Recognizing, managing, resolving kicks is crucial

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SUCCESSFUL OPERATORS AND drilling contractors must meet business goals without sacrificing the safety of personnel, environment or assets. The business and operational impacts of blowouts can be devastating.

Blowouts do not just happen, and usually result from a sequence of events and/or actions.

Blowout is a risk in any well operation, but the contributing factors can be identified and a course of preventive measures implemented. This is called risk management.

Two main factors discussed here are well control.

Safely controlling a well requires the correct training as well as the proper equipment to result in a safe operation.

CONTRIBUTING FACTORS

There are numerous factors that cause simple kicks to escalate into blowouts and fires, causing substantial loss of assets such as rigs and other facilities. Two main factors are equipment failure and human error.

Well control equipment systems should be properly designed and maintained in order to minimize failure during a well control event.

Modern equipment can be highly reliable, but there is a wide variance in their design, installation and maintenance.

Such systems include the blowout preventer (BOP), as well as choke manifold, pumping and fluid handling equipment.

Human error is inherent in all human activities. Training to increase the rig crew's awareness of prevention, recognition and resolution of well control events can minimize such errors.

This will significantly reduce the chance that a routine kick will escalate into a major well control event.

WELL CONTROL EQUIPMENT

Equipment Selection. It is essential to provide BOP equipment that is rated for the anticipated working pressure.

Continued exploration into deeper and higher pressure horizons requires that higher anticipated surface pressures and extended shut-in times be considered.

Pumping well control solutions can cause mechanical failure of the components if shut-in pressures are close to or above the rated working pressure of the BOP system.

BOP equipment can be exposed to harsh conditions during kick handling due to erosion by mud solids, formation solids, liquids and/or gases.

Placement, sizing and configuration of well control equipment must therefore conform to recommended practices and engineering guidelines.

Erosion failures have resulted from the lack of targeted tees or tee blocks, the use of threaded connections or thin wall tubes on kill and choke lines/manifolds, and improperly machined flange adapters.

Equipment Installation. Proper installation and testing of BOP equipment is critical to preventing a blowout.

Vibration, tension, compression and bending moment stresses can cause losses in the integrity of the flanged connections in a BOP stack or the bodies, ultimately resulting in loss of well control.

Human error is inherent in all human activities. Training to increase the rig crew's awareness of prevention, recognition and resolution of well control events can minimize such errors. This will significantly reduce the chance that a routine kick will escalate into a major well control event.

Thus all BOP equipment must be installed according to recommended practices and guidelines regarding torque, bracing, weight distribution and equipment suspension.

Equipment Maintenance. Well control equipment systems are designed to control kicks and prevent blowouts.

When new and commissioned properly, they will perform as intended, and will continue to do so if maintained properly.

A comprehensive preventive maintenance program should therefore be implemented.

The program and its schedule should address such items as lubrication, function and pressure testing, component and part inspection and replacement.

One commonly overlooked area is storage and shelf life for spare parts and components.

This program can be derived from equipment manufacturer's recommendations and practices.

Improperly maintained equipment which has failed to perform when needed is a primary contributor to blowouts and fires.

BOP Equipment Inspection. An audit of the well control systems and its com-

ponents is an essential measure of risk management.

Such audits should include the following elements of the BOP system:

- Accumulator
- Choke manifold
- Choke and kill lines
- Rig pumping system
- Top drive/Kelly
- Mud monitoring equipment
- Mud pit system
- Drill string valves
- Choke manifold exit lines (gas buster and divert lines)
- Gas buster and de-gasser

The audit should be executed by someone who is experienced with all aspects of the equipment, and be fully documented in a detailed report.

A thorough visual inspection, complemented with detailed photographs of all components and systems, should be done in a systematic and methodical manner.

The inspection should identify deficiencies such as lack of proper equipment, improper installation and potentials for mechanical failure.

Items of immediate concern should be discussed with the client so that corrective measures can be implemented.

Information such as size, type, working pressure rating, condition, configuration and suitability should be included.

The suitability of the well control equipment should be based on accepted industry practices, guidelines, rules, regulations such as API, IADC, MMS, etc.

Specifications as driven by the planned work environment, contractor and/or client can also be included as an audit criterion.

The rig audit process identifies the risk of equipment failure which could cause a blowout.

This risk is drastically minimized when equipment is fit for purpose and properly rigged up and maintained.

Successful well control risk management is dependent upon knowledgeable, well trained crews and equipment that is fit for purpose, properly rigged and maintained.

Equipment failure and human error are two main factors that cause simple kicks to escalate into blowouts and fires that could cause significant loss of assets and injuries.

WELL CONTROL CREW AWARENESS

Crew awareness of well control and the appropriate responses is essential to prevent blowouts.

Crew members come with varying experience and knowledge regarding well control.

The risk of human error can be managed by providing crew members with the basic knowledge of how blowouts occur, kick warning signs, the recognition of kicks and the basics of kick resolution, through conducting well control awareness orientation at the well location or other suitable venue.

Kick Occurrence. Blowouts do not just happen, and are usually results of a sequence of events.

A crew that has the proper awareness can recognize these events, and prevent a disaster by using proper kick handling procedures.

This awareness should be provided using a media that can be understood by all crew members, including the roughnecks and derrick men, regardless of experience.

All crew members should be trained in the basic knowledge of hydrostatic pressure, formation pressure and the causes of kicks.

The causes of kicks should be explained, such as insufficient mud weight, poor tripping practices, loss of circulation, abnormal pressure, etc.

Kick Recognition. Awareness of kick warning signs is an essential element to successful well control.

Although there has been much technological advance in equipment for monitoring a drilling operation, the rig crew is still the first line of defense to prevent a kick from escalating to a blowout event.

Very subtle well control warning signs often occur during routine daily tasks on the rig, and certain skills are required to recognize these signs.

A crew member who cannot recognize kicks becomes a weak link in the chain of blowout prevention.

Thus the entire rig crew should be trained to recognize all the visual warning signs, such as increase in flow rate, pit gains, well flowing with the pumps off, improper hole fill and well flow while tripping.

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Kick recognition is critical where the formation pressure encountered is higher than expected, when the rig crew cannot realistically prevent a kick, and the severity of the resulting well control operation is directly related to the size of the kick.

The main goal in training for these situations should be for the crew to learn to minimize the kick size.

Kick Handling. Large kicks result in higher pressures and larger influx volumes on the surface, and thus are more risky to handle than small ones.

One of the factors affected by kick size is the ability of the surface well control equipment to handle the kick.

The equipment must be capable of handling the pressure and the removal rate of the kick fluid on the surface.

For example, the "poor boy" gas buster may not be sufficiently sized to handle the high gas flow rates from larger kicks.

Another factor affected by kick size is lost circulation when circulating out a kick, which can be a serious situation.

If the casing shoe (or weak formation) breaks down, the wellbore can become evacuated, resulting in very high casing pressure, or an underground blowout, either of which can have very expensive consequences.

For example, if the casing shoe in this example is at 5,000 ft, the equivalent circulating density (ECD) at the shoe can reach over 18 ppg for a 100 bbl kick, compared to 14 ppg for a 20 bbl kick.

The margin for error is much smaller in circulating the larger kick.

Awareness training for kick handling should emphasize the importance of the role that each crew member plays during the kick circulation. To emphasize the importance of kick handling procedures, an example of how a simple kick can lead to a blowout should be used.

RISK MANAGEMENT REWARD

Successful well control risk management is dependent on having knowledgeable, well trained crews and equipment which is fit for purpose, properly rigged up and maintained.

The rewards for such a program benefits both the operator and contractor. These benefits include:

- favorable loss history
- lower insurance premiums
- lower deductibles for rig physical damage
- effective control of the well
- reduced loss of hire
- reduced business interruptions
- no denial of liability and casualty coverage
- retaining revenue generating assets
- lower operating costs
- higher rig efficiencies and performance
- better safety record

The biggest reward is avoiding a blowout.

Blowouts are a risk in any well operation, but the contributing factors can be identified and a course of preventive maintenance can be implemented.