HDD Selected For LNG Project

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Four directional drills help minimize environmental impact of gas pipeline project near Freeport, Texas.

Four directional drills were recently completed as part the construction of a 9.66-mi, 42-in. diameter pipeline project near the city of Freeport, Texas. The drills included crossings of the Intracoastal Waterway, a wetland marsh, Oyster Creek and Freeport Harbor, and each presented its own challenges.

The project, part of one of the first liquefied natural gas (LNG) regasification and storage facilities constructed in the United States in more than 20 years, is being undertaken by Freeport LNG Development, L.P. on Quintana Island, near Freeport on the Texas Gulf Coast.

Slated to go online in the first quarter of 2008, the project includes the construction of the above-mentioned 42-in. pipeline. It is designed to transport the regasified LNG from the Quintana receiving terminal to the Stratton Ridge, Texas, custody transfer meter station, where it will interconnect with intrastate natural gas pipelines. Initial facility gas send-out will be 1.5 bcf, with expansion planned for an eventual 4 bcf send-out. The meter station header will initially accommodate two gas pipelines for delivery to customers Dow Chemical Company and ConocoPhillips. It is designed to accommodate 7-10 tie-in points at that location.

Mustang Engineering, involved since the inception of the project's pipeline portion in 2003, performed the engineering design, surveying, permitting, procurement and construction management. Troy Construction, LLP, was the pipeline general contractor, and Laney Directional Drilling Company was the directional drilling contractor.

Aerial photo of wetlands marsh pullback, showing borrow ditch with floating tailpipe section.

Trenchless Engineering Corporation also consulted on the design of horizontal directional drills (HDD), since this installation method constituted approximately one-third of the pipeline's length. Water lay and upland lay techniques each also accounted for one-third of the project.

The selected line pipe was 0.938-in. wall thick API 5L-X65 carbon steel supplied from Italy, with 14-16 mils fusion bonded epoxy (FBE) coating applied domestically. The HDD pipelines were also coated with a 40-mil dual-powder epoxy abrasion-resistant overcoating for additional protection during pullback. Water lay pipe was coated with

4 1/3 in. of concrete. Since a major portion of the line would be permanent after being installed, the thick wall pipe was designed for a maximum allowable operating pressure of 1,440 psi with a safety factor of 2.0 to accommodate future population density increases in the area over the proposed 50 year design life of the pipeline, without requiring a change in class location or a de-rating of the line.

Four directional drills

Four horizontal directional drills were required to minimize any environmental impact and to give adequate clearance under sensitive areas and active waterways. The four locations were the Intracoastal Waterway, a wetland marsh, Oyster Creek and Freeport Harbor.

The Intracoastal Waterway bore, at 1,566 ft, was the shortest of the HDD segments but was complicated because of an especially restrictive right-of-way. The bore was short, but the pipeline had to include a built in "s" curve to accommodate the restrictions. It was drilled to a depth of 55 ft, providing a minimum 30 ft of cover underneath the channel bot-

tom. The profile dictated that it also have a minimum of 10 ft of cover underneath an existing gas pipeline. As with all the bores on this project, its entry was at a 10˚ angle and exit at 5˚ with a 4,200-ft radius. The bore hole was expanded in stages from the initial six-inch pilot hole to the final 54-in. diameter bore. The pipeline pull string was fabricated in one piece and floated in an excavated push-ditch. It was then hydrostatically tested at 2,100 psi before pullback.The 4,965-ft wetland marsh drill was the most complicated. In order to comply with regulatory agencies, including FERC, it was determined that the HDD would provide the most cost-effective and environmentally protective method of traversing the wetlands. Wetland delineations were carefully determined and approved by the U.S. Corps of Engineers. The rig location was critical in order to string the entire 5,000-ft tail pipe section ahead of the exit hole. For that purpose, a borrow ditch was dug in an existing canal. The pipe was set up in a staging area where it could be welded, joints coated, strapped on block floats and floated until the entire string was adjacent to the exit hole for the drill pilot. The pipe was then able to be hydrostatically tested in place before pullback. The borrow ditch was eventually used to accommodate an additional section of pipe laid through the canal.

The wetland HDD was, as estimated by Laney, the longest ever attempted for 42-in. pipe. As such, planning was required for several contingencies. An additional string of line pipe was purchased as standby in the event that a portion of the original pipe got stuck. Two additional hydraulic pull motors, effectively doubling rig pull capacity to 1.8 million lbs., were available as standbys. Additionally, the HDD contractor used a secondary piece of equipment, a Grundoram[1], to assist in the line-pull. This pneumatically driven ram device was affixed to the end of the pipe and caused a vibration, inducing an additional force to assist the forward movement of the pipe and help prevent its getting stuck.

The approximate 5,000-ft tailpipe was floated in a borrow ditch dug in an existing canal adjacent to the wetlands marsh exit hole.

Of the four drills, the Oyster Creek crossing was the least logistically challenging. The 2,995-ft drill was completed to a depth of 75 ft. The main complication was that access to the entry site and the work area were located in marsh, so extensive wood matting was required to stabilize the site.

The 2,584-ft drill under the Freeport Harbor Channel was the last HDD undertaken. It was completed at a depth of 105 ft to account for needed clearance with a proposed dredging of the channel. The sequence of this drill was logistically determined so as not to interfere with an upland pipeline portion being laid by another contractor on Quintana Island. Once that work was completed, the HDD bore could commence. The timing of the project was critical since it was performed in August 2006, at the height of the hurricane season. A contingency plan was developed in the event a storm came within proximity of the Texas Gulf Coast. In that event, all work would have been stopped and the pipe would have been filled with water and left in place.

Pipe buoyancy factor

With the line pipe having a calculated weight of almost 416 lb/ft, buoyancy was a concern, especially on the longer drills where drilling rig capability could be challenged. To counteract the buoyancy, once each string was fully fabricated, hydrostatically tested and dewatered, a linear ballast system was installed with the insertion of a 30-in. diameter high density polyethylene (HDPE) pipe inside the full extent of the line pipe. A six-in. hose then filled the HDPE pipe with fresh water at controlled rates to offset the buoyancy forces as the pullback proceeded, reducing the submerged weight to approximately 33 lb/ft. After the pullback was completed, the HDPE pipe was then retracted and the line pipe was again hydrostatically tested.

Successful completion

All of the HDD-related pipeline installation activities were completed as of March 2007, and the overall project is now awaiting completion of the regasification facility's storage tanks. The line will then be used as a conduit to perform a deadweight water test to validate the integrity of the two 180-ft tall by 270-ft diameter storage tanks. At the conclusion of that test, the pipeline will undergo a final hydrostatic test; will be dewatered, dried, receive a nitrogen pad; and be ready for startup testing for the LNG facility during the fourth quarter of 2007.

The author

Allan W. Taylor, P.E., has 24 years experience in project management, engineering, construction, operations, maintenance and technology of natural gas, industrial gas, product and chemical pipelines in addition to facilities, utility systems and petrochemical plants. He was Mustang's project manager for the Freeport LNG project, and is a Registered Professional Engineer in the State of Texas. ■