Natural Gas Pipeline Construction Process

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Introduction

The Wisconsin Agricultural Impact Statement (AIS) program is an outreach and advocacy program serving farm operations impacted by utility, municipal and transportation projects such as natural gas pipelines, electric transmission lines and highways. To these farm operators, the AIS program offers an opportunity to voice concerns, provide input and offer suggestions to preserve farmland.

The construction of large scale natural gas pipelines is complex and may have a variety of impacts on farm operations. This document provides farm operators a basic overview of typical natural gas pipeline construction practices in Wisconsin. The construction process described here is representative only and may not reflect the exact process used to construct any specific pipeline. For more information on the AIS program, or to view other AIS publications, visit agimpact.wi.gov or contact the AIS program at datcpagimpactstatements@wisconsin.gov or (608) 224-4650.

Construction Process

Generally, natural gas pipeline construction projects follow an orderly set of activities, similar to an assembly line. This document outlines and describes a typical natural gas pipeline construction sequence in Wisconsin, as shown in *Figure 1*. This construction sequence includes 1) surveying and staking of the right-of-way (ROW), 2) clearing and grading, 3) pipe stringing, 4) bending and welding, 5) pipeline installation, 6) hydrostatic "pressure" testing, and 7) cleanup and restoration. To complete these activities, pipeline utilities use a variety of equipment including bulldozers, graders, excavators, trenchers, dump trucks, side booms, ATVs, road boring rigs, horizontal directional drill (HDD) rigs, pickup trucks, tractor trailers, rock trenchers, vacuum excavators, tractors with tillage implements, rock picking machines, welding rigs, and x-ray trucks.

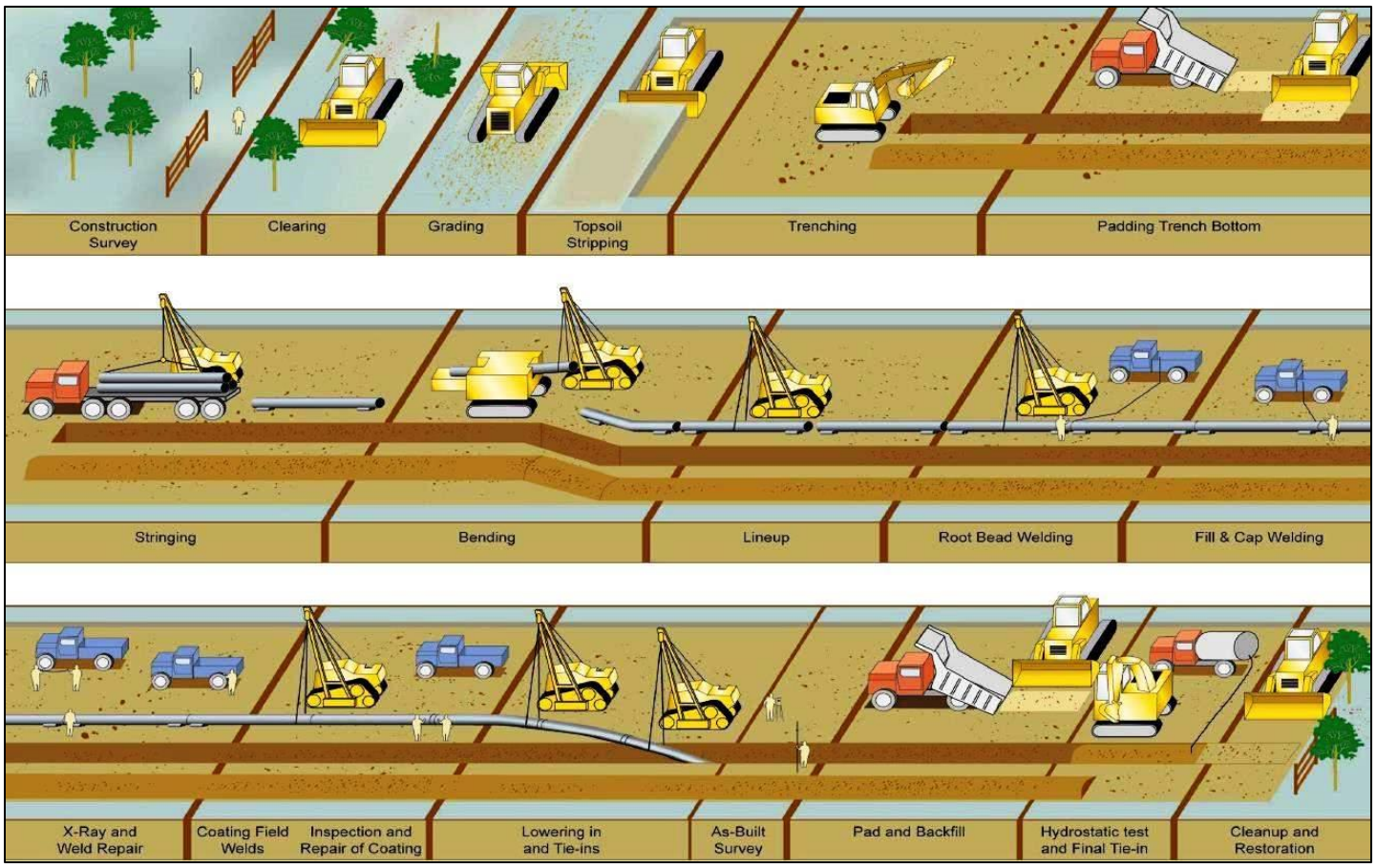

Figure 1: Progression of typical construction practices to install a natural gas pipeline, beginning with construction survey (upper left) and finishing with cleanup and restoration (lower right).
Source: Wisconsin Power and Light, Western Wisconsin Gas Expansion Project Presentation, April 10, 2019.

Surveying and Staking

The natural gas pipeline construction process begins with surveying. The pipeline utility will first survey and stake the pipeline centerline, construction ROW limits, temporary workspace areas, temporary access roads and known underground infrastructure that cross or runs parallel to the pipeline. An impacted landowner should expect to see a survey crew traveling within the approved ROW to mark these areas.

Clearing and Grading

The construction ROW is then cleared and graded by the pipeline utility. These activities provide a level area for pipe-laying operations and the transport of construction equipment. The construction ROW consists of all purchased land, easements and temporary work spaces. Clearing involves the removal of all trees and brush from the work area, as shown in *Figure 2*. Removal of stumps and roots will also occur over the area where the trench will be excavated. Non-woody vegetation is removed by mowing.

A fence crew usually operates with the clearing crew to cut and brace existing fencing and install temporary gates along the ROW. The fence crew also installs necessary fencing along identified sensitive areas and along pastures with livestock.

The pipeline utility will work with affected landowners where the cutting of merchantable timber is required for pipeline construction. Timber may also be cut and left along the edge of the ROW for the landowner's use. If the landowner does not want to retain ownership of the timber, the pipeline utility will remove or dispose of it. Disposal of unwanted woody material and stumps may including burning, burying or chipping at a location approved by the landowner.

Figure 2: Removal of trees and shrubs from ROW.

Topsoil Stripping

The pipeline utility will typically strip the top 12 inches of topsoil, sometimes more, from the full width of the ROW in agricultural areas as shown in *Figure 3*. The topsoil is then stockpiled along the edge of the easement to minimize damage to the productivity of the topsoil. In some locations, maintaining preconstruction soil productivity requires subsoil to be segregated, not only from the topsoil, but also from the underlying parent material (e.g. glacial till, gravel, sand). This is known as three-lift soil management, which is described in DATCP's three-lift soil management fact sheet.

Figure 3: Topsoil stripping.

Pipe Stringing

Pipe stringing consists of the transportation of pipe, by truck, from pipe storage areas to the construction site ROW. The pipe is then positioned along the pipeline route as shown in *Figure 4*. Pipe stringing may be conducted either before or after trenching.

Figure 4: Pipe stringing.

Bending and Welding

After pipe stringing, pipes may be bent to fit the contours of the landscape. The pipe is then placed on temporary supports along the edge of the trench, aligned, and welded together as shown in *Figure 5.* A qualified inspector visually and radiographically, by use of x-ray or gamma rays, inspects the completed welds. Following inspection, a protective coating is field-applied to each weld joint to prevent corrosion.

Figure 5: Pipe welding within the ROW.

Pipeline Installation

Pipelines are typically installed in two different ways: 1) open trench or 2) boring with or without horizontal directional drilling (HDD). Both methods may be used on any project. However, open trench is more commonly used in agricultural areas, while HDD is generally used to minimize impacts to features such as roads, driveways and natural resources.

Open Trench

Open trenches are typically excavated using an excavator or a trenching machine as seen in *Figure 6*. Soils excavated during trenching on agricultural lands are segregated using three-lift soil management techniques. The excavated soils are then temporarily stored within the construction ROW for use during restoration. Any excess soil or material not suitable for backfill is relocated to a suitable location. The trench bottom is inspected to ensure it is free of rocks and debris. If required, sand or soil bedding material is placed in the trench bottom. The trench is dewatered, as necessary, in accordance with applicable permits and regulations.

Figure 6: Open trench excavation.

Lowering-In

The pipeline is then lowered into the trench using side-boom tractors or excavators as seen in *Figure 7*. A final inspection ensures the pipeline is properly placed on the trench bottom, all pipe bends conform to trench alignment, and that the pipe coating is not damaged.

Figure 7: Lowering of pipe into open trench.

Trench Breakers

Upon completion of lowering-in activities, trench breakers are installed as needed in sloped areas to prevent the subsurface flow of water along the pipe. Trench breakers are typically made from sandbags, as seen in *Figure 8*, or reinforced structures covered with a plastic lining.

Figure 8: Placement of sandbag trench breakers.

Drain Tile Repairs

A common impact from open-trench excavation is the possibility of cutting or damaging drainage tile in agricultural fields. Before backfilling the trench, the pipeline utility will repair broken or damaged drain tiles. Repairs may consist of installing a new piece of drain tile or rigid PVC to span the trench and reconnect to the undamaged sections of drain tile, as shown in *Figure 9*. The newly-installed drain tile or PVC will also be supported by a steel channel or I-beam. This ensures the slope of the tile is maintained during backfilling.

Figure 9: Drain tile repair made with flexible drain pipe and steel channel.

Backfilling

After the pipeline is installed in the open trench, the trench is backfilled with subsoils and then topsoil. Prior to back filling, rocks are removed from subsoil and the trench to prevent damage to the pipe. Unsuitable backfill and rocks are disposed of. After backfilling is complete, the ROW is graded to preconstruction contours, to the extent possible, except as needed for soil stability purposes and the installation of erosion control measures.

Boring with or without Horizontal Directional Drilling (HDD)

In some locations, the pipeline utility may bore underground with or without HDD to avoid impacts to features such as roads, driveways and natural resources.

Boring

Boring is typically used to cross short distances under roadways or railways with minimal disruption to traffic. Prior to boring, the construction area is first stripped of topsoil. Bore pits are then excavated on each side of the obstruction. Any groundwater flowing into the pit is pumped into a dewatering structure. A boring machine is placed alongside the bore pit and an auger then bores under the obstruction to remove soil. Before the bore is removed, a carrier pipe is attached. The carrier pipe is then used to either

push or pull sections of the pipeline under the road or railway. After the new pipe is installed and tied into the rest of the pipeline, the bore pits are backfilled and restored.

HDD

HDD is often used to avoid disturbance to environmentally sensitive areas such as wetlands and waterways. HDD construction through wooded areas also reduces the amount of trees removed as compared to open trench construction. To begin HDD, an entry and exit bore pit are excavated on either side of the sensitive area to be avoided. Then a drill machine is set up and a small diameter pilot hole is drilled under the area to be avoided, as shown in *Figure 10*. The pilot hole is then enlarged using reaming tools. During this process, drilling mud composed of clean water, bentonite clay, and synthetic polymers are pumped into the hole to lubricate the reaming tool, remove soil cuttings, and maintain the integrity of the hole. When the hole is the appropriate size, the welded pipe is pulled through the hole. Used drilling mud is taken to an approved upland area or disposed of in accordance with applicable permits and regulations. Exit and entrance bore pits are restored to preconstruction conditions, to the extent possible.

Figure 10: A horizontal directional drill machine.

Hydrostatic "Pressure" Testing

The completed pipeline is then hydrostatically tested for leaks. Hydrostatic testing is performed by filling the pipe with water to determine if the pipe meets the maximum design operating pressure for the pipeline. After testing, the water within the pipeline is disposed of in accordance with permit requirements. The pipeline is also caliper-pigged prior to service using a *Pipeline Integrity Gauge* "pig." A pig is a mechanical device sent through the pipeline to record the internal diameter of the pipe and look for areas that are deformed.

Cleanup and Restoration

Once construction activities are complete, the area is restored to preconstruction conditions to the fullest extent possible. Surface grading is done to re-establish natural contours. Disturbed areas are revegetated to be compatible with preconstruction conditions and adjacent vegetation patterns. Where necessary, soil decompaction occurs and any segregated topsoil replaced. Trash and debris are removed and disposed of in approved areas in accordance with federal, state and local regulations. Fences that were cut or removed during construction are repaired or replaced. Pipeline markers are installed along the length of the pipeline.