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Case Study on the Benefits of the Direct Pipe® Method for the Freeport FLNG Expansion Project

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1. ABSTRACT

This paper discusses the Freeport LNG Expansion, L.P. (Freeport) Project performed by Laney Directional Drilling (Laney) for WHC Energy Services (WHC). The project included the Direct Pipe® (DP) installation of two (2) 42-inch parallel steel pipelines beneath the East Storm Levee which is part of the Freeport Hurricane Protection System located in Brazoria County, TX. Direct Pipe® was the selected method as it offers far less risk of hydraulic fracture than the traditional Horizontal Directional Drilling (HDD) method which was critical beneath the Levee.

The main project challenge was overcome by Laney by maintaining the proper annular pressure limits on the first crossing. An unsuccessful prior HDD attempt occurred which disrupted the subsurface and released drilling fluids in the vicinity of the tunneling path. The unique aspects of this project included the utilization of one launch pit for both pipelines with only approximately 15-ft of separation. In addition, this project marks the first successful pipeline extraction after pulling back a bundle completed in North America. This paper discusses how Laney was able to finish the entire project 30% ahead of schedule saving WHC significant time and money while successfully completing the project without having an inadvertent release of drilling fluids.

2. INTRODUCTION

Direct Pipe (DP) is a trenchless method of installing pipelines in areas where traditional open cut excavations are not feasible for environmental or logistical reasons. DP was developed by Herrenknecht AG (Herrenknecht), a corporation based out of Germany and has been trade marked for a trenchless methodology. WHC, a Houston based pipeline contractor, provided overall construction services and worked closely in conjunction with Laney for the installation of the two (2) 42-inch steel pipelines in Brazoria County, Texas. *Refer to Table 1: Crossing Parameters Summary.*

Table 1: Crossing Parameters Summary

Crossing Name	Length (Feet)
Levee Direct Pipe Product Crossing #1: 42" x 1.00"WT; Grade x-65	2,100
Levee Direct Pipe Conduit Crossing #2: 42" x .75" WT; Grad x-70	2,100
Pipelines to be Installed Within the 42-inch Steel Conduit	
12-inch Steel Pipeline (Concrete Coated)	2,100
8-inch Steel Pipeline (Concrete Coated)	2,100
4-inch Steel Pipeline (ARO Coating)	2,100

Laney was subcontracted to perform both the engineering design and DP specific construction services to install both 42-inch crossings. Direct Pipe® Crossing #1 consisted of the 2,100-lf installation of 42-inch steel pipeline to be used for high pressure gas. Direct Pipe® Crossing #2 consisted of the 2,100-lf installation of 42-inch steel conduit pipe which contained a “bundle” of three (3) individual steel pipes. At the end of the second installation, the 42-inch steel conduit was extracted to help the longevity of the pipeline.

3. ENGINEERING & DESIGN

Laney proposed an installation plan and profile that partially deviated from the originally proposed installation plan and profile of the 42-inch, 12-inch and 8-inch pipelines using the HDD method. The deviations were a result of the change in installation methodology and Laney’s efforts to improve the trenchless design in order to avoid risk associated with inadvertent returns beneath the levee.

First, the proposed entry point was relocated to the west side of the crossing to facilitate stringing of the 42-inch pipe for the DP operations. An important feature of DP is that the pipe is strung from the entry side versus HDD which is typically strung from the exit side. On the entry side, the DP method required the pipe thruster to be anchored behind the entry point which typically requires that an entry pit be excavated. The entry pit required sheet piles to be driven approximately 30 to 45 feet for soil support and the entry pit was designed to be removed upon completion of the DP installation.

There were advantages of an entry pit for DP vs. HDD. In this case the entry pit lowered the elevation of the entry point, thereby reducing the hydrostatic pressure of the lubrication fluid on the tunnel wall. This lowered the annular pressure during installation which reduced the potential of inadvertent returns. In addition, the excavation of the entry pit allowed the DP profile to reach the desired bottom elevation at a lower entry angle; thereby, reducing the 42-inch pipe string over-bend height. The required over-bend was reduced also because of the reduced elevation where the pipe over-bend begins. Reduced over-bend height (greater than 10-feet) allowed for safer and more convenient pipe handling with less equipment. *Refer to Figure 1: Drill Layout and Profile*.

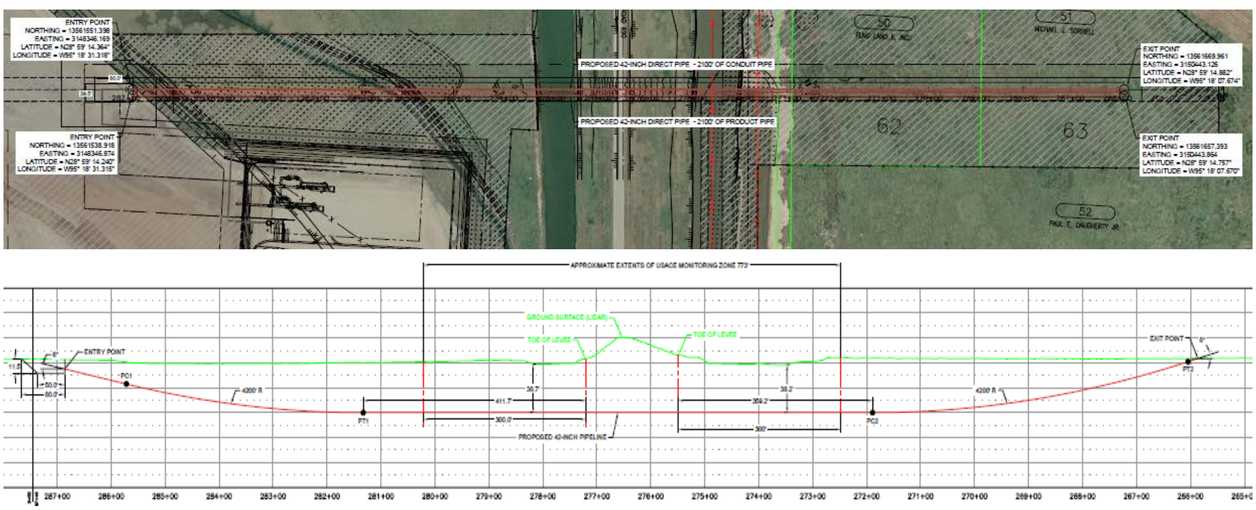

Figure 1: Drill Layout and Profile (not to scale)

Laney proposed a bottom tangent elevation of -40 feet versus the proposed HDD profile elevation of approximately -47 feet. The main reason for the target bottom tangent elevation was that by having the bottom tangent at a higher elevation, the hydrostatic pressure would be reduced on the formation throughout the critical United States Army Corps of Engineers (USACE) levee monitoring zone. Additionally, raising the bottom tangent elevation allowed the use of a shallower entry angle of 6 degrees to maintain the bottom tangent section throughout the entire USACE levee monitoring zone, while still maintaining more than 30 feet of depth below ground surface along the proposed alignment. Laney chose not to target the bottom tangent elevation as originally proposed while the bottom tangent passing through the entirety of the USACE levee monitoring zone. This would have made the entry angle to be increase and to cause the over-bend height resulting in increased safety risks to the project.

Laney's design incorporated the use a 42-inch micro-tunnel boring machine (MTBM) for tunneling operation. The radial overcut of the 42-inch MTBM is approximately 1-inch creating an approximately 44-inch borehole. The annular space created by the MTBM overcut was designed to be filled with bentonite slurry to serve as lubrication for the DP installation. Because of the limited annular space of approximately 1-inch radial overcut, Laney did not anticipate grouting the annular space between the 42-inch pipe and the borehole wall. The DP profile was planned to progress through layers of fat clay which had the potential to swell, further reducing the annular space and cutting off potential flow paths along the annular space. Additionally, because Laney proposed using an entry pit to launch the 42-inch pipe, the 42-inch pipe was designed to be backfilled with approximately 6 to 8 feet of compacted bedding material and native soil after completion of DP construction which created a soil plug between the launch point and the natural ground surface. Laney anticipated that this would further reduce the potential for flow paths along the installed pipelines and protect the intended function of the USACE levee system.

In order to estimate limiting pressures of different soil formation along the drill path, Laney interpreted the soil properties provided Geotechnical Services Report (PSI Project No. 286-1405) dated March 2, 2016 (boring logs C-1, C-2, and C-3) submitted by Professional Services Industry (PSI). The Geotechnical Exploration Report No. 291-108-Rev.1 dated July 3, 2013 submitted by PSI was disregarded in the hydraulic fracture analysis because the borings referenced were completed approximately 250 feet from the DP alignments while borings C-1, C-2 and C-3 were located between approximately 25 feet and 60 feet of the southernmost DP alignment. The estimated limiting drilling fluid pressures along the drill path at points corresponding to estimated annular drilling fluid pressures are illustrated in *Figure 2: Annular and Limit Pressure Chart.*

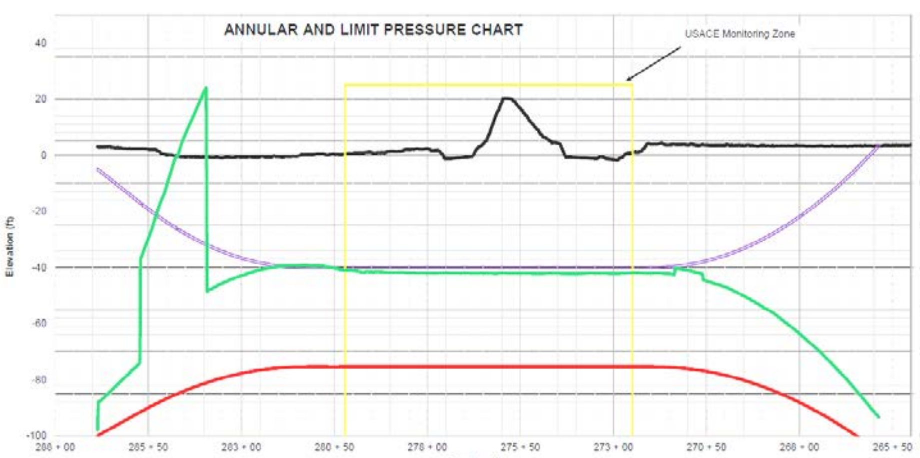

Figure 2: Annular and Limit Pressure Chart

Laney's design also included requirements for a port to be fabricated on the external wall of the MTBM for a pressure sensor to been installed in order to constantly monitor the downhole annular pressures during tunneling operations. This allowed for the downhole annular pressures to be available during tunneling operations and to be observed from a computer readout screen in real time from the driller's console. The downhole annular pressures was readily available for the driller during tunneling operations to ensure that the downhole annular pressures observed did not exceeding the factor of safety of 2.0, as required by the USACE Galveston District. Calculated factors of safety against hydraulic fracture are presented in the *Figure 3: Factor of Safety Chart. Figure 3* shows the factors of safety against hydraulic fracture greater than the USACE required 2.0 throughout the USACE Monitoring Zone.

Additionally, a table with the factors of safety at intermediate stations was been provided along the DP alignment. From station 266+46.86 to the exit point, the DP profile was designed to be located above the drilling fluid equilibrium point and therefore the annulus would not be completely filled with lubricating bentonite column. Between station 266+46.86 and the exit point the hydraulic fracture analysis and the factor of safety is no longer valid. The proposed DP profiles and ground surfaces along the DP alignments are the same; therefore, the hydraulic fracture analysis represented both of the proposed DP installations.

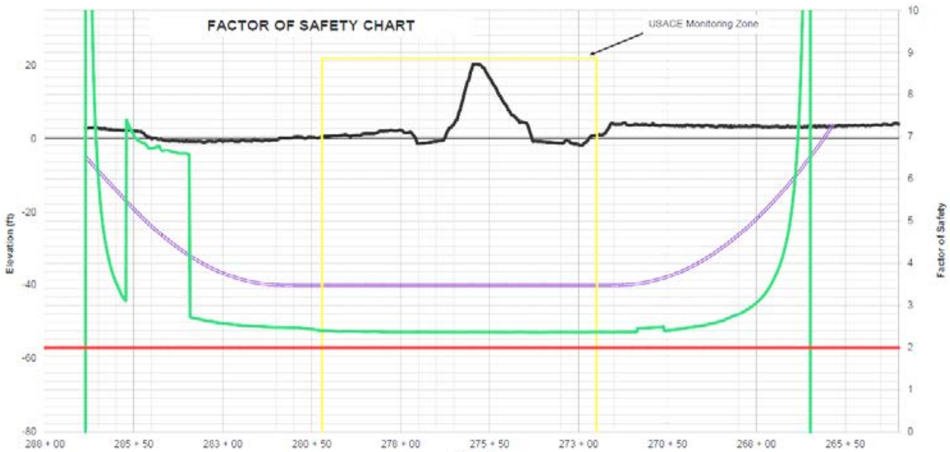

Figure 3: Factor of Safety Chart

4. PROJECT CONSTRUCTION

General

Microtunneling operations were managed in joint efforts between the Laney Project Manager Nick Michels and Division Manager Kent Lawler. Laney on-site Superintendent Shelton “Bubba” Carlisle was the direct point-of-contact during daily operations. Laney’s crew consisted of approximately 9–11 people per shift, including skilled labor provided by Herrenknecht. Laney Drilling Fluids Engineer Tommy LeBlanc managed the fluids program with the Superintendent and made periodic site visits to the project.

Operating hours were from 7 A.M. to 7 P.M. seven days per week during the set-up/rig-up of the microtunneling equipment. Once the tunneling process began, Laney operated 24-hours per day continuously until the completion of the microtunneling. Once the mining and pipeline installation was complete, Laney returned to the operating hours of 7 A.M. to 7 P.M., six days per week to disassemble and demobilize all equipment.

Equipment Selection

For tunneling operations, Laney used the AVN800XC microtunnel boring machine, manufactured by Herrenknecht, AG. The dimensions for this MTBM are 8.85-ft long with a 43.70-inch diameter and a weight of 13,640 lbs. The main features of the AVN800XC MTBM include an articulated shield with face support, excavated material transported by slurry, slurry feed by 3 nozzles into crusher and integral conical stone crusher behind cutting wheel. Hydraulic power supply from the control container is supplied via connection to machine via hydraulic hoses and control cable. The unit has (1) hydraulic drive motor with 47.55 gpm pump capacity, maximum torque of 66,380 ft-lbs and maximum of 111,300 ft-lbs of intermittent torque. Hydraulically remote controlled slurry valves control (6) high pressure water nozzles with a maximum water pressure of 4,350 psi. Finally, the unit utilizes (3) steering cylinders with inductive electronic stroke and maximum single thrust of 134,500 lbs at 6,525 psi. The assembly for the MTBM additionally integrated a 42-inch DP Can with a 75 kW Power Pack, conical interface ring, and weld-on adaptor. Based on the geotechnical data provided, Laney employed a soft ground cutting wheel with a cutting diameter of 43.7-inches.

Laney used the Universal Navigation System Integral Module for the steering and guidance of the tunneling operation as well as the Gyro Navigation System (GNS). Outfitted with a GNS, the machine did not have any components installed inside the pipe and line-of-sight was not necessary between the components. The north-seeking gyro compass was permanently mounted inside of the MTBM and was used to calculate the direction of true North as a reference to the MTBM axis. The current position of the MTBM was also calculated via coupled navigation. Finally, the Hydrostatic Water Levelling (HWL) was used to obtain the elevation data.

Laney utilized a Herrenknecht HK750PT pipe thruster to install the steel pipeline. The maximum push/pull capacity of the pipe thruster was 1,650,000-lbs, but was limited to the surface area of the pipe and the pipeline coating which restricts the thrusting force that was applied. The thruster assembly consisted of a left and right “A-frames”, a clamping unit, the transport plate for the clamping unit, clamping inserts, a carriage, a launch cradle, an extension for the launch cradle and an anti-roll device. The thruster was designed to be set-up inside an entry-pit approximately 39.5-feet wide, 80-feet long and 11-feet deep. A foundation approximately, 6-inch thick, 50-feet by 39.5-feet re-enforced concrete slab was poured inside the pit. The frame of the thruster was first lifted and placed on the concrete slab with the thruster legs fitted within the frame. The thruster frame was then bolted together and anchored to four (4) 42-inch steel pylons driven into the subsurface. *Refer to Figure 4: Direct Pipe® Pit and Foundation Design.*

Laney used a 42-inch Direct Pipe® launch seal supplied by Herrenknecht, AG. The launch seal was outfitted with a Neoprene Seal to assure the best possible resistance against in fluctuation of ground water, soil, and bentonite slurry as the MTBM and 42-inch pipe passed through the launch seal. The actual launch seal be re-used for each DP Crossing as it was just bolted to the launch plate. A visual inspection of the seal was carried out prior to use by the Superintendent and Herrenknecht representative. Laney used an additional launch plate fabricated for the second crossing.

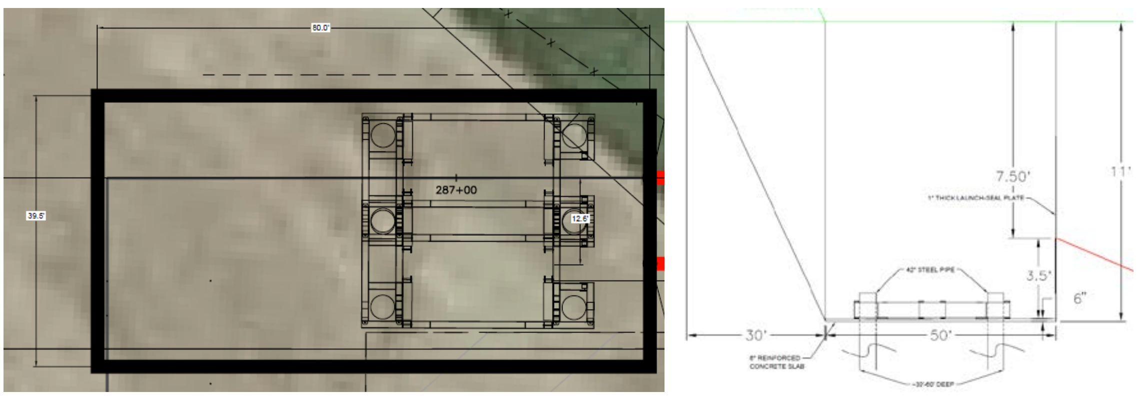

Figure 4: Direct Pipe® Pit and Foundation Design

Laney employed a control cabin, commonly referred to as a driller’s console which is designed specifically for the Direct Pipe® System. The main features of the control cabin included a containerized unit with separate compartments for the Operator, ergonomic layout controls with industrial PC and color monitor for full online visualization of all operating parameters and a data logger capable of recording all drive parameters. The operator control panel was able to show many project parameters simultaneously with operations including, but not limited to, wheel rotation speed and direction, cutting wheel drive operating pressure, slurry pressure at the cutting head, slurry line flow rates, earth annular pressure, pipe thruster pressure and advance speed. The safety features of the control panel included emergency stop control and automatic shut down if oil temperature was too high, oil level was too low, or oil cooler trip. Critical recorded data includes total drive length, vertical deviation, and roll. In addition, vertical and horizontal angles of the cutting head, thrust load, cutting wheel torque and earth annular pressure were collected. *Refer to Figure 5: Typical Display Inside Control Cabin.*

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Laney used Drilling Fluid Recycling System CS-514. The important features of the cleaning system included a 300 BBL (US Barrels) Dragon Tank, Scalping Shakers, and Hydro-cyclones De-sander and De-silter Cones. A centrifuge was also used in conjunction with the cleaning system with efforts to remove fine particles from the drilling fluids. This additional cleansing process ultimately assisted in reducing the annular pressures downhole.

Jobsite Safety

Safety was the number one priority for Laney. Freeport, WHC, and Laney's safety team leaders all met before mobilizing to the site to review all site specific safety requirements and the output of this meeting was inserted into WHC's and Laney's Site Specific Safety Plan for implementation. WHC and Laney held their own Safety Program orientations that all regular and temporary employees attended prior to starting work onsite. In additions, all visitors and sub-contractor's attended the safety orientations and adhered to all of the site specific safety requirements. Before commencement of any operating shift, both WHC and Laney crews completed a Job Safety Analysis (JSA) of the work planned for the shift. The JSA included all the tasks that would be performed during the shift, identifying the potential risks, and providing a discussion to mitigate the risks. WHC and Laney also held weekly tailgate meetings on the subject manner related to operations that were assigned by their respective Safety Departments. As a result of this close coordination and consideration, there were no safety incidents recorded for this project.

Site Preparation

WHC and Laney performed the following steps prior to commencing the microtunneling operations at locations with existing underground utilities. Both WHC and Laney contacted the utility location/notification service for the construction area. Existing lines were located and staked and cables and other underground utilities were exposed or pot holed located within 25 feet of the designed drill path. Onsite work began with site preparation and project mobilization by WHC. WHC was responsible for conducting all "pre-job" services including survey of the project right-of-way and surrounding roadways. Preparatory work crews implemented traffic control and begin preparing the workspace for handling the all-weather travel of heavy equipment. Once the workspace was prepared by WHC with the appropriate matting, Laney began mobilization to move equipment onto the jobsite.

Laney survey crews began by collecting the Owner's survey data and verified all of the coordinates provided with proper field verification in place. The Laney Surveyor then laid-out the precise location and corners of the entry pit as well as to stake the tunnel center line (every 100-ft) to develop a line of sight between Entry and Exit locations. Laney's pre-installation survey also consisted of establishing the line, grade, and the angle of the thruster.

Laney's crew constructed the entry pit in preparation of setting up the tunneling machine and ancillary equipment. The Laney crew employed a vibratory hammer to install the sheet piling and 42-in pylons required for the pit construction. WHC assisted with welding and hot works activities required throughout the pit construction process (i.e. weld additional section(s) of 42-in pylons together, bracing, etc.)

Laney utilized a 200-ton crane and excavators to support the pit preparation and equipment setup. Once the workspace was prepared, and while the microtunneling equipment mobilization continued and was positioned on the jobsite, WHC hauled product pipe to the right-of-way and begin fabrication of the "back string" sections to allow the optimal amount of workspace in the permitted work area. Fabrication of the backstring included setup, welding, field joint coating, and NDT. WHC utilized sidebooms and excavators to support the backstring fabrication and support the microtunneling operations once commenced. WHC was responsible to support the 42-in steel pipelines and supplied additional crane support handle the steel pipelines safely.

Tunneling Operations

The microtunneling technique commenced for Levee Crossing #1 with a single pass installation for the 42-in steel pipeline. A microtunnel boring machine (MTBM) was used to mine a tunnel along a pre-determined path while the steel pipeline was used to transfer the thrusting force required for the MTBM to advance through the formation. The MTBM was steered using the two (2) previously discussed guidance systems with efforts to keep the projected path as designed. During construction, Laney provided and maintained continuous instrumentation to accurately locate the MTBM, measured the cutter head axial and torsional loads, evaluated the thruster loads and the monitored drilling fluid discharge rates. A log of the recorded readings was maintained and became part of the "As-Built" information supplied to the client. Finally, Laney performed one planned "alignment control survey" prior to making the tie-in weld. Refer to *Figure 6: Direct Pipe® Tunneling Operations.*

Figure 6: Direct Pipe® Tunneling Operations

The microtunnelling drilling fluids program consisted of two different systems including a Lubrication System and a Slurry System. The lubrication system filled the annulus space between the pipeline and the tunneled wall, providing lubrication for the pipeline installation and this fluid also supported the tunnel wall. The slurry system was used to control the temperature of the cutter head and also transport the cuttings to the separation plant located on the surface. Laney prepared the slurry fluid in a 500-BBL mixing tank and the tunnel lubrication fluids in a 300-BBL mixing tank. Fresh water was hauled by Laney to the jobsite from a local hydrant located within the Freeport facility. Approximately 40,000–50,000-gal of water were required per operating shift. Laney then disposed the slurry and cuttings at the disposal facility provided.

Survey data was collected over a pre-determined distance which was previously inputted into the DP interface. The manufacturer's recommended length was approximately one foot between survey collections. This data was collected and used to determine the radius for the pipeline installation which was calculated over increments of 90-ft in length. Finally, Laney perform additional survey work by using a total station and survey prism as an "alignment control survey" in comparison to the primary guidance system described above. By employing the total station and gathering periodic survey collections down to the tunneling head, Laney was able to determine the precise alignment of the tunneled path throughout the operation.

After completion of the Levee Crossing #1, the DP equipment spread was broken down into large components and relocated to the adjacent launch location. A precursory survey was performed to confirm existing parameters and all tunneling operations were repeated for Levee Crossing #2.

Bundle Installation

Upon the completion of Levee Crossing #2, the 42-inch steel conduit was prepared to have the bundle of pipelines pulled back through it. This process was completed by using a maxi-sized horizontal directional drilling (HDD) drill spread. Laney began to move equipment onto the jobsite as soon as the DP equipment was removed from the conduit. Laney mobilized a LDD custom-built 583,000-pound drill rig and the necessary ancillary support equipment required to pullback the bundle inside of the existing 42-inch steel conduit. By this time, WHC had already prepared the workspace with the appropriate matting and the set-up the drill spread commenced. R*efer to Figure 7: HDD Equipment Layout.*

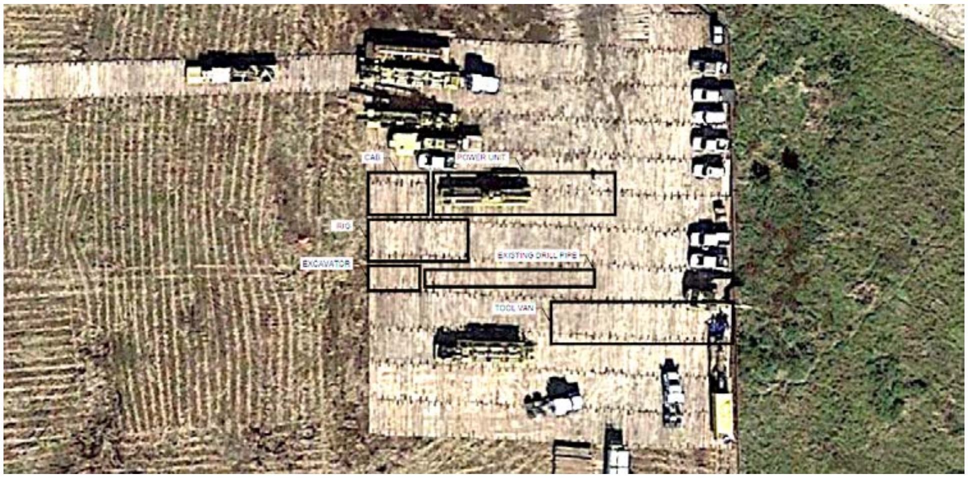

Figure 7: HDD Equipment Layout

A Laney Surveyor performed a site survey to determine the precise location of where the HDD rig had to be placed. The corners of the dead-man were “laid out” using spray paint to identify the location of where the drill rig was placed in relation to the existing 42-inch steel conduit. A small excavation was made to accommodate for the dead-man which was used to anchor the HDD rig on the East side of the crossing. The dead man measured 2 feet deep x 30 feet wide x 4 feet long and is the primary anchorage device for the operation of the drill rig. The excavation was accurate and the top of the dead-man was relatively flush with the ground surface. Anchor piles were driven through the dead-man pockets to provide adequate rig stability. Once the dead-man was in place, the drill rig was positioned and spotted on top of the dead-man. Large steel pins were utilized to secure the rig to the actual dead-man.

Once the drill spread was rigged-up, and all of the equipment was tested and proven to function properly, Laney began by adding segment(s) of drill pipe (approximately 31-feet in length) to the drill rig. The first, lead joint of drill pipe had a cap attached to it with efforts to prevent the inner wall of the 42-inch conduit from being scratched as it is advanced forward. No fluids were pumped inside of the conduit as the drill string progressed to the other side during this operation. Once a continuous section of drill string was installed through the 42-inch steel conduit, Laney prepared to pull the bundle back through the conduit. This process started by extending additional drill stem past the 42-inch conduit so a 30-inch barrel swab could be added to the drill string. WHC had welded the Laney supplied pullheads onto the three pipelines. The pullheads were attached to the drill string using an adequately rated pullback swivel. During this time, the bundle was be supported by WHC throughout the entire pullback. Joints of drill pipe were pulled back towards the drill rig (East side of the crossing) and removed in segments. *Refer to Figure 8: Pulling Assembly and Conduit Cross Section.*

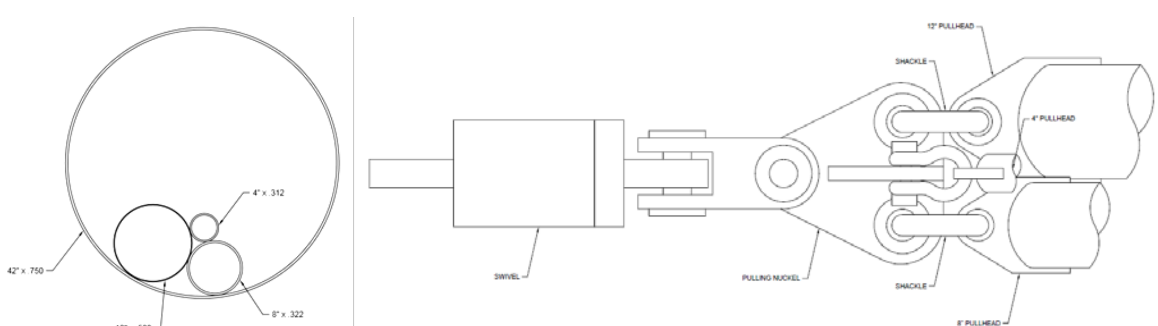

Figure 8: (a) Conduit Bundle Cross Section and (b) Pulling Assembly

Although it was not anticipated, in the case that the pull loads started to increase and drilling fluids were required to help create a buoyant atmosphere inside of the conduit, Laney was prepared to pump the drilling fluids inside of the conduit utilizing the same cleaning system and pumps that were located on the jobsite and were employed for the crossing. Though it did not turn out to be required, the drilling fluids were on standby to be pumped into the open end of the 42-inch steel conduit on the west side of the crossing.

The bundle pullback was performed in a continuous operation until completion except where the joining of a pullback string was required. At the time of pullback, WHC welded the two sections of pipeline together for all three pipelines in order to create the bundle. Once the three "mid-welds" were completed, Laney recommenced the pullback operation and joints of drill pipe were pulled towards the rig and removed at the drilling rig. During the pullback operation, the Laney Driller had full overall responsibility for the pull loads applied to the pipe by the drilling rig. The pullback was anticipated to pull at approximately 400 feet per hour until the successful completion and pulling forces on the pipe were monitored and recorded. Laney submitted a daily report to the Freeport representative and during the pullback operation, Laney provided the Freeport representative access to view the rig pressures (specifically pull load(s)) at any given time as the operation was carried out.

Pipe Extraction

At the direction of Freeport the final step in this project was the extraction of the 42-inch steel casing installed for Crossing #2. This was the result of the cathodic protection not being able to pass the "charge tests" that Freeport performed directly after the successful installation of the pipeline bundle. Prior to final extraction, an additional joint of conduit was welded on, or approximately 40-feet of pipe. This "test section" was pulled back without inducing risk to the bundle inside as Laney was able to determine the amount of force that was required to move the pipe, the speed that the pipe was moving out of the bore path and was able to provide feedback on the likelihood of completing a successful extraction. In addition, the bundle of pipelines was secured to prevent losing them downhole. This process was carried out by leaving the pull heads attached to each pipeline and using a shackle and slings to attach the pipelines to the excavator located on the East side of the crossing. Laney was able to mitigate the risk of the extraction by pulling or thrusting a small section of the conduit each day after the DP Levee Crossing #2 was installed (approximately 3 to 5-feet at the beginning and end of each work shift) with efforts to reduce the skin friction along the conduit. The test pulls described also occurred throughout the portion of the HDD work.

Laney utilized the same Herrenknecht HK750PT pipe thruster that was used to install the 42-inch steel conduit for pipe extraction. The clamping device for the thruster remained assembled to the frame of the thruster which was already be anchored in-place from the completion of the crossing. The clamping device was compressed onto the 42-inch steel pipe and applied a pulling force to the entire conduit. As the conduit was extracted from the bore path, WHC supported the pipe as it exited the ground. The thruster was capable of extracting approximately 15-feet of pipe per stroke. Once the hydraulic cylinders were extended to their capacity, the clamping device was opened and the cylinders were retracted in preparation of repeating the process and removing an additional section of pipe. The Operator had total control on the amount of pull load that was applied to the pipeline as it was extracted. This data was also monitored throughout to prevent any damage to the pipe as it was removed from the bore path.

Based on the experience throughout the installation process of handling the 42-inch steel pipeline, WHC & Laney determined it was most efficient and safer to handle the conduit pipe in 400-foot to 500-foot sections. As the conduit was extracted, WHC used numerous pieces of support equipment in order to properly handle the "break-over" and the remaining section was staged on rollers. Once a full string of steel conduit was extracted, WHC continued to support the conduit and cut the pipe just behind the thruster, near the top of the pit. Once severed, the pipe was handled and stacked-out on wood skids that had been previously laid out prior to the extraction process. The sections of pipe were positioned on the North side of the extraction area and all of the support equipment was set back up in place for Laney to recommence the extraction activities with the pipe thruster. This extraction process was carried out until all of the 42-inch steel conduit had been removed from the bore path. Once successfully completed Laney performed rig-down all of their equipment and demobilized from the project.

5. RESULTS & CONCLUSIONS

This project had several challenges that were overcome by the project team. The largest challenge was maintaining the proper annular pressure limits on the first crossing where the unsuccessful HDD attempt had occurred. Due to the HDD attempt, the subsurface had been disrupted and drilling fluids had remained downhole in the vicinity of our tunneling path. Working inside of the Freeport facility around the other contractors (framing crews, pile driving crews, excavating crews, etc.) also faced a challenge in order to access the jobsite. Due to having high security parameters set in place, all loads had to have detailed coordination and the personnel were required to have safety training and badges in place in order to enter the jobsite. This project was also different because a pipeline extraction had not occurred after successfully pulling back a bundle. This was the first time a successful extraction had been completed in North America. In addition, Laney completed both Direct Pipe® crossings using one launch pit which was unique.

Construction safety training and equipment mobilization started on Monday, March 7th, 2016. Rig-up and foundation activities lasted twenty (20) shifts completing on Tuesday March 29th. Tunneling began on Wednesday, March 30th and was completed utilizing 24 hour a day operations until completion on Monday April 4th, 2016. The total shifts required for crossing #1 was 53 over 42 days. As Crossing #1 approached completion, the Direct Pipe® assemble was relocate to the second launch location. Tunneling began on Thursday, April 14th and was completed utilizing 24 hour a day operations until completion on Monday April 18th, 2016. Pullback of the bundle started on Tuesday April 26th and was completed in (2) shifts. Pipe extraction was completed on Tuesday, May 3rd and required four (4) total shifts excluding one rain day. The total shifts required for Crossing #2 was 53 over 42 days.

Laney was able to complete the total project scope in significantly less time than anticipated. Pit construction was estimated to take 3,192 hours and was actually completed in 2,252. The installation of the Launch Seal took 432 hours instead of the 504 allowed. For the Crossing #1, the budgeted hours were 3,864 while actual construction required only 1,140. The exit & removal and installation of the 2nd launch seal was 3,360 while only 1,044 were required. For the Crossing #2, the budgeted hours were 3,864 while actual construction required only 1,330. Removal & pit demolition took 1,758 which was over the 840 days allotted. Total man hours budgeted were 15,624 and the actual work was completed in just over half that amount with a grand total of 7,956. In the end, Laney was able to finish the entire project 30% ahead of the original HDD schedule, saving WHC significant time and money while successfully completing the project without having an inadvertent release of drilling fluids.

Most importantly, Laney worked closely with WHC to perform the work in a manner to maximize safety and reduce exposure of employees and equipment to hazards and potentially hazardous conditions. Ultimately, Laney successfully performed all microtunneling activities in an effort to minimize ground movement, prevent the subsidence of the surface structures and utilities in the vicinity of the microtunneling site and protect the integrity of the pipeline. Most importantly, the successful execution of this project helped solidify the Direct Pipe® method as the safest, most accurate, and least risky trenchless method for crossings beneath the extremely sensitive USACE levees throughout the Gulf Coast region.

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