upstream technology

The bimonthly magazine for oil & gas innovators • Issue 5 | 2015

Safety kit:
New tools for spill response

Decked out:
Pioneering Spirit gets prepped for big lifts

Rig designers raise the stakes

High specs

Fluid solutions:
Novel approaches to water treatment

Data driven:
Real time predictive modelling

Produced and distributed by upstream

Thinking outside the cap

While there have been no Macondo-scale well control incidents since the 2010 disaster, that has not stopped Houston-based Trendsetter Engineering from looking for alternative containment systems, as Jennifer Pallanich reports.

In traditional emergency spill response systems, the production riser, controls, umbilicals, manifolds, and jumpers all tie in to a containment stack. Trendsetter Engineering devised a concept that can take advantage of a nearby rig's drilling riser and other rental equipment.

"Rigs are some of the first things to respond in an area," according to Mauricio Madrid, Trendsetter's projects director. The containment toolkit uses a high-pressure drilling riser on the rig as the production riser. "This uses the drilling rig riser and the well test equipment already on the rig."

In addition to leveraging the drilling riser, the system uses a flow spool that provides a place to land and lock a subsea test tree. This makes it possible to connect and control a flowline from the wellbore capping stack and flow up the drilling riser in a controlled environment. "It's similar to a regular well test," Madrid says. Capable of handling 33,000 barrels per day per leg, or 100,000 bpd for all three legs, the system can be added to any rig in an emergency, he says.

"It's a different way of attacking the problem that saves a lot of time," Madrid says. The idea of using a drilling rig riser stemmed from the idea that "there's got to be a better way" to approach containment. "We came with this idea of using equipment that already exists, and let's just fill in the blanks."

The new containment toolkit can minimise the environmental impact of a subsea well incident. If a well cannot be shut in, the containment system can be used to flow hydrocarbons from a subsea well to the surface for storage and disposal. It can be assembled with one, two, or three containment legs using the three flowspools to provide additional response flexibility.

The flowspool assembly, a custom manifold with hydraulic valves, is landed on a dummy wellhead to send flow from the incident well to a vertical riser. At the surface, the subsea flowspool is connected to the collection vessel via an internal landing string equipped with a traditional subsea test tree system through a BOP stack.

It's a different way of attacking the problem that saves a lot of time."

Mauricio Madrid, Trendsetter

Photos: Trendsetter

According to Trendsetter, the system simplifies installation, modularises the system for emergency response, and minimises storage and maintenance costs.

Oil Spill Response Ltd (OSRL) ordered and owns the toolkit. The flexible subsea jumpers and subsea flowlines are too large to be transported by air, so sets will be stored in the UK, Brazil, and Singapore, ready for transit. All other components can be transported by air.

The toolkit provided to OSRL includes three flowline end terminals (FLETs), three flowspool assemblies, six »

NEW KIT: Above, Trendsetter designed and manufactured this flowspool for the OSRL containment toolkit. Right, the flowline end terminal for OSRL's containment tool kit.

flowline connectors, three flexible jumper connectors, three jumper choke connectors, seven connectors mounted over pressure protection devices, and custom containers and skids to enable air freight of the subsea intervention equipment.

The system can be disassembled in 36 hours at Trendsetter's Houston facility, where it will be stored. The FLET is split into two pieces and the flow spool is broken down into bespoke engineered containers for air transit. Reassembly takes 72 hours to accommodate the torqueing procedures.

In 2012, Trendsetter suggested to the OSRL using a drilling rig riser for the containment system. Madrid says there was "some back and forth" on the engineering side to fine-tune the concept before they signed the contract in the first quarter of 2013. Trendsetter handled design, assembly and testing in its Houston facility and subcontracted out the machining and high-end components of the containment toolkit. The company started assembly of the new system at the end of 2014 and completed it earlier this year. "The system is ready to go," Madrid says.

FINAL TOUCH: Engineers assemble the pressure caps and jumper connectors for a Gulf of Mexico project.

READY TO ROLL: Technicians complete factory testing of the flowspool, which is part of the OSRL containment toolkit.

TEST TIME: The wellhead fatigue mitigation system is put through its paces in the system integration test to confirm operability and functionality.

New tools

In 2010, the Marine Well Containment Company, comprising 10 companies working in the deepwater Gulf of Mexico, awarded Trendsetter a contract to develop and manufacture a bespoke subsea single-ram capping stack.

In the subsequent years, Trendsetter has built and delivered nine additional custom capping stacks rated to 10,000-foot water depths and pressures of 10,000 psi to 15,000 psi. The company has contracts for two additional high-pressure, high-temperature capping stacks.

"The original capping stacks were based on best available technology available at the time, based on traditional BOPs, 18¾ inch rams and choke lines," Mike Cargol, vice president of oilfield rentals and services, says. Strides in hardware development and lessons learned have been integrated into the newer capping stack designs, he adds. "We can make a better mousetrap, a more bespoke solution."

The newer capping stacks have refinements such as metal-to-metal sealing gate valves and are more compact and reliable, the company says. Trendsetter has manufactured a 15,000 psi and 350° Fahrenheit capping stack, and will deliver stacks rated to 20,000 psi and 400° Fahrenheit.

Well containment concepts have evolved in the five years since Macondo. "Trendsetter provided the hardware only at the time, and we weren't really looking at the applications for it," Cargol says.

The company wanted to move beyond simply providing hardware to a more proactive stance in planning for subsea well control. Now, Trendsetter aims to provide not just the hardware solutions but also to work with the industry to ensure the safest, most efficient use of the hardware, Cargol says.

"We're not just going to give them a fire truck, but we'll make sure the fire truck is right for the job and the people who drive the truck and fight the fire are trained to do their job."

Trendsetter also turned attention to preventing an incident from escalating to the point where a capping stack is needed. The result was the subsea accumulator module (SAM), an independent control

"We can make a better mousetrap, a more bespoke solution."

Mike Cargol, Trendsetter

system that can be used to operate a subsea BOP if the primary controls fail.

Last year, the company deployed its first mudline closure device (MCD) in the Russian Arctic for an exploration drilling campaign. The 18¾ inch, 15,000 psi MCD is installed between the subsea BOP and subsea wellhead, or on the seabed and connected to a surface BOP, to provide well isolation as a contingency. If there is a subsea blowout and the rig cannot operate the MCD, a vessel a couple of miles away could drop a transponder, or "dunker", into the water that would send a code to activate the MCD and shut in the well.

"It's not an end-all, save-all replacement for the capping stack," Cargol says. But the MCD is ideal for environmentally sensitive areas where a week's response time is not reasonable, in shallow water where there's not enough vertical access to install a capping stack, and in areas with logistical constraints.

Another area Trendsetter is focused on is preventing wellhead fatigue during emergency operations. A concern during the Macondo incident was that the movement of a dynamically positioned vessel could introduce fatigue into the wellhead. A capping stack added to the wellhead increases the weight and changes the centre of gravity, which could result in catastrophic failure and prevent future capping attempts.

A wellhead fatigue mitigation system uses tethers and pre-tensions the wellhead or BOP to the seafloor at four locations. If the wellhead is fatigued, this system can prevent further damage, Cargol says. If the wellhead is undamaged but the operator is concerned about the potential for damage, the system can be installed to mitigate the fatigue risks.

The design has passed qualification and testing. Trendsetter is building two systems and expects to deploy them next year.

SUBSEA SAFETY: Preparing the mudline closure device for offshore deployment quayside in Norway.