PROTECTION

EVEY DAY IN PLACES THROUGHOUT THE WORLD, OUR SOLUTIONS SAFEGUARD OIL AND GAS PIPELINES—EXTENDING THEIR DESIGN LIVES AND PROTECTING OUR CLIENTS’ RESOURCES AND THE INTEGRITY OF THEIR INFRASTRUCTURE.

To address the challenging deepwater environments found in the Gulf of Mexico and to expand our coating offerings to markets outside the United States, Bayou is now offering multi-layer polyolefin coating. Utilizing the most current application methods and modern extrusion equipment, Bayou offers both polyethylene and polypropylene coating systems.

For over 30 years, CRTS has developed and operated its patented robotic technology all over the world by applying protective coatings to internal and external field joints. Our exclusive technology provides with extensive corrosion protection which extends the longevity of our customers’ pipeline infrastructure.

With operations across the globe, United responds quickly with specialized personnel, equipment and material resources.

• United has lined over 16,000km of pipelines around the world
• United is the only HDPE lining company to offer a welded connection alternative to bolted flanges
• United’s Safetyliner™ is the only HDPE liner specifically designed for gaseous applications
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Welcome to the first edition of the Aegion Corrosion Engineering Review!

You may remember me as the former President of Corrpro, a longtime participant in NACE. I am currently the Chief Technical Officer for Aegion Corporation, the parent company of not only Corrpro, but also The Bayou Companies, Brinderson, CCSI, CRTS and United Pipeline Systems.

The Aegion family of companies consists of three business platforms: Energy & Mining, Water & Wastewater and Commercial & Structural. All of the businesses share a common purpose, which is to preserve the infrastructure that enables health and economic prosperity. Aegion is globally positioned in the business of pipe protection and infrastructure life extension with corrosion control engineering and cathodic protection by Corrpro Companies, protective coating systems by The Bayou Companies, CRTS and CCSI, lining systems by United Pipeline Systems and Insituform, construction and maintenance services for the upstream and downstream oil markets by Brinderson and pipe and structural repair by Fyfe and Fibrwrap.
The focus of most of companies within the Energy & Mining platform is on pipe protection. Our companies are very active in NACE International and other pipeline related research and standards organizations. Products and services include coatings and linings, cathodic protection and pipeline maintenance.

Since NACE CORROSION 2013, many exciting things have happened at Aegion. A few of these are mentioned below:

- As an Aegion representative, I was appointed to the NACE Technical Advisory Panel for the IMPACT study for International Measures of Prevention, Application and Economics of Corrosion Technologies, which will address the recommendations from the 2002 Cost of Corrosion study.
- Aegion joined Pipeline Research Committee International (PRCI) as a Technical Program Associate member.
- Aegion has developed and implemented a formal stage gate process for managing R&D projects across all of the business units.
- Aegion acquired Brinderson, adding its extensive experience in EPC and maintenance activities.
- Aegion continues to recruit, hire and train the very best people in the pipe protection business. Our professional development program is without equal.
- Corrpro has developed superior project management tools for AC interference mitigation EPC projects, including field testing, predictive modeling, interference mitigation designs, system construction and monitoring.
- Both Fyfe and Corrpro are participating in the Cooperative Industry Program to test the Fibrwrap® composite pipeline repair system.
- United Pipeline Systems recently completed the development of a welded connection, limiting the need for flanged connections and identified additional pipe lining materials for severe service.
- CRTS completed extensive R&D to improve robotics for applying internal girth weld coatings with improvements to the camera system, surface preparation and girth weld repair.
- Bayou designed and constructed a new 75,000 square foot facility for the application of advanced corrosion coatings and thermal insulation systems for high temperature, deep water pipeline construction.
- CCSI has embarked on a program to enhance field joint coating inspection and to develop a liquid epoxy coating ring.

In 2014, we expect to continue advancing our products and services to better serve the pipeline industry.

Contact one of our companies directly to find out how Aegion’s Energy & Mining platform provides comprehensive protection solutions for pipelines and other valuable infrastructure. Let us solve your complex corrosion problems!

Sincerely,

David Kroon, P.E.
Chief Technical Officer
Aegion Corporation
Corrpro recently upgraded its anode bagging system at its Sand Springs facility located outside of Tulsa, Oklahoma. Corrpro’s new state-of-the-art sacrificial anode packaging equipment has the capabilities of packaging more than 2,000 anodes per day. The computer controlled mixing equipment assures that the 75 percent, 20 percent and 5 percent blended mixture is the most precise in the industry. While quality control is always a priority, the dust- and noise-free environment provides a comfortable safe place for the Sand Spring employees to work, which is a paramount requirement.

The new facility improves upon Corrpro’s quality, dependability and on time delivery of its packaged anode systems.

Aegion’s newest acquisition is Costa Mesa, California based Brinderson, L.P., a leading integrated service provider of maintenance, construction, engineering and turnaround activities for the upstream and downstream oil and gas markets. Primarily focused on serving large oil and gas customers in California, Brinderson’s competitive advantages include its industry-leading safety record, a strong reputation for reliability and quality and comprehensive solutions for major refinery maintenance, repairs and retrofits.

Brinderson uses a comprehensive safety management system (SMS) to provide a systematic approach to identify hazards and mitigate risks. It manages every aspect of safety through the organization and requires the organization to ensure we are looking at all risks within each project as a single system, rather than having multiple, competing approaches. Brinderson’s safety process works. Brinderson finished 2013 with a total recordable incident rate (TRIR) of 0.20 and over 11 million hours worked without a lost-time injury. With the dedication and attention to safety by its clients, partners, employees and leadership, these exceptional safety statistics represent Brinderson’s 49-year history of hard work and allegiance in establishing and maintaining a culture of safety performance and excellence.

According to Brinderson President Russell Conda, Brinderson takes continuous performance improvement seriously. He said, “Our leadership mandates continuous safety and performance Improvement and recognizes employees for proactively being ambassadors for safety. Our commitment to extraordinary safety permeates everything we do and our goal continues to be zero accidents.”
CRTS, Inc. was awarded a 2014 Materials Performance Corrosion Innovation of the Year Award for its Robotic Internal Inspection Machine by a panel of experts at NACE Corrosion 2014. According to www.nace.org, the award honors “the most important innovations impacting corrosion control today” and highlights “progressive technological developments in all aspects of corrosion prevention and mitigation and recognize[s] the innovators who have created revolutionary solutions to combat corrosion and protect vital assets from its damaging effects.”

The criteria for the awards included “technologies that have resulted in significant improvements to current products, services, methods and techniques such as groundbreaking advances in coatings and linings, cathodic protection, materials selection and design, instrumentation, testing, integrity assessment, chemical treatments and other practices directly related to corrosion prevention and mitigation in all industries.” Read more about CRTS robotics in the Product Showcase on page 7 of the Corrosion Engineering Review.

INTERRUPTED CLOSE INTERVAL POTENTIAL SURVEY ON 620-MILE PIPELINE SYSTEM
by Chris Dauzat | Operations Manager - Pipeline Services, Corrpro Companies, Inc.

Corrpro was contracted in October 2013 to perform an interrupted close interval pipe-to-soil potential (CIP) survey on a 620-mile pipeline system originating in Midland, Texas and terminating in El Campo, Texas. This pipeline system also contained multiple lateral lines along the main line system.

A CIP survey is used to evaluate the effectiveness of a cathodic protection system and involves establishing an electrical connection to the pipeline by means of a trailing copper coated wire. The pipe-to-soil potential is measured with a set of reference electrodes positioned directly over the pipeline at 2.5-ft. intervals. In order to perform an interrupted CIP survey, all CP current has to be interrupted in order to obtain an IR free potential. This is achieved by installed GPS synchronize current interrupters at all known current sources.

For this project, Corrpro utilized three experienced crews, each consisting of three employees, two vehicles and a UTV. Each crew member had to walk the length of the right-of-way in order to take accurate measurements.

The pipeline right-of-way contained many obstacles and a variety of terrain ranging from hilly rocky areas to marsh land. It also crossed multiple high fenced ranches with access granted by appointment only. Despite all of these obstacles, Corrpro managed to complete this project in just 28 days and nearly two weeks ahead of schedule. That equals to an average walking distance of 22 miles per day, collectively for all the crews.

CRTS WINS 2014 MP CORROSION INNOVATION OF THE YEAR AWARD
by Caroline Fisher | Technical Writer, CRTS, Inc.

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A major natural gas producer operating in the Haynesville Shale in northern Louisiana asked Corrpro to provide expertise with respect to well casing corrosion and cathodic protection. Specific questions to be answered were:

1. What is the likelihood that corrosion is occurring on steel surface casings associated with natural gas producing wells in the field?
2. What rates of corrosion are possibly occurring?
3. What activities, if any, are required to minimize corrosion?
4. What are the costs associated with corrosion protection?

To answer these questions, Corrpro conducted E log I testing on various wells in the area. A circuit set up between each well casing and a temporary anode was energized using a variable output power source with incremental increases to the applied current during the test. Polarized potentials were measured and plotted against applied current. The resulting corrosion and cathodic protection break currents were identified from the data curves. These data were used not only to design impressed current cathodic protection systems and perform cost analysis but also to identify a likely range of corrosion rates and associated times to perforation. This information was used by the owner to prioritize future activities.

Corrpro was able to successfully complete the project by performing the technically demanding and proven E log I test procedure. By tapping into the vast amount of corrosion engineering knowledge within Corrpro, we were able to ensure that the E log I method, which has become somewhat of a lost art in the industry, remains available to our clients.

Trey Johnston has been a Project Engineer with Corrpro since 2007. He received his degree in mechanical engineering from LSU Baton Rouge and is a NACE-certified Cathodic Protection Technologist.
CRTS APPLIES HIGH QUALITY COATINGS WITH ITS ADVANCED ROBOTICS

CRTS’ thriving R&D environment ensures its products and services provide the highest quality in design, manufacturing and services. The CRTS robotic equipment is used to apply liquid epoxies and fusion-bonded epoxies for onshore projects and fusion-bonded epoxy coatings for offshore projects. The CRTS inspection robot is the final piece in seamless internal corrosion prevention for new pipelines around the globe.

HOW DOES IT WORK?

After cleaning and coating new pipeline internal field joints, the inspection machine performs one or more of its multiple features and applications:

- It locates coating defects such as holidays within new construction coated steel pipe.
- It allows visual inspection with its onboard camera.
- It measures dry film thicknesses and detects holidays after coating the internal field joint.

The above features allow any necessary repairs to be made immediately on site and prior to product being introduced to the pipe. The inspection application may also be applied to the entire length of the internal factory-applied coating using a removable circumferential brush. The high-quality video feature can be used to detect faulty welding, display weld bead contours, faulty field-applied couplings, debris, parent coating damage, etc.

The inspection robot can be configured to work simultaneously with welding and nondestructive testing processes both onshore and offshore. Its untethered design enables it to only enter the pipeline once for internal field joint and full-length inspections.

ELIMINATING CORROSION

Holiday detection and weld repair on internal field joints prior to introducing product in the pipeline eliminates or greatly minimizes the chance of internal corrosion anywhere in the pipeline.

RESULTS

The inspection robot does not interfere in any way with current industry methods or standards. Instead, it provides a foundation for optimum internal corrosion management. Although cost savings vary with each project, the overall savings of preventing internal corrosion are achieved in the pipeline’s longevity, product purity, reduced friction, decreased leaks and ruptures and reduced operating and maintenance costs. Inspecting internal field joints is a vital step in pipeline integrity management and corrosion mitigation.
Pipeline rehabilitation specialists, United Special Technical Services (USTS), a joint venture between United Pipeline Systems and STS, recently completed the longest-ever continuous compression-fit liner insertion project in its history.

The project, undertaken using the United Pipeline Systems, Tite Liner® technology, lined an 8,200-ft. section of offshore produced water disposal pipeline.

**PROJECT BACKGROUND**

In 2013, the client was engaged in the further development of two oil fields located offshore Qatar. The production is routed to Halul Island where the water is extracted from the product and then disposed of through a subsea pipeline from the onshore plant to the reinjection well located 1.5 miles offshore.

Due to an increase of production at the Halul Island facility, the existing pipeline no longer had the required capacity and needed to be augmented with an additional pipeline. The proposed pipeline comprised 8,200 feet of 24-inch carbon steel pipeline with a corrosion resistant and compression-fit high density polyethylene (HDPE) internal lining.

A unique feature of this project was that it was necessary to insert the HDPE liner in one continuous length of 8,200 ft. from an offshore platform to the onshore pipeline connection. This length was the longest Tite Liner® installation ever attempted and successfully executed.

Valentine Marine Gulf LLC (VMGL) contacted USTS to provide a solution to install this single shot section using its Tite Liner® technology. The ability of USTS to provide the latest fusion technology and the Tite Liner® powered roller box was a fundamental key to the success of this project. United Pipeline Systems recently debuted an upgraded roller box with fully powered hydraulics for diameters over 20 inches. The roller box installation technique combined with the physical and chemical properties of the Borouge HE3490-L5 HDPE PE100 materials convinced the client that Tite Liner® was the ideal solution to successfully install the liner in a single continuous 8,200-ft. length.

**CHALLENGES**

There were a variety of challenges associated with the project in addition to the record-breaking length. First was the jobsite footprint. Limited space on the island necessitated that all the works related to the host pipeline as well as the HDPE liner were to be carried out offshore. Additionally, the project timing was not favorable. The only available weather window was during the summer, where the HDPE pipe surface was measured midday at 80°C, or 176°F. Therefore any attempted pull would have to be performed at night in order to avoid extreme heat.

In addition, fusion joint welding of the HDPE pipeline was performed on a work barge tied to the pipelay vessel. Each 50-ft length of HDPE pipe was assembled into larger 150-ft sections on the work barge. A watertight towing head was then fused to the lead 45m length and attached to the winch located on a tug. The tug would tow and guide the string of pipe, along with buoys to keep the pipe afloat, with the assistance of the work boats. The sea conditions required that the control of the pipe had to be decisive, as any over pulling by the tug would result in damaging the HDPE. Owing to the combined expertise of VMGL, USTS fusion and marine crews, the fusion operation was performed successfully.

One other issue was location. As a result of the steel pipe location, it was necessary to assemble the equipment inside the welding tunnel of the pipelay vessel. Additional structures and reinforcement supports were added and the tunnel roof was modified so that it could be removed. This enabled the equipment to be positioned and safely restrained to prevent any movement during the insertion.
Following the fusion jointing and testing, the HDPE pipe was positioned on the pipelay vessel with the pipe entry point at roughly 20 feet above the sea surface. A special entry chute was actually constructed to ensure that the joints of the pipe were not overstressed during the pull.

At the time of installation, the winch pack was positioned on Halul Island and radio communication established. The preparation for the insertion started at 8pm. Once preparation was complete, the liner insertion commenced at approximately 2am and the entirety of the liner was installed by 6am.

Jeff Schell, General Manager at USTS said, “Despite challenging conditions, with the combination of experience and our Tite Liner® technology, this project proved lining long distance pipelines can be accomplished offshore with solid wall interactive PE liners.”

The produced water disposal pipeline now has internal corrosion protection from end to end to ensure it remains operational for its entire service life.

Schell added, “Every detail had to be attended to in this critical offshore environment where there is no margin for error. We faced many challenges but in the end we were successful”.

With operations across the globe, United responds quickly with specialized personnel, equipment and material resources.

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- United’s Safetyliner™ is the only HDPE liner specifically designed for gaseous applications

Contact us to learn how we can provide the best HDPE solutions for completing your turnkey projects anywhere in the world.
Pipelines in close proximity to overhead and underground high voltage alternating current (AC) power lines can be subjected to periodic but significant electrical interference, raising concerns about electrical safety and AC influenced corrosion. With this in mind, the need for practical engineering solutions becomes ever more prevalent as regulators press for common utility corridors. AC mitigation helps to address the issue of corrosion. While alternating current interference mitigation (ACIM) has been one of its core competencies for over 50 years, Corrpro has seen a notable increase in this aspect of its business over the last several years. This is particularly true in the United States and Canada where Corrpro has substantial dedicated expertise and industry recognized leaders in this specialized area of pipeline corrosion control.

Unequivocally, Corrpro has the full-service capabilities to address every one of its customers’ ACIM needs, including engineering, equipment for detection and monitoring, predictive modeling, design of mitigation systems for new and existing pipelines, off-the-shelf and specially-designed materials and products and turnkey construction services. Corrpro engineers routinely work with pipeline companies, power companies and power system designers to develop cost effective and maintenance friendly ACIM strategies.

A small sample of Corrpro’s recent projects are highlighted below. Corrpro’s project delivery capabilities are worldwide.

**LONE STAR**

The Lone Star project in North Texas involved the design and installation of ACIM for five existing petroleum pipelines totaling over 200 miles that were operated by three separate pipeline companies. The engineering evaluation and subsequent installation of the ACIM system by Corrpro was in conjunction with the $7 billion “CREZ” project developed by the Texas state legislature which created multiple competitive renewable energy zones throughout Texas. This includes over 3,500 miles of new 345-kV transmission lines that will move up to 18,500 MW of wind power across the state.

Corrpro engineers routinely work with pipeline companies, power companies and power system designers to develop cost effective and maintenance friendly ACIM strategies.

Corrpro was first retained by the power company to evaluate the pipelines, which date back to the 1950s, and their interaction with the soil and the new power lines. This ultimately led to the development of a computer-based predictive model to determine whether mitigation was necessary and then to the optimization of the system’s design. Given the variability of power transmission associated with wind generation sources, Corrpro worked closely with the power company and power line designer to rigorously evaluate different operating scenarios under both normal and upset/emergency conditions.

Corrpro’s ACIM design included 75 miles of parallel mitigation conductor next to the pipelines, including both trenched and directionally drilled sections. The project included the modification of 230 existing cathodic protection test stations and the installation of 100 new test stations. The test stations used steel coupons to measure AC current density, a metric used in determining the significance of AC corrosion and the effectiveness of AC mitigation. Test stations at strategic locations were also fitted with high-precision MetriCorr™ corrosion rate probes and remote monitoring units to further determine and document system effectiveness.

The ACIM engineering and design was managed by Corrpro’s corporate engineering and pipeline services groups, Houston-based. Once the design was complete, the individual pipeline companies retained Corrpro to complete the construction. Spearheaded by our Houston construction group, the construction phase took seven months and involved manpower and equipment resources from our construction departments in Houston, New Orleans, Tulsa and Medina, Ohio, as well as our horizontal directional drilling (HDD) team also based in Medina. This turnkey capability is unsurpassed.

At various points during construction, there were in excess of 30 Corrpro employees working on this challenging and time-sensitive project. Safety was paramount throughout the project and included special training and procedures associated with the removal of hazardous coating from some of the pipeline segments. Baseline testing completed after the construction documented system performance consistent with design expectations.
GULF COAST PROJECT

Another project out of the South involved an existing federally regulated pipeline along the Gulf Coast. The pipeline, routed through swamps, various marshlands and agricultural tracts including soybean, rice and sugar cane, spanned over 100 miles. These areas, along with a total of 26 miles of 84 HDD pipe sections and 27 miles designated by the owner as “avoidable areas” due to landowner issues, access constraints and other variables presented challenges for the ACIM evaluation, design and construction.

In addition to the challenging right-of-way, there are over 40 paralleling and crossing power line circuits with line voltages of 69kV, 138kV and 230kV. Field studies of existing conditions and data from the two involved power companies documented the need for ACIM. As a result, Corrpro’s ACIM engineers worked closely with the pipeline company’s engineering and right-of-way staff to evaluate several mitigation scenarios, ultimately balancing the benefits of dedicated mitigation equipment at specific locations with the logistical constraints of installing the equipment. The complex computer-based predictive analysis resulted in a mitigation system consisting of five sections of parallel mitigation conductors totaling 3 miles, along with more than 30 deep anode grounds to a maximum depth of 208 ft. The design is based on all mitigation elements being connected to the pipeline through electronic DC-decoupling devices that shunt AC and surge/transient currents while blocking normal levels of direct current associated with cathodic protection systems. Part of Corrpro’s analysis included an engineering review comparing the use of zinc ribbon versus copper cable for parallel mitigation.

Corrpro was selected to install the ACIM system based on a competitive bid process. With four crews working simultaneously, all specialty work including installation of the parallel mitigation conductors and deep anode grounds is being handled by Corrpro in-house forces using in-house equipment. The work included close coordination with the various parties involved. To assure specification compliance during the course of the work we had a full-time NACE-certified technician assigned to test the various mitigation components. One of Corrpro’s in-house safety specialists was also on the project full-time. Remote monitoring units (RMUs) have been installed at six locations to evaluate conditions during and after the ACIM construction. These data and other post-installation measurements will be used to gauge ACIM effectiveness and determine what if any additional mitigation may be in order.

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Corrpro offers a full spectrum of AC safety and AC corrosion detection and resolution services. With thousands of miles of pipeline protected, Corrpro’s proven solutions are practical, cost effective and specified to our clients’ needs. Working closely with pipeline operators and power companies alike, the start-to-finish services we provide for future and existing pipelines include:

- Pre-design evaluations
- Computer modeling
- Mitigation design and materials
- Full turnkey construction
- System startup and training
- Operations and maintenance

Corrpro Companies, Inc. is proud to be a part of the Aegion Energy & Mining platform which also includes The Bayou Companies, Brinderson, CCSI, CRTS and United Pipeline Systems.
In 2012, Corrpro’s West Chester HDD (horizontal directional drilling) group was asked to support Sunoco Logistics in the design of individual understructure cathodic protection systems for multiple ambient temperature aboveground storage tanks. The majority of the single bottom tanks were from 140-ft. to 180-ft. in diameter. Design criteria had been requested to be at or above 1.5 milliamps (ma) per square foot. This eastern location was unique as it once was a refinery that had never included cathodic protection as a design factor in its 30 years of operation. When Sunoco purchased the facility in 2011, it was understood that the refinery components would be disassembled and the storage capacity would be upgraded per DOT standards.

Sunoco was interested in specific Bullseye™ design features, such as its reference cell retractability for understructure data collection and the replaceability of individual undertank anode strings. After providing an estimate, Corrpro was awarded a project consisting of nine tanks to start and was given another four tanks throughout the course of the project.

With these tanks being brought to DOT standards, the customer quickly saw the benefits of understructure current distribution and opened Phase II of the tank farm upgrade for discussion and design. Phase II consisted entirely of the process piping corridors feeding the soon to be “breakout” ASTs. Ultimately, 17,000-ft. of directionally-drilled linear anodes with explosion proof junction boxes and rectifiers were identified as the scope for this project.

The Corrpro HDD group had a strong delivery advantage by understanding sub-site soil conditions from previously delivered undertank systems. The 17,000-ft. of necessary linear anodes were broken into over thirty 300- to 800-ft. custom sections for assured tensile strength during delivery. Corrpro secured the confidence of Sunoco by offering high quality 200ma per linear foot. The CorrFlex™ anode with redundant leads and Universal-built rectifiers and junction boxes were used for each section.

The linear drilled construction and component delivery at Eagle Point finished up in less than 10 weeks. The simultaneous commissioning of 13 tanks and their associated pipelines happened soon after. The task involved simultaneous interruption of multiple tank rectifiers and piping rectifiers, while structure-to-earth on/off potentials were profiled under the tanks and along the underground piping runs. Final operating currents were within an acceptable range of the original design and stabilized in full compliance with NACE criteria.

While the unique piping protection project was being delivered, additional tanks were identified for Corrpro’s undertank Bullseye™ system. More importantly, Corrpro’s HDD and West Chester engineering group had no safety incidents or injuries throughout six months of operation and delivery on site.
Bayou Wasco, Aegion’s joint venture with Wasco Energy Ltd, a subsidiary of Wah Seong Corporation Berhad, opened a brand new facility in 2013 near The Bayou Companies’ complex in New Iberia, Louisiana. The new facility is poised to meet the demands of an ever-growing industry and provide new innovations in its coating products.

A PARTNER IN INNOVATION

A collaboration between Bayou Wasco and the Dow Chemical Company last year resulted in a breakthrough innovation for the new insulation coating facility and meets the growing demand for pipelines installed in ultra-deepwater environments. Designed for the broader temperature ranges and higher pressures common in these harsh environments, the proprietary DOW NEPTUNE™ Advanced Subsea Insulation System was selected to receive the Offshore Technology Conference’s 2013 Spotlight on New Technology Award. The annual award recognizes innovative new products that significantly impact offshore exploration and production.

The DOW NEPTUNE™ Flow Assurance System can be used in temperatures as low as -40°C (-40°F) and has been tested at operating temperatures of up to 160°C (320°F). Not only is it impervious to hydrostatic compression to at least 400 bar (equal to a 4,000 meter water depth), but it also achieved a low K-factor in a simulated service test (160°C, 300 bar, 28 days) performed on pipe that successfully completed a simulated reeling test. A single layer of the DOW NEPTUNE™ subsea flow assurance insulation over DOW NEPTUNE™ Fusion Bonded Epoxy eliminates the need for multiple and adhesive tie layers, contributes to a thinner coating profile and maintains a consistent low K-factor from tree to line pipe to field joint. This helps to eliminate the potential risks associated with bonding dissimilar and potentially incompatible materials.

NEW COATING FACILITY

The new facility commissioned by Bayou Wasco is fully functional to coat pipelines with the DOW NEPTUNE™ product and other insulation materials. After roughly one year of construction, the new insulation coating facility was opened and the first pipe coated there.

The facility is strategically located to provide high-quality coating and insulation systems for offshore oil and gas pipelines located in the Gulf of Mexico. Altogether, the state-of-the-art facility equals almost 75,000 square feet and is capable of coating both multi-layer polypropylene (PP) coatings and glass syntactic polyurethane (GSPU) coatings.

ABOUT MULTI-LAYER POLYPROPYLENE COATINGS

Polypropylene insulation systems are used for thermal management of flowlines for offshore applications. Insulation can take the form of solid, foamed or syntactic PP as well as multi-layer combinations of these three materials designed specifically for each project. The facility can coat pipes that range in size from 3 inches to 24 inches. The coating layers consist of a PP foam and syntactic PP. The insulation thickness for PP can be 100mm or more, depending on the project. The materials are applied by a side extrusion process in accordance with project specific requirements.

The SURF 9035™ material, a fully compounded polypropylene based resin, is used to create the multi-layer insulation system. It is ideal for the production of syntactic PP systems for thermal management of flowlines because it is designed to perform at high service temperatures specifically in deep water.

ABOUT GPSU COATINGS

Syntactic polyurethane materials are used as thermal insulation for offshore pipelines. The product is customized to take into account specific project requirements, such as water depth and thermal requirements. The product can be laid by all types of offshore lay barges.

The Bayou Wasco facility is capable of coating GSPU pipes that range in size from 2 inches to 24 inches in diameter. Insulation thickness for GSPU coatings can be 100mm or more, depending on project specifications. One difference between GSPU and multi-layer propylene coatings is that GSPU is applied by an injection molding process to achieve the specific thickness requirements for a project.
A grand opening for the facility was held on May 16 with guests from various Aegion companies and Dow and community leaders represented.

At the event, Aegion’s President and CEO J. Joseph Burgess spoke about the growth of the industry in the area. Mr. Burgess said, “Aegion’s investment in this region is based on our belief in the robust future of the Gulf Coast market. We are proud to be a part of this community and look forward to continuing to provide high-quality products and services for the protection of oil and gas pipelines.”

Dow Chemical offered a statement in a press release: “We are very satisfied with the line pipe coating application process at Bayou Wasco’s new facility,” said Alexander Lane, Dow Global Business Leader for Oil & Gas Transmission. “The DOW NEPTUNE system offers next-generation performance in extreme installation and operating temperatures, and having a new plant like Bayou Wasco’s that is capable of applying DOW NEPTUNE P Insulation coating to line pipes at full scale brings the DOW NEPTUNE System to the forefront as a true end-to-end flow assurance choice for customers.”

Two industry leaders, The Bayou Companies and Wasco Energy, Ltd, have constructed a world class insulation facility in New Iberia, Louisiana. Bayou Wasco’s facility is the first in the Gulf of Mexico to offer both multi-layer polyolefin and molded insulation systems under one roof. Bayou Wasco’s facility meets all of your coating needs.

The Bayou Wasco facility is now operational and we hope to become your complete source for major coating and deepwater insulation projects.

Contact Randall Perkins at randaltp@bayoucompanies.com or 281.598.6404 to learn more about Bayou Wasco’s syntactic polyurethanes, 5 layer polypropylene and Dow NEPTUNE™ Advanced Subsea Flow Assurance System products.

Bayou Wasco Insulation, LLC is a joint venture between Wasco Energy Ltd. and The Bayou Companies, LLC and is a part of the Aegion Energy & Mining Platform.
Since its creation over 30 years ago, Commercial Coating Services International (CCSI) has coated more than two million field joints in the United States, Canada, Latin America, Asia-Pacific and the Middle East. In addition to coating, CCSI offers a variety of protection and monitoring solutions for your pipeline needs. The latest innovation is CCSI’s new Trench Breaker system.

**TRENCH BREAKER SYSTEM**

CCSI’s Trench Breaker system, often referred to as a ditch breaker, is a temporary or permanent barrier installed at regular intervals in pipe trenches. Trench Breaker is generally used in two installation scenarios. The first is an installation in which fill is placed for prevention of erosion caused by the lateral movement of runoff in the open trench. The second scenario allows the pipeline contractor to back fill up to the breaker.

The CCSI Trench Breaker system is a foam breaker paired with specially formulated foam to prevent cathodic protection shielding. The system is comprised of two parts that are mixed and sprayed by using pressurized nitrogen tanks to deploy the material into the trench at the appropriate ratio. Specifically, the foam circulates the pipe and builds up a breaker between the trench walls to the desired height.

Trench breakers are simple to install, require minimal labor and provide a higher yield on material. The application equipment is easy to use and personnel can be trained on how to apply the material right at the pipeline right-of-way. Complicated equipment is not required to obtain the proper ratio — our equipment keeps the material on ratio and application is as simple as pulling the trigger.

In addition to working with a company that delivers unparalleled customer service and support, the Trench Breaker system offers several benefits:

1. It is simple to use and only requires one person to operate.
2. The Trench Breaker installation process means reduced down time and uses no mechanical parts.
3. It can be applied by a contractor.
4. It is available in standard and non-cathodic shielding foam.
5. The average yield of the product is 95 percent — meaning less waste for the customer.
6. The same foam can be used as pipe pillows.

**CCSI COATCHECK™ SYSTEM**

Over many years working with clients, CCSI noticed that an automated method of tracking quality was needed in order to more accurately document the work being performed for customers on their right-of-way. This need is primarily due to the industry becoming more automated and regulated, often requiring strict documentation of the work conducted. CCSI’s CoatCheck™ system was created to meet this need and assist inspectors and owners in the tracking of both the coating quality and location of girth welds before they are buried or submerged.

CoatCheck™ is completed in two stages. The first stage is performed after a blasted or cleaned surface is prepared prior to coating. The anchor profile is measured, the location is logged and the environmental conditions are recorded. After coating, the second step in the process requires the unit to take multiple thickness measurements and conduct a holiday test. Each stage takes about a minute to complete. After all data is logged, it is collected and presented in an inspection report or summary.

CoatCheck™ capabilities include GPS tracking of field joints, recording of environmental conditions, blast profile measurement, surface temperature measurement, visual inspection of joints, holiday detection, holiday marking, custom inspection reports, production reports and real-time coating alerts and inspection reports. This helps keep customers apprised of all work jobsite conditions.

**ABOUT CCSI**

As an industry leader in the field joint coating and custom coating services since being founded in 1983, CCSI owns one of the largest fleets of field joint coating systems in the world and can provide custom coating of pipe, fabricators, valves, bends, fittings and other pipeline appurtenances. Long recognized as a company dedicated to exceptional service within our industry, it is the commitment of CCSI to not only meet, but exceed all customer expectations and provide technical support its customers can rely on. With the introduction of Trench Breaker and the CoatCheck™ system, CCSI continues to stay at the forefront of innovation and continually strives to serve the customer.
TRUSTED

For over 30 years, CCSI has been your trusted supplier of field joint coating equipment and technicians.

We develop, train and equip our customers with the right tools to perform quality coatings wherever they are needed.

- FBE field joints
- ARO overcoat
- Foam ditch breakers
- Rehab coatings
- In-place UV protective coating
- Custom solutions

CCSI is proud to be a part of the Aegion Energy & Mining platform which also includes Bayou, Brinderson, Corrpro, CRTS and United Pipeline Systems.
Weathering steel bridges are found all over the United States. These are easily identified while driving on interstate highways — they are the bridges and overpasses that were never painted and look brown and rusty. They were not painted because the steel used for these structures is not standard carbon steel and is formed with specific alloys.

This type of alloy steel is designated as A-242 from the ASTM International standards group and is designed to oxidize on the outer most surface when exposed to rainy weather. Because the rust layer forms a barrier to protect the inner steel, applying a protective coating system for corrosion protection was originally considered unnecessary.

Over the years, it was found steel bridges in southern climates that were subjected to wet and dry cycles weathered well and were performing as designed. However, in more northern regions where de-icing products such as rock salt are heavily used, those structures were not performing as well due to the accelerated corrosion process.

It has been discovered that the outer rust layer penetrates further into the steel and forms layers of dislodged pack rust. These layers of pack rust become separated from the inner layer, allowing more moisture and corrosive products to attack the inner layers delaminated by the pack rust. This ongoing corrosion cycle leads to heavy section loss and has turned into costly repairs for bridge owners.

Many bridge owners with this problem are faced with a decision: do we replace these structures or attempt to salvage and preserve what we have?

Unfortunately, the amount of the section loss is often not fully realized until the pack rust and other corrosion products are removed by abrasive blasting. The corrosion can be intense in girders, stringers and I-beams when both sides of the web and areas near the bottom flanges are attacked by corrosion – leaving only thin steel in the middle.

Engineers are alerted to areas with severe section loss or heavy pitting after blast cleaning. With this information, engineers determine whether new fabricated plates are needed to be bolted in place to strengthen these deteriorated areas or if the damaged item should be removed and replaced.

A new trend seems to be emerging where owners are acting to save these structures with protective coating systems used on carbon steel bridges before it is too late.

Many states use a three-coat protective coating system consisting of a zinc-rich primer, epoxy intermediate coat and a polyurethane topcoat — the same system used on carbon steel structures. This brings steel bridges closer to the standard look of other bridges that already have a protective coating and helps these rehabilitated bridges look fresh, new and most importantly, be corrosion free.
800+

CORRPRO’S 800+ EMPLOYEES INCLUDE APPROXIMATELY 250 NACE MEMBERS AND 173 NACE CERTIFIED PROFESSIONALS DEDICATED TO PROVIDING CATHODIC PROTECTION SOLUTIONS.

We believe that our employees’ dedication to building strong relationships within the industry is one of our most valuable resources. With over 45 offices on four continents, Corrpro is a leading global provider of corrosion control engineering services and equipment.

Corrpro Companies, Inc. is proud to be a part of the Aegion Energy & Mining platform which also includes The Bayou Companies, Brinderson, CCSI, CRS and United Pipeline Systems.
A multi-level parking facility in downtown Kansas City, Missouri built in 1970 required a major repair program in 1980 due to corrosion caused by chloride used for de-icing. Three years after the repair, the slab was again showing distress from reinforcing steel corrosion. A significant amount of corrosion activity was threatening to destroy the previous repair. Cracks in the concrete topping were allowing moisture and salt to once again penetrate to the reinforcing steel surface. Because the corrosion would result in serious structural damage if left unchecked, replacement of the slab was considered a possibility. As an alternative, cathodic protection was recommended by the client’s structural engineering consultant as a solution to not only control the corrosion problem, but also prolong the life of the structure.

Corrpro’s ELGARD titanium MMO anode ribbon was selected as the cathodic protection system to stop further corrosion of the reinforcing steel. Since a concrete overlay topping already existed from repairs completed in 1981, a saw-cut slotted system with the anode ribbon recessed in the slot was chosen. Between 1989 and 1998, five separate cathodic protection installation projects were undertaken by the client to complete the five levels of the office garage. Over 16 years later, the system is still in place and in good working condition.

With the success of the first garage, corrosion mitigation work continued in nearby structures. Across the street, another multi-story retail parking garage of 250,000 square feet was also suffering from chloride induced corrosion. Corrpro’s ELGARD™ anode ribbon system was again chosen as the cathodic protection system for this nearby garage and in 2010, a project was undertaken to complete half of the garage. Corrpro recently completed the design and procurement of materials for the next phase of the retail garage. Installation began in February 2014 and is set to be complete in May 2014.
RENEW & PROTECT

OUR SOLUTIONS RENEW AND PROTECT OIL & GAS PIPELINES AS WELL AS LARGE-DIAMETER PRESSURE PIPES WITH LITTLE DISRUPTION AND LESS COSTS.

Using Fyfe Company’s Tyfo® Fibrwrap® system, Fibrwrap Construction works worldwide with owners and engineers to renew the lifecycle of large-diameter concrete and steel pipelines. Our unique, turn-key approach includes design, materials and installation.

The Tyfo® Fibrwrap® system’s light-weight, low-profile material provides the structural strength for large-diameter pipelines using specially designed layers of fiber-reinforced polymer composite materials.

Corrpro offers a full spectrum of AC safety and AC corrosion detection and resolution services. With thousands of miles of pipeline protected, Corrpro’s proven solutions are practical, cost effective and specified to our clients’ needs. Working closely with pipeline operators and power companies alike, the start-to-finish services we provide for future and existing pipelines include, pre-design evaluations, computer modeling, mitigation design and materials, full turnkey construction, system startup and training and operations and maintenance.

Fibrwrap Construction Services, Inc. and Corrpro Companies, Inc. are proud to be a part of the Aegion family of companies which also includes The Bayou Companies, Brinderson, CCSI, CRTS, Fyfe, Insituform and United Pipeline Systems.
As part of the New Orleans drainage system, the US Army Corps of Engineers commissioned the Gulf Intracoastal Waterway West Closure Complex to be built approximately one-half mile south of the convergence of the Harvey and Algiers Canals.

Two 653-ton steel sector gate leafs constitute the 225-ft. wide and 32-ft. tall floodgate that protects the residences and businesses in the area from possible storm surge resulting from tropical weather events. Corrpro was subcontracted to provide corrosion protection engineering services for these hinged sector gates, the largest such gates in the world. Services provided include:

- Water chemistry sampling and analysis
- Cathodic protection current requirement and life calculations
- Design of monitoring system
- Coordination of anode installation
- Coating integrity inspections
- Anode continuity testing
- Coordination of coupon test station installation
- Native state potential measurements
- Polarized potential measurements

Specific challenges involved coordinating activities which could impact the successful implementation of the corrosion control system among numerous participating parties, accounting for seasonal fluctuations in water chemistry and ensuring proper monitoring per NACE standards.

By getting involved in multiple phases of the construction, Corrpro was able to ensure that the cathodic protection and monitoring systems were installed properly and that coating integrity was maintained in accordance with project specifications.

The result was the successful commissioning of the cathodic protection system with adequate cathodic protection levels achieved at all locations surveyed. The West Closure Complex was engaged in August 2012 in anticipation of Hurricane Isaac. This was the first time the complex was used due to a storm event. This project is one of many Corrpro has been involved with as part of a massive flood protection effort in coastal Louisiana.
INTRODUCTION

After the devastating effects of Hurricane Katrina, the US Army Corps of Engineers constructed a new floodwall in St. Bernard Parish, Louisiana. The floodwall, constructed in stages from 2009 through 2011, was built using steel H-piles, which are commonly used for deep foundation applications.

Concerns regarding the life span of the steel H-piles were raised due to the use of sacrificial thickness for life extension rather than as a protective coating for corrosion prevention. This study was planned to determine if the corrosion allowance of 0.125 inches in the structural steel was sufficient to allow for a 100-year life span.

This study consisted of the following tasks:
- Soil corrosivity evaluation
- H-pile direct corrosion assessment
- Stray current investigation

The results of this testing determined the corrosivity of the soil and the depth and area of corrosion pitting to date as well as projected a corrosion rate for the pile based on weight loss.

TEST PROCEDURES

1. Soil Corrosivity Evaluation

Resistivity is a common parameter for evaluating the corrosiveness of a soil, i.e., the environment immediately around a structure. Resistivity is the inverse of conductivity, and is measured in the units of ohm-centimeters (Ω-cm). Corrosivity is often an inverse function of resistivity, with low resistivity soils usually more corrosive than high resistivity soils.

In addition to soil resistivity, other factors in the soil play a key role in the corrosivity. Dissolved solids such as chloride, sulfate and sulfide ions can increase the potential for corrosion. Oxygen content and pH moisture are also key factors. Typically, the potential for corrosion increases as dissolved solids, moisture and oxygen content increase. More acidic soils or those with a pH of 5.5 or less also tend to be more corrosive.

A full set of chemical tests was conducted for all of the discussed factors, which included chloride ion content, sulfate ion content, sulfide ion content, pH, moisture content and oxygen-reduction potential (redox). Additionally, a resistivity test was conducted in the lab to confirm the field readings taken from the Wenner 4-Pin Method.

2. H-Pile Direct Assessment

In order to determine the true extent of corrosion on the H-piles, excavations were planned to allow for a visual inspection of the pile and determine measurements of corrosion pitting and thickness. The excavations would expose a minimum of four feet of pile as near to the top of the pile as feasible.

Upon completion of the Wenner 4-Pin soil resistivity testing, a brief analysis of the data was made to determine if the soils were generally homogeneous or if there were specific locations where variations in resistivity were present. In the event of changes in soil resistivity, additional excavations were performed to capture the different corrosion effects based on the change of soils.

It should be noted that by excavating the piles and backfilling, oxygen is reintroduced to the newly disturbed soils. Therefore Corrpro attempted to capture a representative set of data while minimizing the number of excavations. It is expected that the most significant corrosion patterns will be found in the future at the excavated piles.
Once the piles were uncovered, the presence and expanse of corrosion along the surface of the structure was documented by measuring the depth of the corrosion pits and the total area over which the product was identified. A total volume of metal loss can be calculated by using the depth and area of corrosion. This total volume of metal loss can then be used to calculate how it affects the strength of the H-pile. Unlike in pipeline applications where the deepest pit is analyzed because a single point of lost containment can be catastrophic, the H-pile is affected by more widespread corrosion and total metal loss, affecting the overall strength of the member.

3. Stray Current Evaluation

There are some locations on the project where underground pipelines pass through a wall. Most of these pipelines are regulated by the federal government and have an active cathodic protection system providing corrosion prevention. When a metallic structure benefiting from cathodic protection passes near a separate underground metallic structure, there is a potential for interference which could generate stray currents on the second structure. There is a greater chance of interference if the second metallic structure is located near to the active anode groundbed of the cathodic protection system.

In order to determine if stray currents are a concern for the structure, the pipelines were identified and the immediate area at each crossing and in either direction from the wall as far as visually possible was inspected to identify the pipeline right of way and any potential cathodic protection rectifiers and anode groundbeds – which can be the largest source of potential stray currents.

In order to document any stray current effects from the pipelines themselves, an interrupted stray current interference test was performed using a series of coupons installed with structural test wires at each excavation. The coupons were used to represent a small area of bare metal which, when coupled to the steel piles, behaved as a representative area of the pile. By monitoring the current flow between the pile and the coupon as well as the interrupted coupon-to-soil potentials, the magnitude of stray currents present on the steel piles can be determined.

FINDINGS

Each individual H-pile was then evaluated for total corrosion loss, corrosion pit depths and ultrasonic thickness measurements. The H-piles were steel construction with no applied coating. The area evaluated consisted of four feet of pile from the base of the concrete overhang extending downward. Once it was determined that the embedded steel was experiencing no corrosion beneath the grout, no further grout had to be removed, minimizing future corrosion.

The soil evaluation indicates that the service environment of the piles is highly corrosive with laboratory soil resistivity measurements ranging from 170 ohm-cm to 16,000 ohm-cm, with the majority of readings falling below 2,000 ohm-cm. As expected, the deeper samples displayed a lower resistivity due to the increased moisture content. However the reduction in resistivity also corresponds to a reduction in oxygen at the deeper levels. Although the Wenner 4-Pin soil resistivity measurements fell in the same range as the laboratory analysis, they tended to be on the lower end of the range indicating that the soil ranges from corrosive to highly corrosive with respect to resistivity.

Stray current testing performed using the coupons indicated that none of the steel piles are being affected by outside cathodic protection system at the crossings.

CONCLUSION

Based on Corrpro’s direct examination, the density and viscosity of the clay soils provides an oxygen deficient environment along the steel piles, significantly reducing the corrosion rate along the H-piles. The corrosion rates seen by engineers on the project were correlated to the pitting seen over the H-piles. However, the actual measured amount of volumetric loss of metal does not confirm these corrosion rates over the entirety of the structure. The most aggressive corrosion rate calculated was the first foot at the top of the pile. It was noted that the typical corrosion activity on newly installed steel structures tends to display a higher than average corrosion rate during the early life of the structure, which then reduces to steady-state rates.
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