New jet cutter design gives improved capabilities

Terry Edwards,
Halliburton Well Control Coordinator

AN EXTERNAL ABRASIVE jet cutter is used to cut-off damaged well heads caused by oil or gas blowouts. Now, a well-proven external abrasive jet cutter system has been revamped with a modular design that greatly increases its effectiveness in the harshest environment, well fires.

Because of the new modular design and repackaging of the hydraulic power supply, the abrasive jet cutter is now contained on a single small skid.

This smaller packaging enables faster and more efficient deployment to locations that may not have been accessible with the former configuration.

JET CUTTER TECHNOLOGY

In the past, wellheads were removed by wrapping a sand/resin coated cable around the wellhead and attaching the ends to two bulldozers that moved back and forth, literally sawing the wellhead apart.

Obstacles such as the rig substructure or simply breaking the cable before a cut was completed often prevented or greatly delayed a successful cut.

Abrasive jet cutter technology was launched in 1991 to help control the fires burning in Kuwait. The well fires in Kuwait were unique in that they were man-made disasters caused by placing multiple explosive charges on each wellhead. This often created a fire that was more horizontal than vertical. Controlling the fires necessitated cutting the wellhead assemblies away and redirecting the flow to a vertical direction.

This environment and the operational requirements led to the design and manufacture of the remote-controlled external abrasive cutting system.

JET CUTTING APPLICATIONS

Today, the principle is the same except most modern applications are focused on wellsites with a drilling rig in place when the well control situation occurred resulting in the rig burning down around the wellhead.

Usually in today's drilling industry, the annular preventer under the rig floor is attached to the rig substructure for stabilization.

With the rig damaged or even burned down, it is necessary to move the substructure away from the wellhead; however, the remains of the rig are attached to the well.

This situation requires the external abrasive jet cutter, mounted on an Athey wagon (a 90-ft boom - Refer to Figure 2) to be maneuvered into place by at least a D-8-type a bulldozer.

The abrasive jet cutter can then cut the wellhead, enabling the rig to be skidded away from the lower remaining wellhead and casing.

SYSTEM CONFIGURATION

The abrasive jet cutter allows the operator to precisely control nozzle movement to direct sand-laden water at a wellhead. High-pressure pumping equipment is needed to pump the sand and water slurry at 168 gal/min through two tungsten carbide jet 3/16-in. nozzles.

As the abrasive jet cutter was positioned, adjustments were made to the rotary actuator and the hydraulic winch as directed by the well capping specialist.

The modular cutter used today has four main components:

- The rotary actuator with knuckle jointed mounting flange
- Low profile cutting arm platforms with adjustable nozzle assemblies.
- Scissor arm cross bars that determine the width spacing for the cutting arm platforms in relation to diameter of the well head being cut.
- Hydraulic winch assembly

The rotary actuator is the main component of the abrasive jet cutter. This allows the cutter, when fully rigged up, to rotate the dual arm cutter clockwise or counter clockwise in order to position the tool relative to a tilted wellhead.

After the cut, debris was removed from around the wellhead and a decision was made to perform a second cut.

The low profile cutting arm platforms attach to the rotary actuator by use of the scissor arms.

The nozzles, one attached on each platform track, move in the same rectilinear direction at the same velocity, each nozzle opposing the other.

In theory, each nozzle cuts or abrades one half the diameter of the wellhead.

The hydraulic winch assembly allows the operator to raise or lower the cutter assembly on the end of the boom during positioning of the cutter into the cutting position.

To enhance personnel safety, movement or positioning the cutter is done from a remote location, up to 250 ft away.

All hydraulic components, hydraulic hoses and high-pressure pump hose are encased in a stainless steel water jack-

et, permitting the cutter to operate in an environment in excess of 2,000°F.

The external abrasive jet cutter cuts at a rate of ½ in. per minute. The speed can be changed during the cutting process plus the jets can be stopped and backed up if warranted.

For a 13-5/8 in., 10,000 psi wellhead, cutting the 30 in. diameter flange would take as little as approximately 1 hr.

The redesigned abrasive jet cutting system is packaged in a single skid frame 60 in. wide, 102 in. long and 62 in. high. The total weight of the skid is 6,580 lb.

Because of the single skid design, transporting the abrasive cutter to an international remote location is often done on a commercial airline.

For domestic travel, the cutter skid can be shipped via hotshot trailer.

The flexibility in shipping a smaller footprint skid allows faster response time and deployment to location.

This new system has been deployed to domestic locations in Texas, Mississippi, Louisiana, New Mexico and California and internationally to Oman and Saudi Arabia.

WHY REDESIGN A PROVEN SYSTEM?

An obvious question is, what was the reasoning behind the redesign of a proven jet cutting system?

The bottom line is cost savings to an operating company experiencing the worst case scenario, a well blowout. During a blowout, firefighting and capping specialists responding to the disaster charge by the day instead of by the job. Fast deployment of personnel and equipment to location is usually the number one concern of any operating company.

The second cut is underway.

Another concern of an operating company is minimizing environmental and formation damage so speed in capping the well is the main focus.

Compared to the old resin coated cable technology that could take up to a week or more, the cost savings with the abrasive jet cutting system is readily apparent.

CASE HISTORY

While an operator was drilling to total depth on a well in southeast United States, the drill pipe became stuck.

During the process of trying to get the drill pipe unstuck, the Kelley pipe parted near the surface of the well. This led to the well blowing out and catching fire, burning down the drilling rig.

The rig was totally destroyed.The drilling rig collapsed on top of the blowout preventers causing the blowout preventer stack to bend backward into the drilling rig substructure.

Options to remove the wellhead were limited due to several factors:

- Access to the wellhead was limited by debris and rig substructure.
- Visibility of the wellhead was very limited.
- To cut the wellhead away the cutting device would have to be adaptable to the bent wellhead.
- Measured temperature close to the well was 1,500° F.

This was a perfect application for the newly designed external abrasive cutter's maneuverability and remote operation capability to sever the wellhead.

Because the wellhead was listing backwards and leaning to the right, the abrasive jet cutter had to be positioned at an acute angle, plus the tool had to be rotated clockwise to cut on an adapter flange.

As the abrasive jet cutter was being placed into the fire, adjustments were made to the rotary actuator and the hydraulic winch was directed by the well capping specialist.

The second cut was completed in 35 minutes.

The cutter was positioned to cut on an 11-in., 10,000 psi flange as part of the blowout preventer stack, just above the B-section with the broken Kelley pipe inside.

OD of the flange being cut was 25-3/4 in. Placement of the cutter into the cutting position required approximately 45 minutes.

Once placement was complete, everyone was directed off location and the cutting operation began.

High pressure pumping equipment was used to pump water containing 20/40 Ottawa sand.

This slurry mixture was pumped at high pressure/low rate through the tungsten carbide nozzles.

After the cut was completed in only 56 minutes, the cutter was removed from the wellhead. Time of total operation was 2 hr 20 minutes.

Upon completion of debris removal, a decision was made to make an additional cut below the wellhead.

This cut consisted of 16-in. conductor pipe, 10 3/4-in. surface casing, 7 5/8-in. intermediate casing that was hanging in a slip bowl with 100K lb tension, and Kelley pipe in the center.

Cutting time was 35 minutes to completion.

Total operation time was 1 hr 50 min. The well was capped in 4 days. ■