



Natural Gas Pipeline Construction Process

The information below explains the pipeline construction process. (Portions adapted from information provided by the Interstate Natural Gas Association of America).

Permits

Prior to construction, Dominion Energy must obtain numerous local, state and federal permits and clearances. The permits address all natural resources - land, air, water, vegetation and wildlife, as well as the interests of the general public. Requirements typically include, but are not limited to, the following:

- Local
 - Building permits
 - Road crossing permits
- State
 - Land (Erosion and Sedimentation Permit)
 - Water (Hydrostatic Testwater Acquisition and Discharge Permit, Stormwater Discharge Permit)
 - Stream and River Crossings
 - Cultural Resources Preservation
 - Threatened and Endangered Species Preservation
 - Air Emissions
- Federal
 - Wetlands Preservation and Crossings
 - Streams and Rivers
 - Threatened and Endangered Species
 - Air Emissions
 - Environmental Resource Reports
 - Noise

Copies of all permits and permit applications are submitted to FERC prior to beginning construction, if required.

FERC Filing

To get approval for constructing a natural gas pipeline, Dominion Energy must file a detailed application with FERC. Among other things, this application must include maps showing the pipeline route, a description of the proposed pipeline facilities, and specific environmental resource reports. These

resource reports cover topics such as water use and quality, vegetation and wildlife, cultural resources, socio-economics, geological resources, soils, land use, air and noise quality 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. Before FERC will authorize construction, however, 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. FERC also develops an Environmental Assessment or Impact Statement to evaluate the project's anticipated impact on the public and the environment.

FERC's review process also may include public meetings in the communities to be affected by the project. Announcements of these public meetings are published in local newspapers. The meetings also provide a forum for the local community to ask questions and express any comments or concerns about the project.

If a certificate is issued, FERC will authorize construction to begin when the conditions they established in their order issuing the certificate are implemented.

Acquiring Rights of Way

Right of way acquisition often raises many questions with landowners - "Why is this the 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 from the sponsors will contact each affected landowner along the route to discuss the project and negotiate an easement agreement.

In addition to a permanent easement that the project will require to operate and maintain the pipeline after it is constructed, we also will require a temporary easement during construction. Larger pipelines require the use of bigger equipment and 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 typically 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 of 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 for full use and enjoyment 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

The pipeline construction will look much like a moving assembly line. The pipeline will be broken into manageable lengths, called construction spreads, to be constructed by a fully equipped, highly specialized qualified workgroup. Each spread will be 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. A construction spread may be 50 to 60 miles in length, with the front of the spread clearing the right of way and the back of the spread restoring the right of way.

Cleaning and Grading

The survey crew carefully surveys and stakes the right of way to ensure that only the pre-approved construction workspace is cleared. 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 fences along edges of streams and wetlands to prevent erosion of disturbed soil. Trees inside the right of way are cut down and removed or stacked along the side of the right of way. Brush is commonly shredded or burned.

As may be necessary in agricultural areas, topsoil may also be stripped to a predetermined depth and stockpiled along the sides of the right of way.

Stringing

At steel rolling mills where the pipe is fabricated, pipeline representatives will carefully inspect new pipe to assure 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 project location. 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, concrete coating may be used under streams and wetlands, and heavier wall pipe is required at road crossings and in special construction areas.

Trenching

The trenching crew will use a wheel trencher or backhoe to dig the pipe trench.

The U.S. Department of Transportation requires the top of the pipe to be buried a minimum of 30 inches below the ground surface in rural areas, so the depth of the trench will be at least five to six feet deep for pipe 30 to 36 inches in diameter.

For less rural areas, the pipe must be buried a minimum of 36 inches. 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 will use special equipment or explosives to remove the rock. The contractor will use explosives carefully, in accordance with state and federal guidelines, to ensure a safe and 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 ensures the topsoil is returned 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 a 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.

In recent years, contractors have used semi-automatic welding units to move down a pipeline and complete the welding process. Semi-automatic welding, done to strict specifications, still requires qualified welders, and personnel are required to set up the equipment and hand-weld at connection points and crossings.

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 as that to 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. The weld has a greater tensile strength than the pipe itself.

A second quality-assurance test ensures the quality of the ongoing welding operation. To do this, qualified technicians take X-rays of the pipe welds to ensure 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 location 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 polyethylene heat-shrink sleeves. 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 ensure 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 to protect the pipe and coating from damage.

Backfilling

Once the pipe has been placed in the trench, the trench will 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.

As the operations begin, the soil is returned to the trench in reverse order, with the subsoil replaced first, followed by the topsoil.

This ensures 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, or bring in clean fill to cover the pipe or the pipe is covered 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 the final 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 section is filled with water and pressured up to a level higher than the maximum operating pressure. 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 to assure it has no water in it before 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 lime or fertilizer, restoring fences, etc.

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

The restoration crew also installs riprap, consisting of stones or timbers, along streams and wetlands to stabilize soils.

As a final measure the crew may plant seed and mulches the construction right of way to restore it to its original condition.

Special Construction

Open Cut River and Stream Crossings

This crossing method involves excavating a trench across the bottom of the river or stream to be crossed with the pipeline. Depending on the depth of the water, the construction equipment may have to be placed on barges or other floating platforms to excavate the pipe trench. If the water is shallow enough, the contractor can divert the water flow with dams and flume pipe to allow backhoes, working from the banks or the streambed, to dig the trench.

The contractor prepares the pipe for the crossing by stringing it out on one side of the stream or river and then welding, coating and hydrostatically testing the entire pipe segment. Sidebooms carry the pipe segment into the stream bed, similar to construction on land, 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 ensure the pipe will stay in position at the bottom of the trench once the contractor removes the flotation devices.

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 considered for longer crossings and requires special geological conditions at the crossing location. Basically, it involves drilling a hole large enough for the pipeline to be pulled through it and in the shape established by the designers.

Before a directional drill can be designed, core samples must be taken on both sides of the crossing to evaluate the underground rock and sand formations.

If the subsurface will support a directional drill, the engineer can design a crossing that establishes the entry point, the exit point of the pipeline crossing and its profile as it would traverse under the crossing.

While this drilling is in progress, the line pipe sections are strung out on the far side of the crossing, opposite of the drilling, 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 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 then is connected into the pipeline on both ends.

Wetlands

"Pipelining" in wetlands or marshes requires another special construction technique. 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 soils.

Road Bores

For crossing most small 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 major 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 gas pipeline is inserted inside the casing. The benefit of the road bore is that it allows installation of the pipeline without disrupting traffic.