MARCELLUS SHALE COALITION™

RECOMMENDED PRACTICES:
Horizontal Directional Drilling

MSC RP 2020-1 September 28, 2020

RECOMMENDED PRACTICES: Horizontal Directional Drilling

1.1 Purpose

These recommended practices support our guiding principles and address relevant considerations and guidelines for horizontal directional drilling (HDD) associated with pipeline construction. Please see 25 Pa. Code 78a.68 for relevant regulatory requirements associated with HDD operations in Pennsylvania and the reference material below for more detailed practices related to HDD design and construction. These reference materials have been prepared by respected organizations who have engaged industry leaders to both author and update each document, including:

- The North American Society for Trenchless Technology's (NASTT) "HDD Good Practices Guidelines";
- Pipeline Research Council International's (PRCI) "Installation of Pipelines by Horizontal Directional Drilling, An Engineering Design Guide";
- American Petroleum Institute's (API) Work Group HDD education document;
- The Federal Energy Regulatory Commission's (FERC) "Guidance for Horizontal Directional Drilling Monitoring, Inadvertent Return Response, and Contingency Plans"; and
- The American Society of Civil Engineering's (ASCE) "Pipeline Design for Installation by Horizontal Directional Drilling".

2.1 Planning

Pre-construction planning is the first and most critical component of all construction projects. This includes evaluating the feasibility of a pipeline HDD, including:

- An evaluation of the topography and regional geology for feasibility of conducting a horizontal directional drill;
- The performance of a geotechnical investigation of the area in or adjacent to geotechnical hazards, including aquatic resources, roads, railways, and sensitive lands;
- An evaluation to determine if HDD or other technique is the most appropriate pipeline installation method;

Once it is determined that HDD is the most appropriate pipeline installation method, the planning process for a pipeline HDD project should, at a minimum, include the following:

- A survey of the path of the intended bore;
- The development of the bore profile, including pull-back space;
- The development of a scope of work;
- A geohazard risk review and prioritization;
- The appropriate contract terms & conditions with the HDD contractor;
- The appropriate oversight of the HDD contractor during construction by an experienced professional;
- The preparation of a site-specific inadvertent release Contingency Plan in the event of an incident (this should be in place well ahead of construction and must be present onsite during HDD operations per 25 Pa. Code 78a.68a(b));
- The obtaining of all requisite permits and authorizations, including locating buried utilities through the state regulatory authority (SRA), an example of which is Pennsylvania One-Call (811).
- Understanding the professional licensure requirements in the state where the project is located.

2. 1.1 Site Selection

The feasibility of HDD depends on the local geologic setting, as well as site topography and the presence of other surface features. It is also important to understand sensitive receptors in the general area of the HDD construction area (drinking water wells, surface water bodies, …), which may be high-risk locations to avoid. If high-risk areas cannot be avoided, additional geotechnical investigations may be needed. These site-specific conditions should be investigated prior to drilling by a qualified professional to determine whether conditions are favorable, and to identify any ground preparation procedures that may be necessary.

2. 1.2 Geotechnical Investigation

In most situations, at least one preconstruction geotechnical borehole should be drilled on each side (entry and exit) of the proposed HDD site. Additional borings and/or geophysical studies within the water or on land may be needed to fully understand local geotechnical conditions and hazards. In addition to waterways, saturated areas such as wetlands may be included in an investigation to determine subsurface density and identifying potential voids, which can reduce the risk of an inadvertent release. Where potential obstructions are known or suspected, test pits may be needed to identify their extents. The depth of the geotechnical borings should provide an opportunity to collect subsurface data sufficient enough to plan a successful HDD bore. The depths of the borings should intersect the profile of the proposed HDD and be of sufficient depth to allow for manipulation of the HDD profile during design to be able to drill through the best formation. The borings should be located at an offset of the HDD alignment as boring directly on top of the HDD path may increase the chance of inadvertent release. The depth of the borings and development of a geotechnical testing program should be developed and implemented by personnel experienced in HDD design development. A "Findings Report" with recommendations for the geotechnical aspects of pipeline construction for the aquatic resource crossing, roadway crossing, etc. should be provided and is usually signed and sealed by a licensed professional and reviewed with the HDD contractor as part of a pre-construction meeting.

The geotechnical investigation helps to determine the feasibility of an HDD crossing. The investigation can identify potential problem soils or rock, such as loose sand, cobbles and boulders, highly fractured rock or a variable top-of-rock interface, or environmental contamination. If necessary, an HDD bore path should be adjusted (e.g. lengthened, deepened, made shallower) based upon the observed subsurface conditions.

On HDD sites with an appreciable thickness of soil overburden (e.g. a "soil site"), it is recommended to carry out a formal hydrofracture analysis if HDD is determined to be a viable construction method. A plan to monitor for and handle inadvertent releases of fluid (IRs) should be in place on any HDD site. However, a hydrofracture analysis aims to reduce the overall likelihood of IR occurrence and poor outcomes.

On HDD sites with minimal soil interaction along the bore path (e.g. a "rock site"), characterization of the rock mass becomes critical. The rock strength informs the contractor of "drillability", necessary drilling techniques, equipment, or fluids, level of effort, and other information.

2.1.3 Bore Path/Profile Survey

Since an HDD is a three-dimensional installation, surveying the limits of the right-of-way and the topography along the bore are equally important. A professional surveyor should locate the limits of the right-of-way based on land lease agreements, which often include extra workspace on the entry and exit sides of the bore. When designing the bore profile, the engineer should consider the type of pipe, anticipated stresses, and subsurface soil or rock conditions. Those factors may dictate length and entry/exit locations of the bore.

2.1.4 Permitting and Other Authorizations

It is incumbent on those proposing to install pipelines to obtain all permits and authorizations from the SRA.

2.1.5 Jobsite Safety

Separate safety plans may be drawn up by the project owner and contractor performing HDD, though many elements are likely to be similar to the safety plan of the overall construction project. At a minimum, such guidelines should include identification of known hazards, emergency contact information and response activities. Safety contingency plans should be developed prior to the commencement of construction work in the event that an unexpected event occurs (including inadvertent releases). Third party safety qualification programs can also be utilized to review contractor safety performance prior to contracting.

2.1.6 Developing a Scope of Work

The project owner should develop a scope of work with sufficient detail for a contractor to successfully execute the project in compliance with the project owner's specifications and all applicable laws, regulations and permits. The scope of work should detail safety expectations and describe oversight that may be provided by a separate firm (it is recommended that oversight be performed by a licensed professional who has the relevant oversight experience).

2.1.7 Pipeline and HDD Contractor Selection and Contracting

The project owner should select experienced pipeline and HDD contractors with equipment and appropriate personnel to successfully execute the scope of work. The company should strive to select only those contractors with proven success rates in the geologic region of the HDD and with good environmental, health and safety records.

It is important to understand the importance of contractor competency, as the quality and competency of HDD contractors can vary significantly. Contractor references and experience qualification review can help rate and rank prospective contractors. Additionally, scorecards can be utilized to help monitor existing contractor performance and provide direct feedback throughout the construction period.

2.2. Implementation

Once determined that HDD is appropriate, installation of a pipeline is generally accomplished in five stages:

1. Directionally drilling a small-diameter pilot hole along a pre-determined path.
2. Enlarging (or reaming) the pilot hole to a diameter that will accommodate the product pipeline(s). Several "reaming" passes may be necessary to enlarge the diameter of the bore hole incrementally, depending on the size of the required bore.
3. Pre-installation inspection. This includes radiographic inspection of all welds, and a preliminary hydrostatic test.
4. Pulling the product pipeline through the enlarged hole.
5. Post-installation inspection. This includes inspection for coating damage, in-line and remote monitoring inspection tools, and hydrostatic testing.

2.2.1 Review of Health and Safety Plan

Prior to commencing any activities at the HDD location, the contractor and the project owner should review the site-specific health and safety plan to determine what equipment should be provided.

2.2.2 Field Locating Buried Utilities

Prior to beginning HDD, the contractor in the field should locate any buried utilities within or adjacent to the proposed bore path. The contractor may excavate small holes, known as "potholes" to physically identify the shallow-seated utilities.

2.2.3 Drilling Fluids and Water

At all times during drilling operations, the contractor should maintain full annular circulation of drilling fluids. Drilling fluid release at locations other than entry and exit points should be minimized. If annular circulation is lost, the contractor should take immediate action to restore circulation. In the event of an inadvertent surface release of drilling fluids, the contractor should take immediate action to contain and collect release fluids in conformance with governing environmental regulations. In the event surface release fluid volumes are present, drilling operations should be suspended until the volumes are contained.

2.2.4 Instrumentation

At all times during drilling operation, the contractor should provide and maintain instrumentation that can:

- Locate the pilot hole.
- Measure the drill string axial position.
- Measure torsional loads and push/pull forces.
- Measure drilling fluid annular pressure and volume.

The contractor should provide the project owner access to instrumentation and instrument readings at all times.

2.2.5 Pilot Hole Drill Tolerances

The pilot hole should be drilled along the axis shown on the plan and profile drawing in conformance with specified tolerances including:

- Entry/Exit Point Location
- Elevation
- Axial
- Bend Radius

If a pilot hole exceeds the specified tolerances, deviations should be subject to approval by the project owner. If required, the contractor should redirect or drill another hole as directed by the project owner. If it becomes necessary to abandon the hole, it should be sealed by installing a full-length grout plug, as specified by the project owner. The pipeline owner should check the pipe stresses and strains if deviation is approved.

2.2.6 Pipe Installation and Pull-Back Operations

The contractor should determine the number of reaming passes necessary to achieve the desired borehole diameter. The contractor should minimize vibration during hole-reaming passes using centralizers or stabilizers. After the last reaming pass is completed, the contractor and project owner should assess the borehole to determine if swabbing passes should be made or if the pipe may be pulled. One swab pass at a minimum should be completed, and additional swab passes may need to be performed based on the first swab

While installing the pull section, the contractor should inspect 100 percent of the section length for imperfections in pipe coating after the last cradle. Any coating damage should be repaired in conformance with pre-specified standards.

3.1 Corrective Actions for Inadvertent Release

During construction of the HDD, personnel should monitor the ground surface in the vicinity of the bore for inadvertent releases and maintain communication with the contractor to note loss of circulation.

The drilling crew shall take immediate corrective action to stop a release by reducing fluid pressure in the borehole. The project owner and contractor should work together to stop the inadvertent release and re-establish circulation to the entry/exit pits as quickly as possible. After the inadvertent release is stabilized and any required removal of the released drilling fluid is completed, it is a recommended practice to document post-cleanup conditions with photographs and prepare an incident report describing time, place and actions taken to remediate the release and measures implemented to prevent recurrence in accordance with regulatory requirements (including all notification, reporting, and clean-up requirements).

3.2 Notification Procedures

Release of bentonite to a watercourse may need to be reported to the appropriate regulatory agencies. In Pennsylvania, it must be reported immediately to the PA DEP in accordance with 25 Pa. Code 78a.68a(i). Additional reporting may be required by a river basin commission. Additionally, if the inadvertent release has the potential to impact surface water intakes, the project owner should notify those intake operators immediately. Notification contact information should be communicated appropriately.

4.1 Abandonment

If abandonment is warranted, the following procedures should be implemented to abandon the drill hole:

- Pump thickened drilling fluid into the hole as the drill assembly is extracted, using cement grout to make a cap.
- Closer to the surface of the hole(s) (within approximately 10 feet of the surface), a soil cap should be installed by filling with soil extracted during construction of the pit and berms.
- Re-grade the entry pit location to restore original grade and condition after the drill hole has been abandoned.

This document provides general guidance on recommended practices for the subject(s) addressed. It is offered as a reference aid and is designed to assist industry professionals in improving their effectiveness. It is not intended to establish or impose binding requirements. Nothing herein constitutes, is intended to constitute, or shall be deemed to constitute the setting or determination of legal standards of care in the performance of the subject activities. The foregoing disclaimers apply to this document notwithstanding any expressions or terms in the text that may conflict or appear to conflict with the foregoing.

400 Mosites Way • Suite 101 • Pittsburgh PA 15275 412.706.5160 • www.MarcellusCoalition.org

MSC RP 2020-1 September 28, 2020

