

**SECTION 15080****HORIZONTAL DIRECTIONAL DRILLING****PART 1 - GENERAL****1.01 SCOPE OF WORK**

- A. The work specified in this section consists of furnishing and installing underground utilities using the horizontal directional drilling method of installation, also commonly referred to as directional boring or guided horizontal boring. This work shall include all services, equipment, materials, and labor for the complete and proper installation, testing, restoration of underground utilities and environmental protection and restoration.

**1.02 RELATED SECTIONS**

- A. Section 15060 - Piping and Fittings
- B. Section 15070 - Jacking and Boring

**1.03 SUBMITTALS**

- A. The Contractor shall furnish the Engineer of Record with five copies of his site surface and sub-surface (soil borings) examination data prior to starting work. The Engineer of Record and the governing authority will analyze this information in conjunction with the equipment and methods specified below to see if any changes are required. However, no changes will be permitted unless specifically authorized in writing by the Engineer of Record and the governing authority.
- B. Work Plan: Prior to beginning work, the Contractor must submit to the Engineer of Record a work plan detailing the procedure and schedule to be used to execute the project. The work plan should include a description of all equipment to be used, down-hole tools, a list of personnel and their qualifications and experience (including back-up personnel in the event that an individual is unavailable), list of subcontractors, a schedule of work activity, a safety plan (including MSDS of any potentially hazardous substances to be used), traffic control plan (if applicable), an environmental protection plan and contingency plans for possible problems. Work plan should be comprehensive, realistic and based on actual working conditions for this particular project. Plan should document the thoughtful planning required to successfully complete the project.
- C. Equipment: Contractor shall submit specifications on directional drilling equipment. Equipment shall include but not be limited to: drilling rig, mud system, mud motors (if applicable), down-hole tools, guidance system, rig safety systems. Calibration records for guidance equipment shall be included. Specifications for any drilling fluid additives that Contractor intends to use or might use shall be submitted.
- D. Material: Specifications on material to be used shall be submitted to Engineer of Record. Material shall include the pipe, fittings and any other item which is to be an installed component of the project.

- E. The Contractor shall furnish the Engineer of Record with copies of his site surface and sub-surface (soil borings) examination data prior to starting work. The Engineer of Record will analyze this information in conjunction with the equipment and methods specified below to see if any changes are required. However, no changes will be permitted unless specifically authorized in writing by the Engineer of Record.
- F. The Contractor shall perform directional drilling in accordance with an approved drilling method. The drilling method and sequencing of the drill shall be submitted by the Contractor at the scheduled pre-construction meeting. The Contractor shall also submit, for approval, the proposed layout drawing, drilling method, along with his proposed crossing(s) configuration, including entry and exit angles, radius of curvature, and entry and exit points.

#### 1.04 QUALITY ASSURANCE

- A. All work performed within the right-of-ways of Florida Department of Transportation (FDOT), South Florida Water Management District, railroad company or other governing agencies' right-of-ways shall comply with all requirements and conditions of the governing authority, permit requirements and all requirements and conditions of these specifications.
- B. The requirements set forth in this document specify a wide range of procedural precautions necessary to insure that the very basic, essential aspects of a proper directional bore installation are adequately controlled. Strict adherence shall be required under specifically covered conditions outlined in this specification. Adherence to the specifications contained herein, or the Engineer of Record's approval of any aspect of any directional bore operation covered by this specification, shall in no way relieve the Contractor of their ultimate responsibility for the satisfactory completion of the work authorized under the project.
- C. The Contractor shall haul, string, weld, coat field joints and hydrostatically test the pipeline sections. X-ray services shall be provided for all welds. The Contractor shall provide adequate security and shall be responsible for the integrity of the pipe section until after the pullback and final test of the pipeline.
- D. The Contractor shall assume all responsibilities for its permittee while complying with all FDOT; railroad company, where applicable, and governing authority requirements having jurisdiction over their work. The Department reserves the right to enforce any and all requirements.

## **PART 2 - PRODUCTS**

### 2.01 GENERAL EQUIPMENT

- A. The directional drilling equipment shall consist of a directional drilling rig of sufficient capacity to perform the bore and pullback the pipe, a drilling fluid mixing, delivery and recovery system of sufficient capacity to successfully complete the crossing, a drilling fluid recycling system to remove solids from the drilling fluid so that the fluid can be re-used, a guidance system to accurately guide boring operations, a vacuum truck of sufficient capacity to handle the drilling fluid volume, trained and competent personnel to operate the system. All equipment shall be in good, safe operating condition with sufficient supplies, materials and spare parts on hand

to maintain the system in good working order for the duration of this project.

## 2.02 DRILLING SYSTEM

- A. Drilling Rig: The directional drilling machine shall consist of a hydraulically powered system to rotate, push and pull hollow drill pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill (bore) head. The machine shall be anchored to the ground to withstand the pulling, pushing and rotating pressure required to complete the crossing. The hydraulic power system shall be self-contained with sufficient pressure and volume to power drilling operations. Hydraulic system shall be free of leaks. Rig shall have a system to monitor and record maximum pull-back pressure during pull-back operations. The rig shall be grounded during drilling and pull-back operations. There shall be a system to detect electrical current from the drill string and an audible alarm which automatically sounds when an electrical current is detected.
- B. Drill Head: The drill head shall be steerable by changing it's rotation and shall provide the necessary cuffing surfaces and drilling fluid jets.
- C. Mud Motors (if required): Mud motors shall be of adequate power to turn the required drilling tools.
- D. Drill Pipe: Shall be constructed of high quality 4130 seamless tubing, grade D or better, with threaded box and pins. Tool joints should be hardened to 32-36 RC.

## 2.03 GUIDANCE SYSTEM

- A. A Magnetic Guidance System (MGS) or proven gyroscopic system shall be used to provide a continuous and accurate determination of the location of the drill head during the drilling operation. The guidance shall be capable of tracking at all depths up to one hundred feet and in any soil condition, including hard rock. It shall enable the driller to guide the drill head by providing immediate information on the tool face, azimuth (horizontal direction), and inclination (vertical direction). The guidance system shall be accurate to  $\pm 2$  percent of the vertical depth of the borehole at sensing position at depths up to one hundred feet and accurate within 1.5 meters horizontally.
- B. The Guidance System shall be of a proven type and shall be operated by personnel trained and experienced with this system. The Operator shall be aware of any magnetic anomalies on the surface of the drill path and shall consider such influences in the operation of the guidance system if using a magnetic system.

## 2.04 DRILLING FLUID (MUD) SYSTEM

- A. Mixing System: A self-contained, closed, drilling fluid mixing system shall be of sufficient size to mix and deliver drilling fluid. Mixing system shall continually agitate the drilling fluid during drilling operations.
- B. Drilling Fluids: Drilling fluid shall be composed of clean water and appropriate clay additives. Water shall be from an authorized source with a pH of 8.5 - 10. Water of a lower pH or with excessive calcium shall be treated with the appropriate amount of sodium carbonate or equal.

The water and additives shall be mixed thoroughly and be absent of any clumps or clods. No potentially hazardous material may be used in drilling fluid.

- C. Delivery System: The mud pumping system shall have adequate capacity of required throughout the project and be capable of delivering the drilling fluid at a constant pressure. The delivery system shall have filters in-line to prevent solids from being pumped into the drill pipe. Connections between the pump and drill pipe shall be relatively leak-free. Used drilling fluid and drilling fluid spilled during drilling operations shall be contained and conveyed to the drilling fluid recycling system. A berm, minimum of 12 inches high, shall be maintained around drill rigs, drilling fluid mixing system, entry and exit pits and drilling fluid recycling system to prevent spills into the surrounding environment. Pumps and or vacuum truck(s) of sufficient size shall be in place to convey excess drilling fluid from containment areas to storage and recycling facilities.
- D. Drilling Fluid Recycling System: The drilling fluid recycling system shall separate sand, dirt and other solids from the drilling fluid to render the drilling fluid re-usable. Spoils separated from the drilling fluid shall be stockpiled for later use or disposal.

## 2.05 OTHER EQUIPMENT

- A. Pipe Rollers: Pipe rollers shall be of sufficient size to fully support the weight of the pipe while being hydro-tested and during pull-back operations. Sufficient number of rollers shall used to prevent excess sagging of pipe.
- B. Pipe Rammers: Hydraulic or pneumatic pipe rammers may only be used if necessary and with the authorization of Engineer.
- C. Restrictions: Other devices or utility placement systems for providing horizontal thrust other than those previously defined in the preceding sections shall not be used unless approved by the Engineer prior to commencement of the work. Consideration for approval will be made on an individual basis for each specified location. The proposed device or system will be evaluated prior to approval or rejection on its potential ability to complete the utility placement satisfactorily without undue stoppage and to maintain line and grade within the tolerances prescribed by the particular conditions of the project.

## 2.06 PIPE AND FITTINGS - HIGH DENSITY POLYETHYLENE (HDPE)

- A. High density polyethylene (HDPE) pipe used in directional drilling shall be as specified herein.
- B. Smooth wall high density polyethylene (HDPE) liner pipe shall be a Type III, Class C, Category 5, Grade P 34; PE 3408; as defined in ASTM D1248. Minimum cell classification, as given by ASTM 3350, shall be PE 335434C. Pipe shall meet the standards of ASTM F714, as modified herein, including the "Governmental/Military Procurement" sections. Minimum hydrostatic design basis shall be 1600 psi. In all cases, hydrostatic design basis and pressure rating shall be as determined using the methods of ASTM F714. Pipe of this type shall be butt-fusion welded at joints. All welding of joints shall be in strict conformity with the recommendations of the pipe manufacturer and performed by a firm or individual recommended in writing by the manufacturer.
- C. As a part of the shop drawing submittals, the Contractor shall furnish, sign by a Florida

Registered Engineer, all calculations to be determined, the pipe thickness, SDR rating, allowable stresses, in accordance with ASME B31.8, Table A842.22 and recommended coating, as required by the manufacturer.

### **PART 3 - EXECUTION**

#### **3.01 GENERAL**

- A. The installation shall be coordinated with the railroad companies, FDOT, municipality in which the job is to be performed, Florida Department of Transportation (FDOT), Florida Department of Environmental Protection (FDEP), Dade County Department of Environmental Resources Management (DERM), Army Corps of Engineers or agency having jurisdiction over the work. The Contractor shall not begin work until he has received permission from the Department and the governing authority to do so. In the event railroad companies, FDOT or governing agency require payment for any services rendered, including services required due to around-the-clock construction, the costs shall be borne by the Contractor.
- B. The Contractor shall obtain all necessary permits required for around-the clock operation from the various agencies having jurisdiction over the work area, if he intends to schedule work as such. Additionally, the Contractor shall furnish and install temporary noise barriers as required to comply with noise ordinances of the various agencies having jurisdiction over the work area.

#### **3.02 PERSONNEL REQUIREMENTS**

- A. All personnel shall be fully trained in their respective duties as part of the directional drilling crew and in safety. Each person must have at least 3 years directional drilling experience. A responsible representative who is thoroughly familiar with the equipment and type work to be performed, must be in direct charge and control of the operation at all times. In all cases the supervisor must be continually present at the job site during the actual Directional Bore operation. The Contractor shall have a sufficient number of competent workers on the job at all times to insure the Directional Bore is made in a timely and satisfactory manner.

#### **3.03 DRILLING PROCEDURE**

- A. Site Preparation: Prior to any alterations to work-site, Contractor shall photograph or video tape entire work area, including entry and exit points. One copy of which shall be given to Engineer of Record and one copy to remain with shall for a period of one year following the completion of the project.
  - 1. Work site as indicated on drawings, within right-of-way, shall be graded or filled to provide a level working area. No alterations beyond what is required for operations are to be made. Contractor shall confine all activities to designated work areas.
- B. Drill Path Survey: Entire drill path shall be accurately surveyed with entry and exit stakes placed in the appropriate locations within the areas indicated on drawings. If Contractor is using a magnetic guidance system, drill path shall be surveyed for any surface magnetic variations or anomalies.

- C. Environmental Protection: Contractor shall place silt fence between all drilling operations and any drainage, wetland, waterway or other area designated for such protection by contract documents, state, federal and local regulations. Additional environmental protection necessary to contain any hydraulic or drilling fluid spills shall be put in place, including berms, liners, turbidity curtains and other measures. Contractor shall adhere to all applicable environmental regulations. Fuel may not be stored in bulk containers within 200 feet of any water-body or wetland.
- D. Safety: Contractor shall adhere to all applicable state, federal and local safety regulations and all operations shall be conducted in a safe manner. Safety meetings shall be conducted at least weekly with a written record of attendance and topic submitted to Engineer of Record.
- E. Pipe: Pipe shall be welded/fused together in one length, if space permits, with welds X-rayed prior to being placed in bore hole. Pipe shall be placed on pipe rollers before pulling into bore hole with rollers spaced close enough to prevent excessive sagging of pipe.
- F. Pilot Hole: Pilot hole shall be drilled on bore path with no deviations greater than 5 percent of depth over a length of 100 feet. In the event that pilot does deviate from bore path more than 5 percent of depth in 100 feet, Contractor shall notify Engineer and Engineer may require Contractor to pull-back and re-drill from the location along bore path before the deviation.
  - 1. In the event that a drilling fluid fracture, inadvertent returns or returns loss occurs during pilot hole drilling operations, Contractor shall cease drilling, wait at least 30 minutes, inject a quantity of drilling fluid with a viscosity exceeding 120 seconds as measured by a March funnel and then wait another 30 minutes. If mud fracture or returns loss continues, Contractor shall cease operations and notify Engineer. Engineer and Contractor will discuss additional options and work will then proceed accordingly.
- G. Reaming: Upon successful completion of pilot hole, Contractor shall ream bore hole to a minimum of 25% greater than outside diameter of pipe using the appropriate tools. Contractor shall not attempt to ream at one time more than the drilling equipment and mud system are designed to safely handle.
- H. Pull-Back: After successfully reaming bore hole to the required diameter, Contractor shall pull the pipe through the bore hole. In front of the pipe will be a swivel and reamer to compact bore hole walls. Once pull-back operations have commenced, operations must continue without interruption until pipe is completely pulled into bore hole. During pull-back operations Contractor shall not apply more than the maximum safe pipe pull pressure at any time.
  - 1. In the event that pipe becomes stuck, Contractor shall cease pulling operations to allow any potential hydro-lock to subside and shall commence pulling operations. If pipe remains stuck, Contractor shall notify Engineer of Record. The Engineer of Record and Contractor will discuss options and then work will proceed accordingly.
  - 2. The bore pipe will be pulled back in one continuous section and the Contractor must utilize a swivel to minimize the rotation of the product pipe during pull back. The Engineer of Record shall have access at all times to any measuring or gauging devices used for horizontal drill as well as any drilling logs maintained by the Contractor.

### 3.04 DAMAGED OR IMPROPERLY INSTALLED PIPE

- A. If the pipe or protective coating is damaged before installation or does not meet the specifications it shall be replaced at no expense to the Owner. If the pipe is damaged during installation by the Contractor's operations, is placed at the improper grade or line or cannot be advanced because of an unseen obstruction or any other reason, it shall be abandoned in place, and filled with concrete. After abandoning a pipe, an alternate installation shall be made, as directed by the Engineer of Record. With the exception of pipe that has to be abandoned in place due to unseen obstructions, the cost for abandonment of pipe shall be at the expense of the Contractor. No additional payment shall be made for the pipe which is abandoned, including dewatering, excavation, drilling etc.

### 3.05 PIPE TESTING

- A. The Contractor will hydrostatically test the pipe after pullback to ensure its integrity, according to testing specifications. A calibrated pressure recorder shall be used to record the pressure during the test period. This record shall be presented to the Engineer of Record and made available to the Department. The Contractor will supply portable mud tanks or construct temporary mud pits to contain excess drill fluids during construction. Upon completion of the work, the Contractor shall legally dispose of any drill cuttings and excess drill fluids in accordance with DERM regulations. The Contractor shall provide as-built drawings reflecting actual installation.

### 3.06 SITE RESTORATION

- A. Following drilling operations, Contractor shall de-mobilize equipment and restore the work-site to original condition. All excavations shall be backfilled and compacted to 95% of original density. Landscaping shall be subcontracted to a local professional landscaping company.
- B. In the event that the Contractor must abandon a drill hole before completion of the crossing, the Contractor will seal the bore hole and re-drill the crossing at no additional cost to the Department.
- C. In the event that the pipeline becomes lodged and cannot be pulled out of the drilled hole during the installation, the Contractor shall seal the pipe and existing hole. The Contractor shall re-drill a pilot hole and again commence the pulling of the pipeline. Cost of the pipe and its welding to replace the portion of the pipe not retrieved shall be borne by the Contractor.

### 3.07 RECORD KEEPING, AS-BUILTS

Contractor shall maintain a daily project log of drilling operations and a guidance system log with a copy given to Engineer of Record at completion of project. The Contractor shall provide as-built drawings of the completed operation and certified as to accuracy by the Contractor.

END OF SECTION