locations and depths at the direction of the Engineer. At least \_\_\_\_\_ (e.g. four) SPT energy measurements shall be made per hammer at each test site location to cover the range of depths encountered. The Drill Crew shall advance the soil test borings to the depths required and will assist the Contractor as required in performing the SPT energy tests. SPT measurements shall be taken at 5 or 10 foot (1.5 or 3 m) intervals, or as directed by the Engineer. The Drill Crew shall record the hammer blow counts (N values) and provide a copy of the field boring logs to the Contractor.

All test data and interpretation of the results shall be submitted in a report to the Engineer by the Contractor not later than one week after completion of the field testing. The report shall interpret all test data and shall present the energy results in the form of graphs and/or tables. Transfer energies computed

by the force-velocity integration method (as detailed in ASTM D4633) shall be provided along with associated energy transfer ratios (transfer energy divided by the theoretical SPT hammer free fall energy) and the  $N_{60}$  value as detailed in ASTM D6066.

SPT dynamic force and velocity measurements are difficult. The Contractor must provide a pretested instrumentation system which has successfully measured SPT sampling conditions. The Contractor's personnel shall have at least 5 years of experience performing dynamic force and velocity measurements of pile driving and SPT drilling activities, including similar SPT calibrations for the US Army Corps of Engineers, the US Bureau of Reclamation, a US State Highway Department, or some other appropriate regulatory agency.