Figure 1. Bringing in another joint of pipe.

Perfect SCORE

Scott Funderburk, Director - Global Marketing Pipeline Segment, Lincoln Electric USA explains how McDermott achieved zero weld defects on a natural gas pipeline offshore Australia.

Offshore Australia reside a number of thriving oil and gas fields; a rich, natural resource on the continental shelf. The region is fertile for gas and oil exploration, but it can pose hurdles for those constructing new pipelines to further tap its riches.

In some areas, the nature of its gas fields produces a 'sour service environment' for pipelines. Sour service environments have the presence of oxygen and hydrogen sulfide (H_2S) in the lines: a highly corrosive combination.

With this in mind, it is no surprise that the pipeline fabrication and installation team from McDermott faced a number of challenges when starting work on a recent offshore gas development.

McDermott, a leading engineering, procurement, construction and installation company focused on executing complex offshore

Figure 2. Welding in the pipe tunnel on *DB30*.

Figure 3. McDermott's JBBS welding system.

oil and gas projects worldwide, tackled a looped, 40 mile (64 km) project with one goal in mind – producing quality joints, using advanced process GMAW (MIG) welding.

Pipe installation on this major endeavour involved using PGMAW welding on 5500 joints with tight acceptance criteria in two nearby gas field developments. McDermott's team of 30 welders assembled the pipeline offshore using its *DB30* S-lay barge, welding the joints together with the latest technology.

"We needed not only a skilled crew who knew how to handle a job of this magnitude but also equipment that would deliver quality welds to a challenging pipeline," says John MacDonald, McDermott's Asia Pacific Automatic Welding Manager.

He noted that the company used new technology from The Lincoln Electric Company, including the new Power Wave® S350. It was the first time McDermott had used this innovative power source.

The latest welding technology

It was not, however, the first time the company had used Lincoln Electric equipment. In 2007, McDermott re-evaluated its welding power sources at its Batam Island facility and ultimately converted to Power Wave® technology.

"During our evolution into a new line of power source machines, we started to use some of Lincoln Electric's earlier Power Wave® technology over the past few years, as well as the Power Wave® 455M/STT® machines" says Clyde Noel, Global Automatic Welding Manager for McDermott. "We developed a good track record with that. Ultimately, our goal was to get the newest technology into our shops and out into the field. That's where the Power Wave® S350 comes in. It is part of our ongoing welding procedure development to ensure we deliver the finest quality weldments possible."

The multi-process Power Wave® S350 offers Lincoln Electric's performance technology on both the input and output sides of stick, DC TIG, pulsed DC TIG, MIG, pulsed MIG and flux-cored applications. It provides an extremely fast arc response and includes more than 65 standard welding waveforms for optimised performance.

Its patent-pending PowerConnect™ technology automatically adjusts input power from 200 - 600 V, 50 or 60 Hz, single- or three-phase, while leaving welding output constant through the entire input voltage range. Built-in Production Monitoring™ 2 capabilities help operators track equipment usage, store weld data and configure fault limits to aid in production analysis and improvements.

"We fine-tuned the procedures we developed on our earlier Power Wave® machines to this new power source," Noel explains. "We needed reliable equipment that could hold up to the starting and stopping that comes with pipeline fabrication and still deliver clean, defect-free welds."

Technology and training

To ensure the highest quality welds in the field, welders hired for the job underwent extensive welding training at three different locations: McDermott's Batam Island, Indonesia, fabrication facility; onboard *DB30* and at a first-class local training facility.

"We shipped our proprietary training kit there and had technicians and a welding foreman train on an actual pipe cycling scenario," MacDonald explains. The kit, which mirrored the four welding stations on the laybarge, included McDermott's customised Bug-and-Band System with a dual-torch bug that integrates with the Power Wave® S350.

The kit also included pipe samples and a custom 1 mm welding wire that Lincoln Electric has produced specifically for McDermott for the past 15 years.

Welders were first trained on grooved pipe prior to welding on fully prepared pipe, which gave them maximum welding time, avoiding lost time in setting up. McDermott has successfully used this approach during training for other projects.

Besides specific welding techniques, the team was trained in applying proper pipe end coatings to protect

Power Wave® S350: portable, powerful, multi-process

- Powers stick, DC TIG, pulsed DC TIG, MIG, pulsed MIG and flux-cored processes.
- Provides an extremely fast arc response.
- Includes more than 65 standard welding waveforms for optimised performance.
- Reduces operational costs by using patent-pending PowerConnect™ technology to adjust input power from 200 - 600V, 50 or 60 Hz, single phase or three phase. Welding input remains constant through the entire voltage range.
- Offers a Tribrid™ Power Module that delivers exceptional welding performance.
- Uses included Production Monitoring™ 2 software to track equipment usage, store weld data and configure fault limits to aid in production analysis and process improvements.
- Features an optional 115 V (10 A) AC duplex auxiliary power receptacle with patent-pending Surge Blocker™ technology to ensure simultaneous welding performance is not compromised by high starting current devices, such as grinders.
- Offers a standard Ethernet connection for effortless software upgrades.
- Features a compact, rugged case that's IP23 rated to withstand harsh environments.
- Uses optional STT® (surface tension transfer) for critical pipe root pass welding.

The project at a glance…

- Some gas fields produce a 'sour service environment' for pipelines.
- Sour service environments demand high-strength pipelines with zero defects in joint welds.
- Welds on this particular project were performed using an automatic GMAW process on DNV-grade 450 steel in standard 40-ft lengths, measuring 14 in. and 18 in. in diameter.
- McDermott's team of 30 welders used a custom 1 mm welding wire from Lincoln Electric.
- The team produced 5500 joints with zero defects on the pipeline job.
- Company officials credit a strong welding training program and the latest technology – Lincoln Electric's Power Wave® S350 power source – as major contributors to the project's weld quality.

the critical area around the weldment and how to use pipe facing machines that deliver consistent end-bevel preparations.

All welders were assessed and rated on both practice and cycle welds. During this training, all welds were inspected with x-ray and AUT, and judged to stringent workmanship standards.

"All of this is addressed at the outset to improve quality," MacDonald says. "We cannot over emphasise the importance of good training and hiring quality personnel. A project like this is a team effort, and intensive training is a key factor in achieving the results required."

Quality workmanship

Pipeline fabrication first involved manufacturing pipe made from DNV-grade 450 steel in standard 40 ft lengths at the company's Batam Island facility and shipping the pipe to the worksite offshore Australia.

Installation began with the mobilisation of *DB30*, a, multi-purpose derrick/lay vessel with 3080 t lift and 60 in. diameter pipelay capability to the jobsites. A McDermott dive support vessel, *Emerald Sea*, also assisted with subsea installation and evaluation. The

Figure 4. Workdeck on *DB30*.

pipe used on the job included 14 in. pipe with wall thicknesses of 15.9 mm and 17.5 mm, and 18 in. pipe with wall thicknesses of 12.7 mm and 14.3 mm.

The McDermott team completed the around-the-clock pipelay with two shifts of welders using an automatic welding procedure. The team finished work in just less than four months with zero weld defects across the entire pipeline project.

"It's exceptionally rare to have zero defects and even more so in a pipeline of this size, with 5500 welds," MacDonald says. "On certain highly restrained portions of the pipeline, the acceptance criteria are so stringent that even the smallest of errors can be considered a defect."

Another factor that makes flawless welding rare on this kind of job is the sheer number of moving parts and processes that go into pipelay operations for each weld. The likelihood of every single part achieving perfection is miniscule, which makes this job's total of 5500 defect-free welds a massive achievement. As Noel notes, the new power source also contributed.

"We credit this accomplishment not only to the skill of our welding team but also to the performance of our robust power supply," he says. "We had a quality level that needed to be executed and we fine-tuned our procedure through training and upgraded technology to meet this challenge." WP

Figure 5. A completed weld.