PIPELINE DESIGN & CONSTRUCTION

For Enable Midstream and it's subsidiaries

Every step involved in building a natural gas pipeline is guided by Enable Midstream professionals with years of experience and in compliance with the highest industry and government standards for safety, environmental protection and operational reliability. Natural gas transmission pipeline is composed of high strength carbon steel and is constructed in accordance with U.S. Department of Transportation pipeline regulations.

For more information on natural gas pipeline design and construction, visit *http://www.ingaa.org/Pipelines101.aspx*.

Construction Process[1]

Building a new pipeline involves many steps, may include the following:

- Permit Acquisition
- FERC Review and Approval
- Acquiring Rights-of-Way
- Pipeline Construction
  - Clearing and Grading
  - Stringing
  - Trenching
  - Pipe Bending
  - Welding
  - Coating
  - Lowering In
  - Backfilling
  - Hydrostatic Testing
  - Restoration
  - Special Construction Techniques
    - Open Cut Stream Crossing
    - Directional Drilling
    - Wetlands
    - Road Bores

Permits

Prior to construction, Enable Midstream and its subsidiaries must obtain numerous local, state and federal permits, approvals, and clearances. The permits address all of our natural resources - land, air, water, vegetation and wildlife, as well as the interests of the general public.

Required permits and consultations for the Central Arkansas Pipeline Enhancement (CAPE) Project may include the following:

- Local
  - Building permits
  - Road crossing permits
  - Erosion and sediment control permit
- State
  - Water Withdrawal Authorization – Arkansas Natural Resources Commission
  - Hydrostatic Test Water Discharge Permits – Arkansas Department of Environmental Quality (ADEQ)
  - Stream and River Crossings - ADEQ
  - Cultural Resources Preservation - State Historic Preservation Office
  - Threatened and Endangered Species Preservation - Arkansas Game and Fish Commission, Arkansas Natural Heritage Commission
- Federal
  - Wetland and Water Crossings - U.S. Army Corps of Engineers
  - Threatened and Endangered Species - U.S. Fish & Wildlife Service
  - Soils and Revegetation – Natural Resources Conservation Service
  - Certificate of Public Convenience and Necessity – Federal Energy Regulatory Commission (FERC)

1. Portions adapted from information provided by the Interstate Natural Gas Association of America

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FERC Filing

To gain approval for constructing an interstate pipeline project, Enable Midstream must file a detailed project plan with the FERC. Among other things, this plan will include maps showing the preliminary pipeline route, a description of the proposed pipeline facilities, and up to 13 specific environmental resource reports. These resource reports cover topics such as water use and quality, vegetation and wildlife, cultural resources, socioeconomics, geological resources, soils, land use, air and noise quality, safety, and project alternatives.

FERC has the authority to approve the pipeline location and construction. It does so by issuing a Certificate of Public Convenience and Necessity (Certificate). Before the FERC will issue a Certificate, it will conduct a thorough review to determine if the project is in the public interest. This review includes an evaluation of need for the project, costs of transporting natural gas by the pipeline, financing and market competition. The commission also conducts an environmental review to evaluate the project's anticipated impact on the public and the environment.

Part of the Commission's review process includes public meetings in some of the communities that the project will be located near. Announcements of these public meetings are published in local newspapers. The meetings provide a forum for the local community to ask questions and express any comments or concerns about the project.

If a Certificate is issued, the FERC will authorize construction to begin once any conditions established in the Certificate order are satisfied.

Acquiring Rights-of-Way

Right-of-way acquisition often raises many questions with landowners:

- Why is this the proposed route for the pipeline?
- Why is the pipeline needed?
- What is the procedure for acquiring approval for use of my land?
- How will I be compensated?
- How will the land be restored after construction?
- Can I use the land after the pipeline is installed?

The cornerstone of the right-of-way acquisition process is the negotiation of an easement agreement. This agreement covers key issues such as compensation, special construction concerns, restoration of the land and restrictions on future use of the land. Once the pipeline route is selected, a right-of-way agent representing the company will contact each landowner along the route to discuss the project and negotiate an easement agreement.

In addition to the permanent easements required to operate and maintain a pipeline after it is constructed, temporary easements are also required during construction. Larger pipelines require the use of large equipment that require more room to operate. The amount of workspace required also depends on the type of terrain being crossed and any special construction requirements.

The landowner is compensated a fair market value for the permanent easement, which typically allows the landowner continued use and enjoyment of the property, but with some limitations. The limitations typically prohibit excavation as well as structures and trees within the easement in order to preserve safe access for maintenance equipment when necessary and allow for uninhibited aerial inspection of the pipeline system. The landowner is generally compensated a lower value for the use of the temporary construction easement, since this land reverts back to the landowner after construction without any restrictions. Additionally, landowners are compensated for any damages or losses, such as loss of crop revenues, they may incur as a result of the construction across their property.

Pipeline Construction

Enable Midstream is committed to safe and reliable operations, and we design, construct, test, operate and maintain our natural gas pipeline facilities to meet or exceed the requirements of federal pipeline safety regulations.

Enable Midstream's projects will look much like a moving assembly line during construction. A project is typically broken into manageable lengths, called construction spreads, to be built by a fully equipped, highly specialized qualified workgroup. Each construction spread is composed of various crews, each with its own set of responsibilities. As one crew completes its work, the next crew will move into position to complete its piece of the construction process, such that the front of the construction spread clears the right-of-way and the back of the spread restores the right-of-way.

Clearing and Grading

First, the survey crew carefully surveys and stakes the construction right-of way so that only the pre-approved construction workspace is cleared. Then, the clearing and grading crew leads the construction spread. This crew is responsible for removing trees, boulders and debris from the construction right-of-way and preparing a level working surface for the heavy construction equipment that follows

The crew installs silt fence along the edges of streams and wetlands to prevent erosion of disturbed soil. Trees inside the right-of-way are cut down, and the contractor removes or stacks the timber alongside the right-of-way. Brush is commonly chipped or burned. In agricultural areas, topsoil will be stripped to a predetermined depth and stockpiled along the sides of the right- of-way.

Stringing

At the steel rolling mills where the pipe is fabricated, new pipe is carefully inspected to verify that it meets industry and federal government safety standards. For corrosion control, the outside surface will be treated with a protective coating.

The pipe will be transported from the pipe mill to a pipe storage yard in the vicinity of the pipeline location or directly to the right-of-way. The pipe lengths typically are 40 to 80 feet long. A stringing crew using specialized trailers will move the pipe from the storage yard to the pipeline right-of-way.

The crew will be careful to distribute the various pipe joints according to the design plan since the type of coating and wall thickness can vary based on soil conditions and location. For example, a heavier wall pipe may be required at road crossings, railroad crossings or in special construction areas.

Trenching

The trenching crew will use a wheel trencher or backhoe to dig the pipe trench in which the pipeline will be installed. The depth of the trench can vary across the entire pipeline to accommodate site-specific design criteria, pipe diameter and overburden requirements. The typical minimum depth for the pipeline will provide for 36 inches of cover above the top of the pipe, but the pipe will be buried even deeper at stream and road crossings.

If the crew finds large quantities of solid rock during the trenching operation, it could use special equipment or explosives to remove the rock. The contractor will use explosives carefully, in accordance with state and federal guidelines, for a safe, controlled blast.

In cultivated areas, the topsoil over the trench will be removed first and kept separate from the excavated subsoil, a process called topsoiling. As backfilling operations begin, the soil will be returned to the trench in reverse order with the subsoil put back first, followed by the topsoil. This process returns the topsoil to its original position.

Pipe bending

The pipe bending crew will use a bending machine to make slight bends in the pipe to account for changes in the pipeline route and to conform to the topography.

The bending machine uses a series of clamps and hydraulic pressure to make a very smooth, controlled bend in the pipe. All bending is performed in strict accordance with federally prescribed standards to ensure integrity of the bend.

Welding

The pipe gang and welding crew will be responsible for welding, the process that joins the various sections of pipe together into one continuous length. The pipe gang uses special pipeline equipment called side booms to pick up each joint of pipe, align it with the previous joint and make the first part (pass) of the weld. The pipe gang then moves down the line to the next section repeating the process. The welding crew follows the pipe gang to complete each weld.

As part of the quality-assurance process, each welder must pass qualification tests to work on a particular pipeline job, and each weld procedure must be approved for use on that job in accordance with federally adopted welding standards. Welder qualification takes place before the project begins. Each welder must complete several welds using the same type of pipe that will be used in the project. The welds are then evaluated by placing the welded material in a machine and measuring the force required to pull the weld apart.

A second quality-assurance test makes certain of the quality of the ongoing welding operation. To do this, qualified technicians take X-rays of the pipe welds to check that the completed welds meet federally prescribed quality standards. The X-ray technician processes the film in a small, portable darkroom at the site. If the technician detects any flaws, the weld is repaired or cut out, and a new weld is made. Another form of weld quality inspection employs ultrasonic technology.

Coating

Line pipe is externally coated to inhibit corrosion by preventing moisture from coming into direct contact with the steel. Normally, this is done at the mill where the pipe is manufactured or at another coating facility before it is delivered to the construction site. All coated pipe, however, has uncoated areas three to six inches from each end to prevent the coating from interfering with the welding process. Once the welds are made, a coating crew coats the field joint, the area around the weld, before the pipeline is lowered into the ditch.

Pipeline companies use several different types of coatings for field joints, the most common being fusion bond epoxy or two-part epoxy. Prior to application, the coating crew thoroughly cleans the bare pipe with a power wire brush or sandblast to remove any dirt, mill scale or debris. The crew then applies the coating and allows it to dry prior to lowering the pipe in the ditch. Before the pipe is lowered into the trench, the coating of the entire pipeline is inspected to make sure it is free of any defects.

Lowering In

Lowering the welded pipe into the trench demands close coordination and skilled operators. Using a series of side-booms, which are tracked construction equipment with a boom on the side, operators simultaneously lift the pipe and carefully lower the welded sections into the trench. Non-metallic slings protect the pipe and coating as it is lifted and moved into position.

In rocky areas, the contractor may place sandbags or foam blocks at the bottom of the trench prior to lowering in the pipe to protect it and the coating from damage.

Backfilling

Once the pipe has been placed into the trench, the trench can be backfilled. This is accomplished with either a backhoe or padding machine depending on the soil makeup. As with previous construction crews, the backfilling crew takes care to protect the pipe and coating as the soil is returned to the trench. The soil is returned to the trench in reverse order, with the subsoil put back first, followed by the topsoil so that the topsoil is returned to its original position.

In areas where the ground is rocky and coarse, crews screen the backfill material to remove rocks, bring in clean fill to cover the pipe, or cover the pipe with a material to protect it from sharp rocks. Once the pipe is sufficiently covered, the coarser soil and rock can be used to complete the backfill.

Hydrostatic Test

Before the pipeline is put into natural gas service, the entire length of the pipeline is pressure tested using water. The hydrostatic test is a construction quality assurance test. Requirements for this test are also prescribed in DOT's federal regulations. Depending on the varying elevation of the terrain along the pipeline and the location of available water sources, the pipeline may be divided into sections to facilitate the test.

Each test section of pipeline is filled with water and pressurized to a level higher than the maximum operating pressure of the pipeline. The test pressure is held for a specific period of time to determine if it meets the design strength requirements and if any leaks are present. Once a test section successfully passes the hydrostatic test, water is emptied from the pipeline in accordance with state and federal requirements. The pipeline is then dried before natural gas is put into the pipeline.

Restoration

The final step in the construction process is restoring the land as closely as possible to its original condition. Depending on the project's requirements, this process typically involves decompacting the construction work areas, replacing topsoil, removing large rocks that may have been brought to the surface, completing any final repairs to irrigation systems or drain tiles, applying soil amendments, restoring fences, etc.

The restoration crew carefully grades the right- of-way, and in hilly areas, installs erosion- prevention measures such as slope breakers, which are small earthen mounds constructed across the right-of-way to divert water.

As a final measure, the crew will plant seed and apply mulch, as needed, to revegetate the construction right-of-way and work areas

Special Construction Techniques

Open cut river and stream crossings

This crossing method for rivers and streams involves excavating a trench across the bottom of the river or stream to be crossed. The contractor prepares the pipe for the crossing by stringing it out on one side of the stream or river and then welds, coats and hydrostatically tests the entire pipe segment. Sidebooms carry the pipe segment into the stream bed, or the construction crew floats the pipe into the river with flotation devices and positions it for burial in the trench. Concrete weights or concrete coating may be used to counter any pipe buoyancy and ensure the pipe will stay in position.

Directional Drilling

Another crossing method is the use of directional drilling. While not always feasible, this method avoids the excavation of a trench across the bottom of the crossing. It is a method typically considered for longer crossings and requires suitable geological conditions at the crossing location. Basically, it involves drilling a hole large enough for the pipeline to be pulled through it.

Before a directional drill can be designed, core samples must be taken on both sides of the crossing to evaluate the underground rock and soil conditions. If the subsurface will support a directional drill, an engineer can design a crossing that establishes the entry point of the pipeline crossing, the exit point, and its profile as it would traverse under the crossing. During the directional drilling process, a clay-based drilling mud is circulated into the bore to assist in the removal of drilling debris, maintain the integrity of the bore and reduce the friction between the soil and the pipe during pullback.

While this drilling is in progress, the line pipe sections are strung out on the far side of the crossing, opposite of the drilling rig, to be welded. Once welded, the joints are X-rayed, coated, hydrostatically tested and then placed on rollers in preparation for being pulled back through the drilled hole.

Once the drilling operation is complete, the cutting head is removed, the bore is swabbed to ensure that it is free of obstructions and debris, and the drill string is attached to the welded pipeline segment. The crew uses the drilling rig to pull the pipeline segment back through the drilled hole, where it is then connected into the pipeline on both ends.

Wetlands

Placing a pipeline in wetlands or marshes also requires special construction techniques. In one technique, crews place large timber mats ahead of the construction equipment to provide a stable working platform. The timber mats act much like snowshoes, spreading the weight of the construction equipment over a broad area. The mats make it possible to operate the heavy equipment on the unstable wetland soils.

Road Bores

For crossing small or lightly-trafficked roads, pipeline contractors use the “open-cut” method. Traffic is diverted while the contractor digs the trench across the road and installs the pipeline. The contractor subsequently repairs the road bed and replaces the pavement.

For highways and roads with heavy traffic, pipeline contractors often use road bores to install the pipeline. Similar to a directional drill for river crossings, the road bore is accomplished with a horizontal drill rig or boring machine. The boring machine drills a hole under the road to allow insertion of the pipe. In some instances, a casing is first installed in the hole, and the pipeline is inserted inside the casing. The benefit of the road bore is that it allows installation of the pipeline without disrupting traffic.