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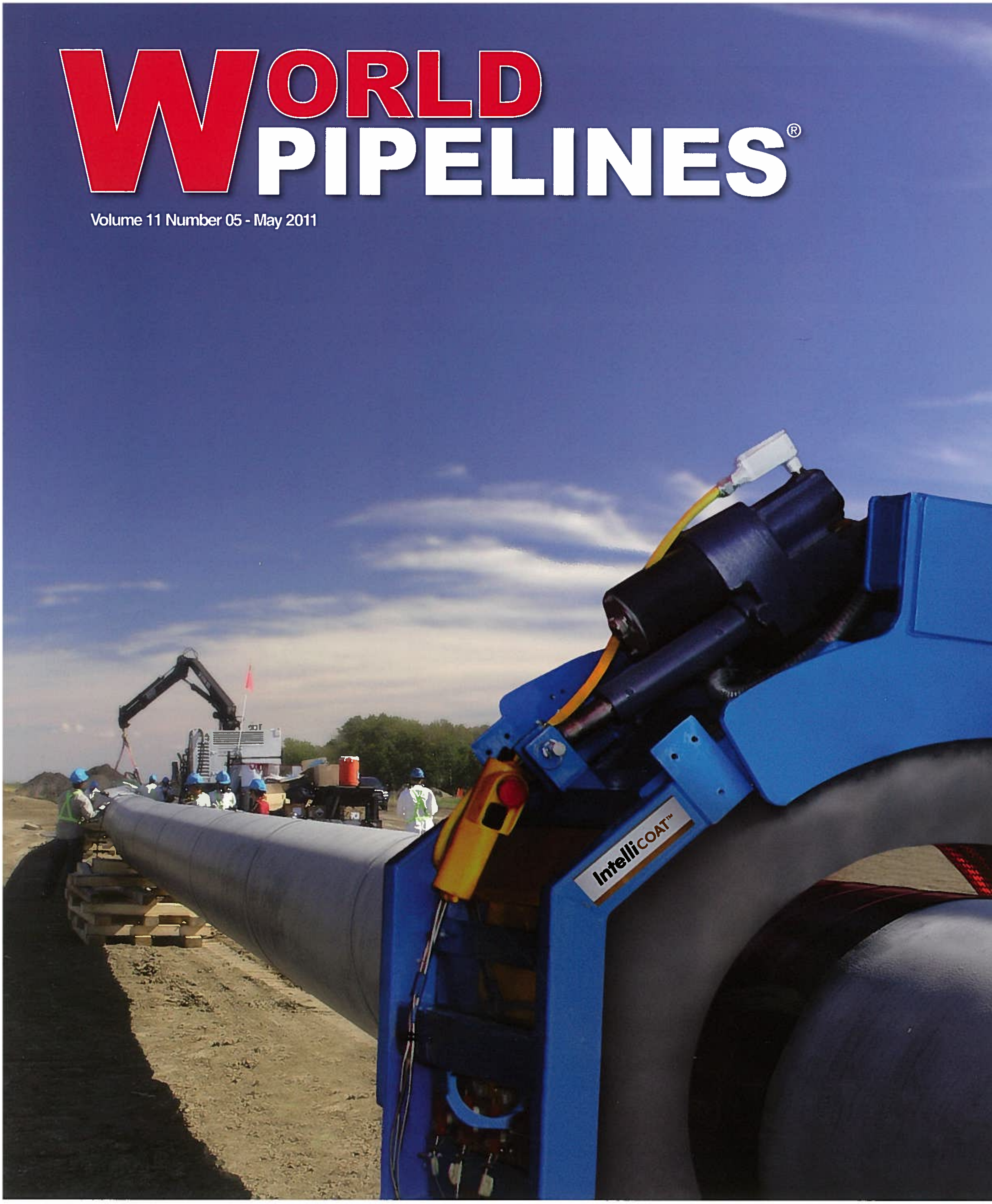

CONQUERING CHALLENGES

Jim Tolly, Farwest Corrosion Control Company, USA, explains how directional drilling can be performed safely and efffectively, even in difficult conditions.

In the pipeline industry, a common method used to install a section of new pipe is via a directional drill. This is done when it is either impractical or impossible to dig an open trench, such as under a highway, body of water, railroad, environmentally sensitive area, or in a heavily congested residential or commercial area. Directional drilling technology has improved to the point that this method of pipeline installation is now regularly, safely, and effectively undertaken worldwide.

The basic process consists of drilling a pilot hole, reaming it a number of times to the appropriate size, attaching the new pipeline to the end of the drill pipe, and pulling the new section of pipe back through the bore. However, in the same way that all construction projects encounter unexpected surprises, directional drilling projects seem to encounter more than their fair share. For example, a drilling contractor may have an excellent idea of what to expect once drilling has commenced based on previous projects in the area and geological surveys. The reality is that drilling into an unforeseen hard rock formation can lead to more expense, work, and frustration, and require significantly more time to complete the project.

How do you take this already difficult process, which is fraught with challenges, and make it even more challenging? One way would be to ream the bore to a

Figure 1. Pipelines pulled through the bore of a directional drill are subjected to stresses that can very easily damage or destroy their protective coatings.

Figure 2. Coatings used in directional drilling projects are typically sturdier and more abrasion resistant than those used in direct bury applications.

Figure 3. Rock, shale, and gravel can cut through or abrade coatings all the way to the pipe surface.

diameter of 54 in., and instead of pulling one new pipe section through it, you pull 10 bundled casings, totalling nearly 2100 ft in length. This was the task facing a project owner, group of engineers, pipeline and drilling contractor and crews, and sales and technical representatives.

In September 2009, an engineering firm in charge of the design for this directional drilling project contacted Jim Tolly of the Corrosion Control Products Company division of Farwest Corrosion Control Company, for assistance. Their project consisted of 10 bundled casings, including 3 - 14 in., 2 - 12 in., 2 - 10 in., 1 - 6 in., and 2 - 4 in. pipe casings, which were to be installed under a network of new railroad tracks in an area being dramatically redeveloped to transport freight. The engineering firm was interested in field-applied coating options for the girth welds on each of the casings.

When deciding on which field-applied girth weld coating to approve for use, the engineering firm had to ensure that the coating: (a) had to be designed for use in a directional drilling application; (b) had to be compatible with the plant applied coating; (c) had to offer the same corrosion and mechanical protection as the plant-applied coating; and (d) had to have a proven track record of successful use.

Pipelines pulled through the bore of a directional drill are subjected to stresses that can very easily damage or destroy their protective coatings. Rock, shale, and gravel can cut through or abrade coatings all the way to the pipe surface. Consequently, coatings used in directional drilling projects are typically sturdier and more abrasion resistant than those used in direct bury applications. Additionally, girth weld coatings are sometimes viewed as being the weak link in the pipeline coating chain, adding to the importance of choosing the right product for the job.

There are a multitude of field-applied girth weld coatings available for use in directional drilling projects: field-applied dual layer fusion bonded epoxy, liquid epoxies, cold-applied tapes covered with a fibreglass protective outer wrap, and 2-layer and 3-layer heat shrink sleeve systems, etc. There are numerous coating options that will complement plant applied coating systems and also provide effective corrosion and mechanical protection.

When the goal is a successful field-applied coating system, a number of equally important components are required:

1. Coating choice. Choosing the right product for each project is critically important. The decision is usually made based on the pipeline operating temperature, compatibility with the plant applied coating, and the method of pipeline installation.

2. Contractor and inspector training. Regardless of previous experience, at the start of each project, the pipeline contractor's coating installation crew and the coating inspector should be trained to apply the coating based on the manufacturer's requirements.

3. Proper pipe surface preparation. To what degree does the pipe need to be cleaned? This will be specified by the coating manufacturer, and its primary purpose is to promote maximum coating life.

Figure 4. There are a multitude of field-applied girth weld coatings available for use in directional drilling projects.

Figure 5. Pulling bundled casings.

Figure 6. There are numerous coating options that will complement plant-applied coating systems and also provide effective corrosion and mechanical protection.

4. Coating application or installation. Coatings must be installed according to the manufacturer's guidelines.
5. Coating inspection, both visual and with a holiday detector; and when necessary, coating repair.

The plant-applied coating on the casings was a three-layer polypropylene system. Tolly worked with the engineering firm to specify Canusa-CPS TBK-PP-65 heat shrinkable three-layer directional drilling kits for the girth welds, which were previously used on directional drills in the project area and have a long history of successful use. Each kit comprises: (a) a 100% solids, liquid epoxy primer, which becomes the primary anti-corrosion layer; (b) a heat shrink sleeve with a polypropylene backing and a high shear, hot-melt adhesive. This heat shrink sleeve also provides corrosion protection to the girth weld and mechanical protection against the stresses encountered when the new pipe is pulled through the bore; and (c) a secondary heat shrinkable sleeve is included in each kit and functions as a sacrificial wear cone.

In January 2010, the pipeline contractor started work on the project and by early February was ready to begin coating the girth welds. Farwest's Corrosion Control Products Company division supplied the contractor with Canusa-CPS TBK kits. Along with Scott Smith and Steve Anderson from Canusa-CPS, Tolly provided onsite pipeline contractor and inspector training.

In order for the end result to be a high quality product, the pipeline contractor's installation personnel and the pipeline owner's quality control representatives were trained per the manufacturer's recommendations. Training included proper pipe surface preparation and the directional drill kit installation, inspection, and repair.

The installation procedure for Canusa-CPS TBK-PP-65 heat shrinkable three-layer directional drilling kits consisted of:

1. Ensuring the girth weld area was clean by wiping down the adjacent plant-applied coating and the bare steel with a solvent-soaked rag in order to remove grease, oils, and other surface contamination.
2. Abrasive blast cleaning the bare steel girth weld to a minimum of a NACE 2/SSPC-SP10 near white metal finish, with 2 - 4 mils of anchor profile. The adjacent plant applied coating was lightly abraded with 60 grit sandpaper. The plant applied coating edges had already been chamfered to less than 30° by the coating plant.
3. The bare steel girth weld was preheated with a shrink sleeve torch in order to raise the temperature to 105 - 120 °F. This was done in order to dry any moisture in the steel and to allow the liquid epoxy primer to better flow into the anchor profile.
4. The 100% solids, liquid epoxy primer was thoroughly mixed and then painted on the bare steel to an average thickness of 6 mm.

5. The liquid epoxy primer was force cured with the shrink sleeve torch, and the girth weld and the adjacent plant applied polypropylene coating temperatures were raised to 195 °F. Silicone heat bands were placed over the adjacent plant-applied coating in order to keep the torch flame from damaging the polypropylene.
6. The primary heat shrink sleeve was centred over the girth weld, loosely wrapped around the pipe, and shrunk down from the centre to each edge with the shrink sleeve torch. Once the shrinking of the primary sleeve was completed, and while its polypropylene backing was still hot and soft, a hand roller was used to remove any entrapped air.
7. The sacrificial shrink sleeve was centred on the leading edge of the primary heat shrink sleeve, loosely wrapped around the pipe, and also shrunk with the torch. Hand rolling followed.
8. Once the primary heat shrink sleeve and the sacrificial shrink sleeve had cooled down to 120 °F, additional liquid epoxy was painted around the leading edge of the sacrificial sleeve.

After installation, the TBK-PP-65 kits were visually inspected for coating damage and then high voltage holiday tested.

Eventually, all of the girth welds on each of the casings had been coated. The separate casings were then bundled together on top of custom-made pipe rollers. On one end of the casing bundle, a pulling head was fabricated. Its purpose was to allow the casing bundle to be attached to the end of the drill pipe where it exited the bore.

Finally, the drilling of the pilot hole was completed and the bore was reamed a number of times to the appropriate size. The end of the drill string was attached to the pulling head on the end of the casing bundle and pipe pullback began. After only a few hours, the entire casing bundle was pulled into the bore.

The good news: challenges led to solutions that brought successful results. The casings are in place and will allow the enclosed pipelines to transport oil, water, gas, electrical and instrumentation cables from their sources to their destinations. WP