WELL CONTROL GLOSSARY

Version 1.0

Abstract

This Well Control industry is full of jargon specific acronyms, equipment and other language. The intent of this WC Glossary is to share some of this content with the industry for educational purposes.

Steve Wehrenberg
Steve.wehrenberg@klxenergy.com

Great White Well Control (GWWC) strives to be leaders in innovation, safety, efficiency and education in the Well Control industry. Understandably there are large gaps in experience in the oil & gas industry when it pertains to a Well Control event, the applications of Well Control or Special Services. Many oil & gas professionals will serve their entire career and never encounter the need for Well Control services. This knowledge gap leaves many in the industry with little understanding of Well Control terminology, equipment and techniques used in the Well Control industry.

GWWC is pleased to share this glossary and abbreviations to those with a desire or need to further their own knowledge pertaining to Well Control.

Contents

Glossary

Abrasive Jet Cutter (AJC)

The AJC is a multi-purpose external cutter that uses a blend of abrasive materials such as sand and water. This slurry is pumped at high pressures through a single or dual nozzle to sever casing, flanges, wellheads, valves, etc... In the past this service was performed by wrapping a resin/ oil coated wire with sand. The wires were attached to either opposing winch drums or in some cases bulldozers to literally saw back and forth in an attempt to saw the damaged obstruction away. This was an extremely time-consuming means of making a cut and often times constrained by equipment in the way or cable failure that prevented this type of cut from being made efficiently.

Today's AJC's come in many variations from multi-axis frames, hydraulically driven and manually driven. A large credit has been given to the AJC for expediting the well control effort in 1991 when Kuwait was invaded, where over 700 wells were damaged.

Figure 1 : AJC making a cut on CT Lubricator

Athey Wagon

The Athey Wagon is a multi-purpose tool used in blowouts and well capping. Athey Wagons have an A frame tower affixed to a platform with tracks and a boom section. They Athey Wagon gets its name from the tracks it uses, Athey Wagons were used in the lumber industry before their acceptance in Well Control. The Athey Wagon can be affixed with a hook, rake, diverter tube, capping stack, stingers, etc... The Athey Wagon allows Well Control experts to remove debris from burning wells at a safe distance, allows placing a flow tube at the blowout source to put the well flow safely above the workers while near the blowout, allows for placement of the Abrasive Jet Cutter, placing capping assemblies atop a well blowout and provides an excellent means to sting into a well to attempt bullhead kill operations in some instances.

The boom section is controlled by a winch that is ran to a Bulldozer and in some instances Athey Wagons have hydraulic controls.

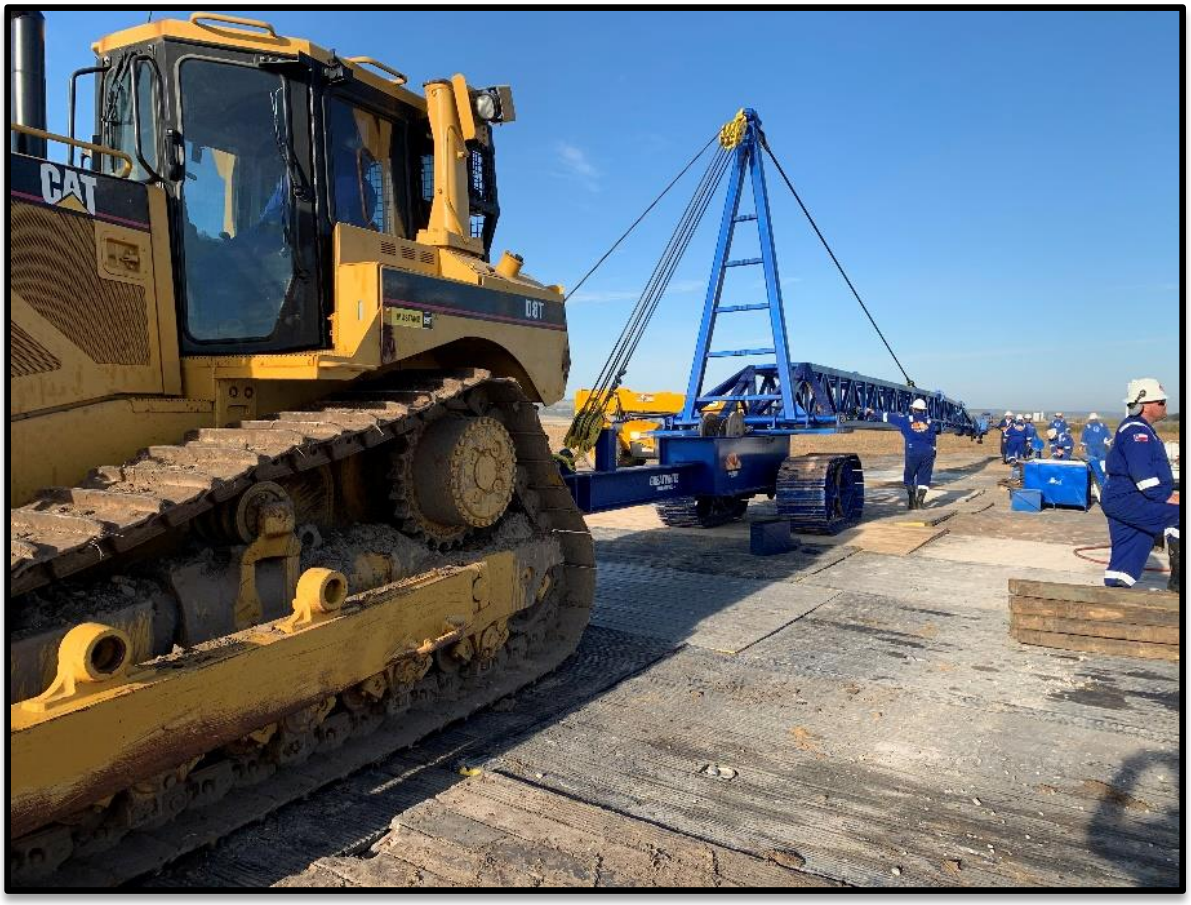

Figure 2 : Prepping the Athey Wagon

A-Frame Job Box

The A-Frame Job Box is a compact tool container used in Well Control operations. The A-Frame Job Box has a small footprint and can easily be shipped rapidly to a well site. Typically, these A-Frame Job Boxes have assorted hand tools, pneumatic tools, non-sparking tools, digging tools & chains and hoists. The tool inventory has been well thought out based on the needs and experiences encountered by Well Control professionals.

Bar Clamp

A Bar Clamp is a specially designed clamp used in various of aspects of Well Control and Snubbing. For Well Control applications Bar Clamps can be used as a safety clamp to hold a tubular in a Pipe Light or Pipe Heavy situation. Common uses in Well Control aspects are to utilize a Bar Clamp for production tree removal when the production tubing has been severed or has parted, leaving the remaining tubing in a Pipe Light situation. A Bar Clamp can be installed in this type of situation to remove the tree while maintaining control of the tubing.

Blowout Contingency Play (BCP)

Blowout Contingency Plans are typically developed with specific detailed plans, procedures and responses for Loss of Control events. These plans incorporate scenarios that walk through the entirety of an event and all aspects of the necessary interventions. The BCP is a great tool to identify organizational planning gaps, reduce cost, assist in expediting source control and minimizing the environmental impact.

Blowout Broaching

Broaching to surface is an occurrence when wellbore fluids exit the casing and broaches outside of the parent wellbore. This occurrence creates further difficulties in re-establishing well control and typically results in a severe environmental impact.

Bullhead (Bullheading)

A bullhead kill is a technique typically used when a kick in a well cannot be circulated out effectively, adequate surface equipment is not readily available, workover setting or there is no pipe in the well to allow circulating or stripping techniques. There are readily available Bullhead Kill Sheets to be used as guides while applying this technique.

C-Clamps

C-Clamps are a fabricated and extremely robust clamp used to clamp two or more flanges together for BOP, valve of wellhead removal during a blowout. Depending on many variables it is sometimes necessary to remove a damaged piece of wellhead or pressure control equipment. Well Control specialists will begin removing studs from the target flange, Well Control specialists will begin removing studs from the target flange 180° apart from each other. They then install (1) each of the C-Clamp where the studs were removed. Once these are tightened down the remaining stud bolts are removed. Drag lines are then attached to the C-Clamps and typically attached to (2) opposing Bulldozers. The line is pulled tight and at the direction of the Well Control specialist the Bulldozer operators move forward yanking the C-Clamps free.

Figure 3: C Clamp for head removal

Capping

Capping involves the process of stopping the flow of a blowout by a surface intervention by way of new pressure control equipment. This process can involve capping with a series of valves, BOP's. In some instances, it is necessary to install a new wellhead to accommodate the new pressure control equipment.

Figure 4: Capping with 11" 10M Capping Stack

Casing Clamps

Casing clamps are incorporated into Well Control activities in several ways. The most common use of Casing Clamps is during re-heading of a well, these clamps are installed to pull recommended tension into the casing string to set the appropriate weight into the new casing bowl. The other use is to stabilize a wellhead that has suspect corrosion or other structural issues. Casing clamps can be installed below the wellhead, then compact hydraulic cylinders can be placed under the clamps to “jack into” the clamps to alleviate strain or receive a load from added BOP rig up weight or other components being added to the wellhead. Most casing clamps come in a fixed size, GWWC does have a multi bowl casing slip with a tubular catch range of 2.375” to 7.625”.

Clam Shell Cutter

Clam Shell Cutters are part of a series of “cold mechanical cutters” that Well Control experts use. The Clam Shell Cutter is in essence a portable lathe, typically these are fixed sizes used to attach to the exterior of a tubular. The Clam Shell Cutter is then powered often times by a pneumatic source, the cutter begins making revolutions around the tubular making a precise cut with no sparking or flame hazards involved.

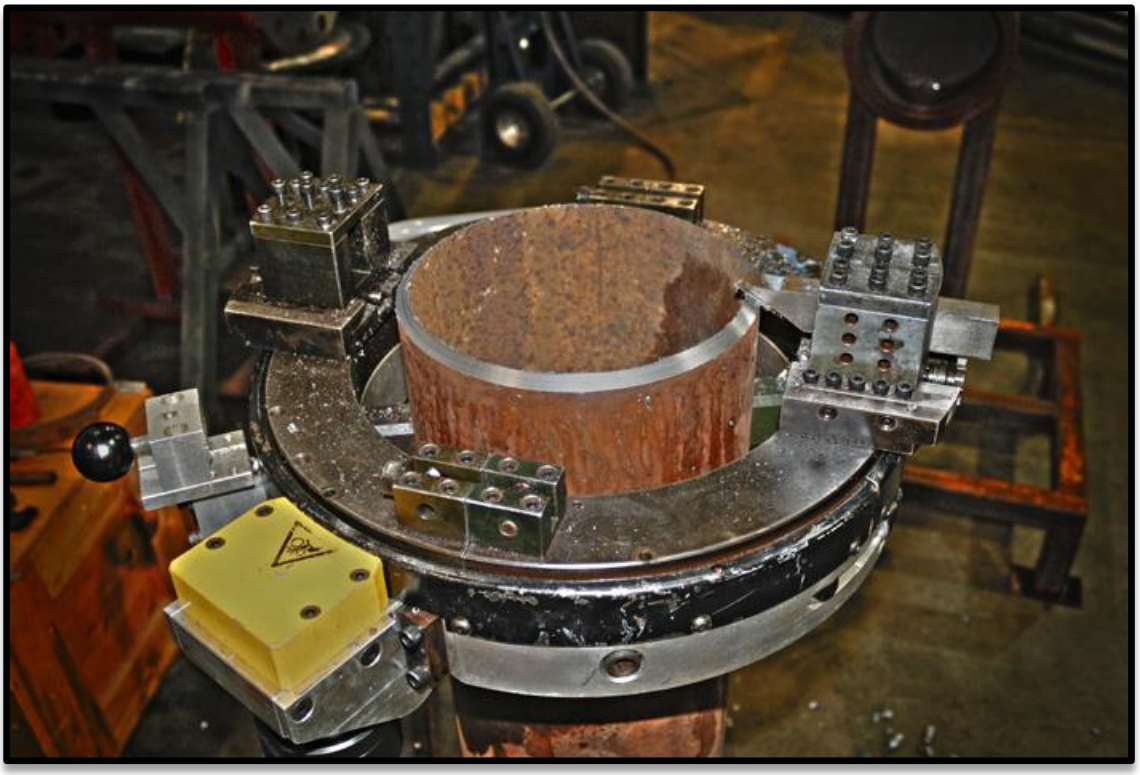

Figure 5: Clamshell Cutter. Courtesy of MacTech Inc.

Cofferdam

Cofferdam's are a tool used by Well Control companies when a well to be worked on becomes submerged or resides in a shallow body of water. The Cofferdam is constructed and lowered around the wellhead, once the Cofferdam is in place the water is pumped out of the Cofferdam and a water tight seal is formed.

Cryogenic Freeze

The Cryogenic Freeze process incorporates liquid nitrogen into a freeze operation. Due to the extreme cold nature of liquid nitrogen (-320F / -196C), a thorough job procedure must be developed and followed throughout. The area to be froze is typically wrapped with cryogenic lines that can transfer the temperatures while allowing flexibility in the lines to form tightly against the area to be froze. For this reason, copper tubing is typically chosen to perform this task. It is not uncommon for a specialized cryogenic hose to be used for this function as well. It is extremely important to monitor temperatures at the freeze interval so that the Well Control or Special Service techs can not only control the temperatures precisely but too also gain confirmation of the ice plug forming. Equally important to controlling the temperatures, properly wrapping the area to be froze, monitoring temps and pressures is the prep work to be done prior to the freeze. The freeze plug adheres to the steel being froze internally. Well Control specialist look for suitable areas that have diameter changes to help achieve anchor points for the freeze plug. This area must be void of any oily residue prior to placement of the freeze medium. The freeze medium typically consists of a freshwater bentonite gel.

Figure 6: Cryogenic Freeze operation

Deluge System

Deluge systems consist of iron piping with specialized spray nozzles that remain open, the piping runs back to a high-volume pump where once activated water discharges through the spray nozzles creating fire suppression for personnel or to control radiant heat.

Diamond Wire Saw

The Diamond Wire Saw (DWS) is another cold cutting tool. The DWS serves as a great tool for cutting multiple strings of casing in one pass. The DWS serves a great purpose in the offshore market during platform decommissioning. The DWS is incorporated to saw through the platform legs for platform removal.

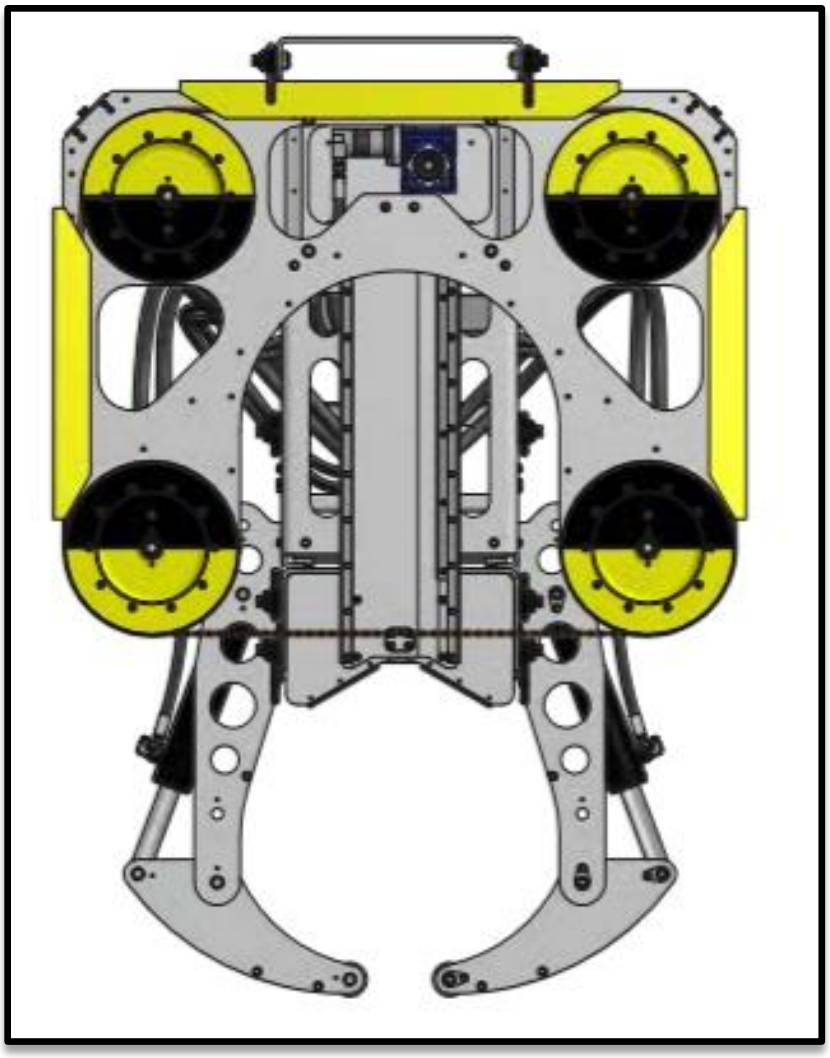

Figure 7: Diamond Wire Saw (DWS). Photo courtesy of MacTech Inc.

Diverting

The use of diverting in a blowout situation is based primarily on similar reasons that diverter systems are used in a drilling environment. Typically, in well control, diverting is used when there is concern with the integrity of the casing, surface equipment, casing shoe, etc... Diverting during a blowout can be used during a blowout to divert away well effluents, hazardous well fluids and fire. Diverting during post capping is also very common so that after the well has been capped the well can be safely diverted away while an intervention strategy is being performed. This allows the well to be shut in after the well has been killed or flow rates and pressures have been lowered to a more acceptable level.

Dry Ice Freeze

The Dry Ice Freeze utilizes the cold temperature of Dry Ice (-109F / -78C) to form a freeze plug in a desired location. In the past wooden boxes were constructed around the area to be froze, Dry Ice would then be crushed and packed in tightly to remove any air gaps in the freeze box. This box and component to be froze would then be heavily insulated. There are of course pro's and con's top this type of freeze. The Dry Ice freeze typically requires large quantities of Dry Ice to be stored and delivered, this type of freeze does typically take longer to form a plug. On the positive side the coldest temperature Dry Ice can achieve is -109F, this reduces the chance of taking temperatures too low in certain circumstances.

Dual Barrier Principle

"In the context of well integrity, a barrier is an impenetrable object that prevents the uncontrolled release of fluid. Two-barrier philosophy considers two independent well barrier envelopes; primary well barrier *and* secondary well barrier. *Primary well barrier is the first enclosure that prevents flow from a potential source of flow. Secondary well barrier is the second enclosure that also prevents flow from the potential source of inflow. The secondary well barrier is a back-up to the primary well barrier and it is not normally in use unless the primary well barrier fails."*

Ref: Khalifeh M., Saasen A. (2020) General Principles of Well Barriers. In: Introduction to Permanent Plug and Abandonment of Wells.

Dynamic Kill (DK)

The Dynamic Kill process involves a kill technique for a flowing well. This method of kill uses hydrodynamic forces from the frictional loss of the fluids flowing up a tubular. This process is typically performed where a relief well has been drilled, once the blowout well has been intercepted the kill string from the relief well begins injecting kill weight fluid (KWF) into the blowout well. The hydrodynamics of the KWF continue to build until a point of equilibrium is reached in the blowout well, where the well becomes static. The Dynamic Kill process is used in conjunction with Snubbing and Coiled Tubing services as well. With the ability of Snubbing and Coiled Tubing to introduce a tubular into a pressurized well, these types of equipment are sometimes used when it is deemed safely and practical to do so.

Emergency Response Plan (ERP)

An Emergency Response Plan (ERP) is designed to help companies address various emergency situations that could occur within their organization. The ERP should include who to contact, how to respond to the incident, how to structure the Incident Command and resources necessary. A well written ERP can greatly mitigate socioeconomic impact.

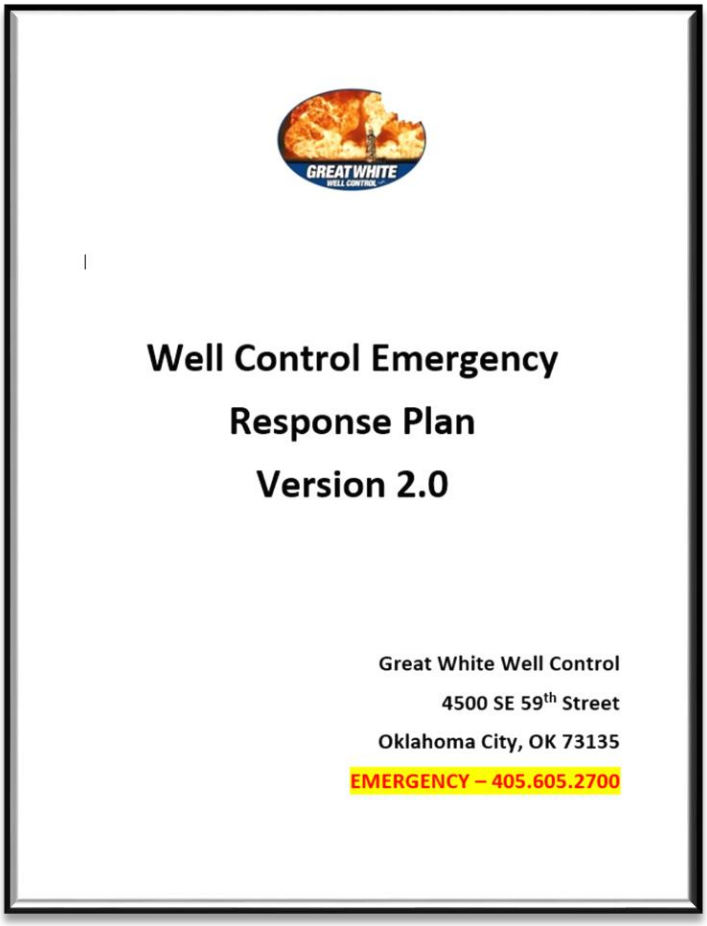

Figure 8: GWWC Emergency Response Plan

Emergency Slip On Head

During typical construction of a well a Slip On Weld Socket (SOW) wellhead is used in the “A” section. This type of wellhead requires welding and post weld cool down to ensure integrity at the weld site. However, during a blowout this traditional SOW head is impractical due to the ignition source of the welding at the blowout source. For this reason, many wellhead providers have so called “emergency heads” that incorporate a series of slips and seals, that when engaged over the casing can seal provide a seal and suspend the casing load.

Equalizing Pressure

During the course of well work there will be times when it will be necessary to equalize pressures across a BOP, valve or other pressure control equipment. The equalizing process is imperative to perform prior to opening a valve, BOP, etc... To prevent washouts, uncontrolled pressure release or other failures. A sudden release of pressure acting against an area can create tremendous forces. To prevent these system failures the process of equalizing pressure should always be performed.

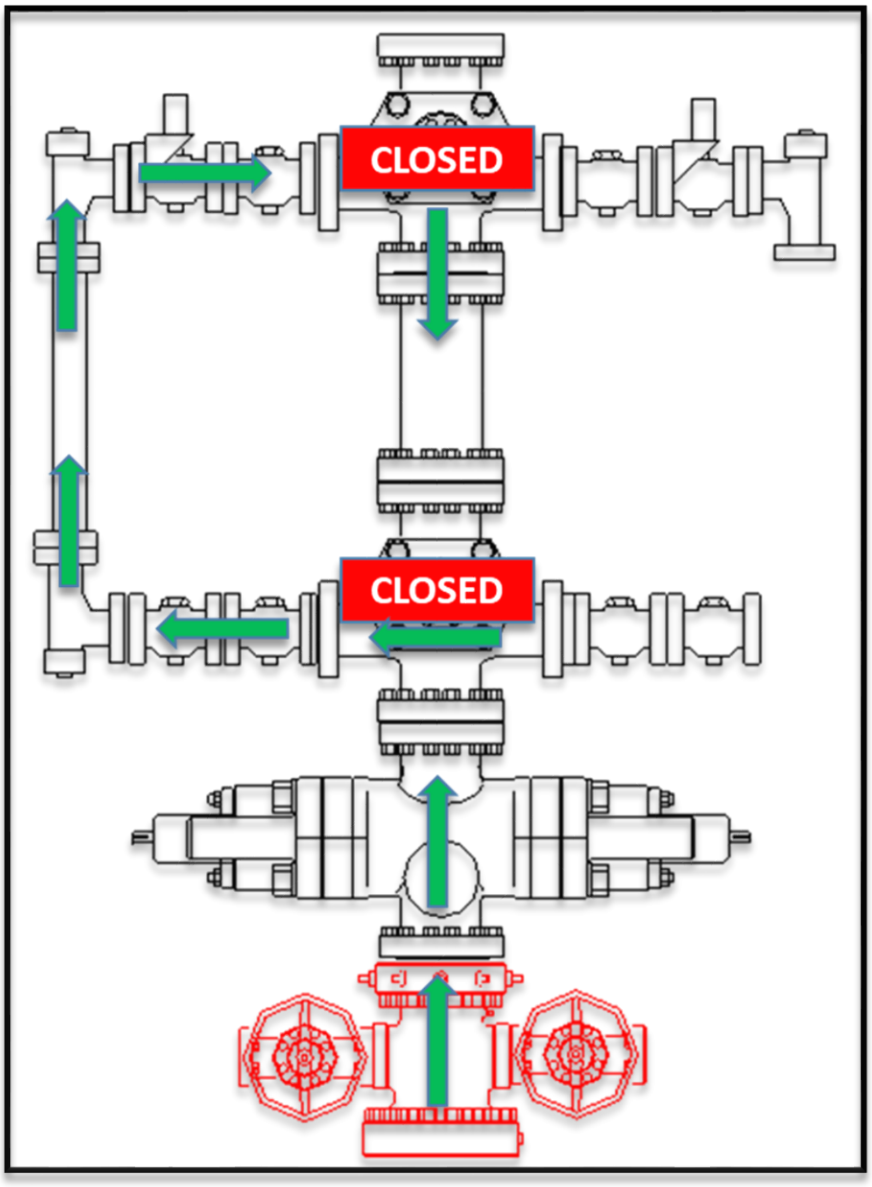

Figure 9: BOP with Equalizing Loop

Exothermic Torch (Thermal Lance)

The Exothermic Torch is used in Well Control applications to remove debris from around a blowing out well to gain access to the wellhead. The use of these torches in the past has been more common on drilling sites where the rig as collapsed around the wellhead. The Exothermic Torches have the ability to cut through any ferrous and non-ferrous material. The torch consists of a hollow tubed rod that is fed by pressurized oxygen, once the rod is ignited the torch can even be operated in subsea operations.

Figure 10: Cuts made by an Exothermic Torch

Fire Pumps

Well Control Fire Pumps are used in many roles during a well control operation. Their primary use is to protect the well control personnel while working near blowouts. The Fire Pumps provide water suppression to control radiant heat, lower the LEL near the blowout source, keep equipment and offset wells cool, wash away oil and other well effluent collection near the wellhead and extinguish the well fire. Great White Well Control (GWWC) maintains a fleet of Fire Pumps that range in output from 2500GPM, 4000GPM & 6000GPM.

Figure 11: Fire pumps providing deluge for WC Ops

Fire Fighting Package (FiFi)

Traditional well control FiFi packages consist of Fire Pumps, Monitor Sheds, Fire Monitors and a series of either lay flat high visibility firefighting attack hose or aluminum piping. The FiFi supply water must be a close source that has the ability to control and maintain a large volume of freshwater. It's typical to have at minimum 10 frac tanks of freshwater.

Figure 12: Providing suppression during an AJC cut

Gate Valve Drilling Unit (GVDu)

The Gate Valve Drilling Unit is designed to rig up atop an inoperable valve to be drilled out. The specialty built GVD's can drill the valve out under pressure. GWWC incorporates a specialty designed balanced chamber so that the drill rod never experiences any snub loading. The GVD is typically rigged on top of a newly tested valve that is affixed to the inoperable valve, the GVD is then pressured up to the anticipated shut in pressure below the inoperable valve. The GVD can then begin drilling through the inoperable gate. GWWC incorporates a small compact hydraulic power pack to operate and control the GVD a safe distance from the valve being drilled.

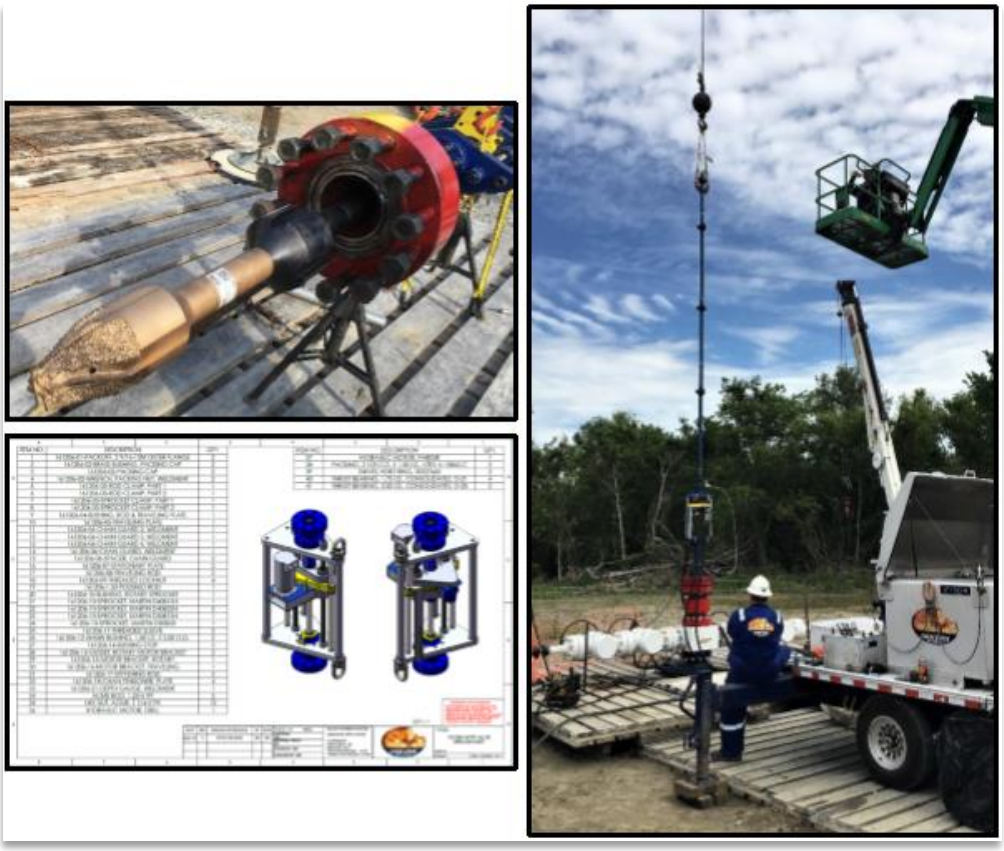

Figure 13: GVD Unit with 5.500" Taper Mill

Hot Tap Unit (HTu)

The Hot Tap unit is a small compact drill that is designed to drill a hole into a tubular under pressure. GWWC incorporates the same balanced system design they use in the GVD units. These compact Hot Tap units can typically be rigged up and tested in less than 1-hour time. They can be controlled manually, hydraulically or pneumatically. Most Hot Taps drill a .562" or .625" hole into the tubular. After the hole has been drilled the tubular or bull plug can be bled off, flowed down or pumped into to kill.

Junk Shot

A Junk Shot can consist of nearly anything that is readily available on site that can be pumped into a well to create a bridge or plug off flow exiting a leak path. Typically rope, rags or some form of hard plastic or other elastomer is used in conjunction with a “Shot”. There are multiple things to consider when performing a Junk Shot: will the material withstand the forces it is being subjected to, can the material obstruct the pathway for pumping, flowing, WL, CT or other intervention options, will the material stay in place during a kill operation, will the material rapidly degrade from temperature, erosion or well effluent? Most Well Control specialist have “Junk Shot Kits” they have put together in advance that is full of multiple materials they have had success with in the past and have an abundance of this material available.

Figure 14: Recovered Junk Shot from a well Blowout

Rail Mill

The Rail Mill is the go-to tool used by well control experts for milling a longitudinal cut into casing to assist in peeling back the casing. The Rail Mill runs off of a hydraulic or pneumatic power source allowing for a cold cut to be made near an active well. The Rail Mill offers precise control for depth engagement reducing the chance of interacting with an internal string of pipe.

Relief Well

The need for a Relief Well can become necessary due to many different variables. Some examples include severe broaching, loss of casing integrity, offshore, wellbore obstructions, etc.

A relief well intercept requires tremendous engineering and planning to coordinate the efforts of a successful intercept. Once the blowout well has been intercepted, dynamic kill operations will commence to successfully kill the well from the relief well pad site.

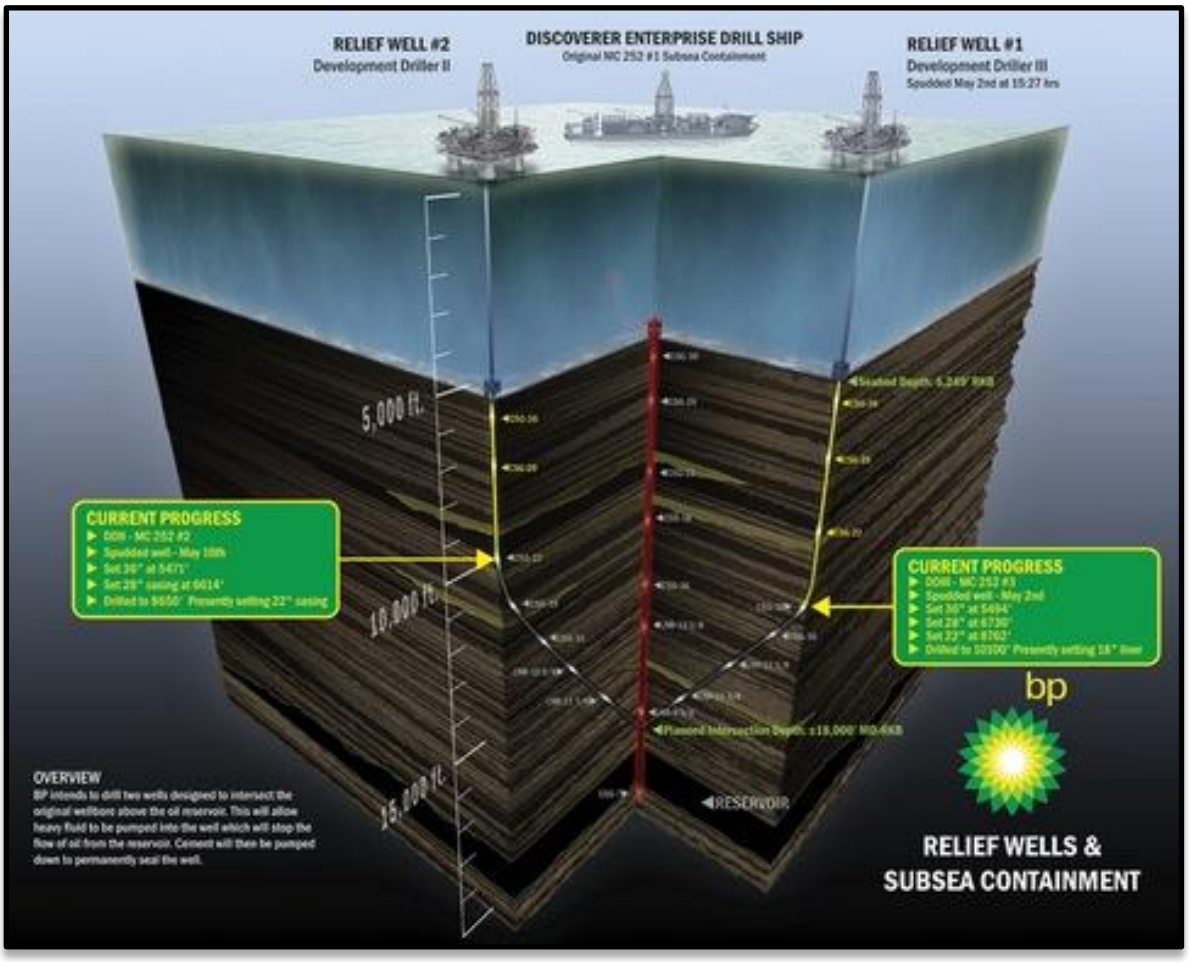

Figure 15- Relief Well graphic. Credit: BP

Saddle Clamp

Saddle Clamps are designed and built in-house by Great White Well Control to use along with Hot Tap services. Saddle Clamps are designed in such a way they provide a pressure control barrier for tubulars, bull plugs, pump iron, valves, etc. as the component is being tapped. The Saddle Clamp supports the weight of the additional pressure control equipment as well as the weight of the Hot Tap unit as a hole is being tapped.

Figure 16 - Bull Plug Saddle Clamp

Figure 17 - High Pressure Saddle Clamp

Stinger Assembly

Stingers are prefabricated tapers used by well control experts to “sting” into a tubular or valve in a well blowout situation. Typically, the Stinger Assembly is fabricated in a way the stinger has a vertical vent line with a hydraulically operated valve on the vent line, once the stinger has been stung into the valve or tubular, the stinger is anchored down, kill fluid begins to be pumped and the hydraulically operated valve is then closed. The Stinger tool is meant to be used for bullhead kill operations or in some instances to pump a junk shot.

Figure 18: Stinger Basket Assembly

Pragmatic Safety

Well control experts adopt a Pragmatic Approach to safety during their work. This system of planning and safety realizes the hazard involved in an operation to be performed. The well control team identifies, discusses and mitigates the seen and unseen safety concerns in their approach. Once the attack plan has been developed and agreed to, the plan is adhered to from start to finish, there is ZERO change in the plan once the work begins. If a change is necessary an all stop to work is called to discuss and outline the change. Due to this approach of work in a highly skilled and technical field GWWC is proud of their safety record with no recordable incidents since the founding of the company.

Snubbing Off

As discussed in the example above about Pragmatic Safety, there can be inherent risks on occasion that need to be planned for and remedied to safely move forward. It can be common in some instances where something such as a tubular or part of pressure control will be necessary to cut off with the well flowing. Due to that risk it would be necessary to “Snub Off” the piece that will be cut to prevent it from flying off uncontrolled. It’s common to utilize large diameter cables and specialty-built clamps to prevent this occurrence.

Underground Blowout (UGBO)

An underground blowout can be defined when reservoir fluids flow from one formation and into a different formation. This could be occurring deep within the wellbore but it can also be occurring shallow where the difficulty can become greater to contend with. The example here would be an instance where the surface casing shoe has been set shallow with a LOT of 10PPG, then a large portion of the well has been drilled between casing set points leaving a large portion of open hole exposed to higher pore pressures of 14PPG EMW. This example shows the potential for the deeper formation to exert enough pressure to fracture the shoe. This can become a very big and challenging problem if the UGBO is allowed to flow into a shallow and highly permeable area.

In addition, another situation that can occur to which one well can flow into another well. With the case of an UGBO flowing into a neighboring legacy well, there have been instances where the legacy wells were utilizing artificial lift with surface pressure control equipment that cannot contain the pressures exerted from the UGBO.

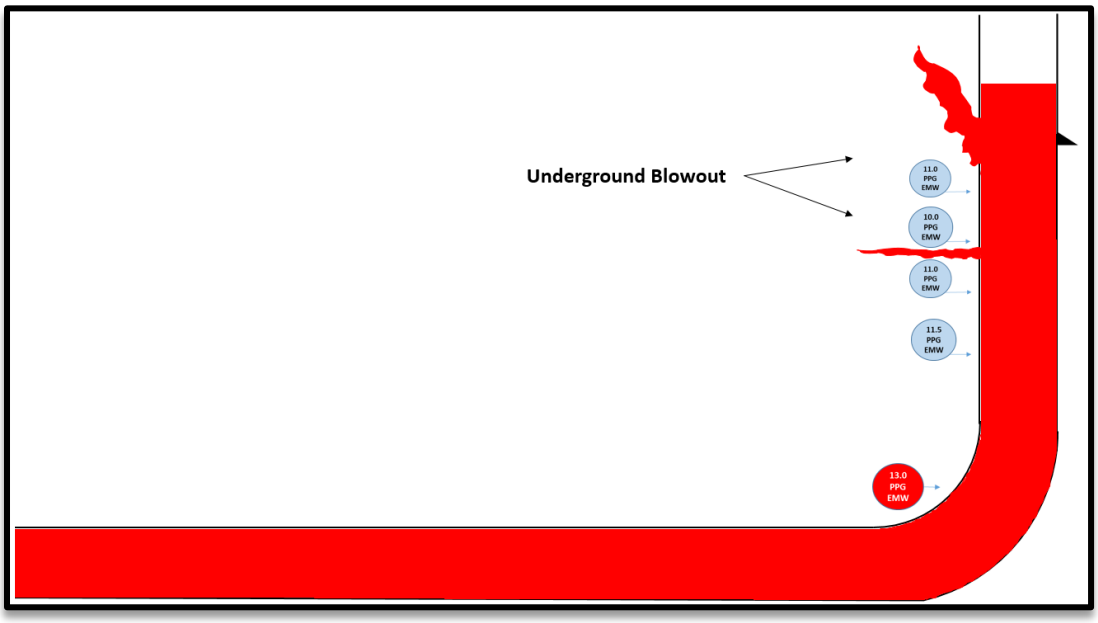

Figure 19- Underground Blowout (UGBO)

Well Control Diagnostics

Performing diagnostics during a Well Control operation can glean invaluable date to help achieve an effective solution early on during the intervention. An example or Well Control diagnostics would be the use of Wire Line services to identify an active Underground Blowout. In this example WL can be utilized in many different ways. WL can be deployed to perform a Noise Log to identify inflow and outflow areas, Temperature logs can be deployed to identify temperature deltas that can also identify areas where crossflow is occurring. Diagnostics help the Well Control specialist zero in on the specific target area to assist in formulating a thorough and sound forward operations plan.

For further information regarding KLX Energy or Great White Well Control's services, feel free to reach out to me.

Regards,

Steve Wehrenberg
VP Well Control & Special Services

Great White Well Control
Off: 405.605.2700
Mob: 405.778.4854
Toll Free: 833.849.3861
Email: steve.wehrenberg@KLXEnergy.com