Best Available Technology (BAT) Analysis
Well Blowout Source Control

After evaluating the two primary methods of regaining well control during a blowout scenario (Well Capping and Relief Well Drilling), BPXA believes Well Capping constitutes the BAT for source control. BPXA will continue the refinement of Well Capping techniques, decision trees and timelines for inclusion in well control preparedness and spill planning prevention efforts. The rationale for this decision is discussed in the following document.

Well Capping

Availability

Well Capping technologies are available from a wide range of service providers around the globe. BPXA maintains an open contract with WELLCALL, a well control alliance organization comprised of many specialized service providers.

Well Capping response operations will be highly dependent on the severity of the well control situation. Specialized personnel and equipment can be on location within 24-48 hours. The materials required to execute typical capping responses (junk shots, hot tapping, freezing or crimping) are small enough that they can be quickly made available to even remote locations (by helicopter, if necessary).

In the mid 1990's, BPXA purchased a spread of well control fire fighting equipment to station on the North Slope. This equipment includes two 6,500 gpm fire pumps, associated piping, lighting, transfer pumps, Athey wagons, specialized nozzles and fire monitor shacks. This equipment is a standard spread of fire fighting equipment normally mobilized by well control specialists in a blowout event. Maintaining this equipment in place on the North Slope significantly minimizes the quantity of heavy equipment requiring mobilization in an actual blowout event.

Other equipment necessary during well capping operations are fairly standard items on the North Slope (D8 bulldozers, cranes, pumps, block and tackle, large diameter casing, etc) and can be made available within a few hours of the actual emergency. For offshore locations (i.e. Northstar), heavy lift helicopters can be mobilized from the Pacific Northwest and be on location within 48 hours.

Transferability

Specialized equipment necessary for a well capping operation (capping stack, cutting tools, etc) can be mobilized with specialist personnel and be on location within 24-48 hours. BPXA maintains an operating agreement with WELLCALL, a well control specialist organization that can assist in the intervention and resolution of any well control emergency. WELLCALL acts as BPXA's single point of contact and is an alliance of several international service providers (Boots & Coots/International Well Control, Safety Boss, Halliburton, Anadrill Schlumberger, Baker Hughes INTEQ, Dowell Schlumberger, Baroid and MI Drilling Fluids). This alliance of global service providers ensures access to the best fit for purpose technology in response to a variety of emergency responses.

Fire fighting and supplemental heavy equipment needed for well capping is readily available on the North Slope. Specialized well capping equipment can be mobilized to any North Slope location within 24-48 hours.

Effectiveness

Current well capping technology is compatible to North Slope operations and is especially suited to remote locations due to it's proven applications in remote and/or offshore applications around the world. Industry data (Scandpower Report 27.83.01) indicates that of all the development and exploration wells drilled in the North Sea and Gulf of Mexico between 1980-1999, only 26 "deep" (below surface casing) blowouts occurred. Of these 26 "deep" blowouts, over half (54%) stopped flowing as a result of bridging of solids in the wellbore. Only 2 of these 26 "deep" blowouts required well capping as a mitigating measure. The other blowouts were controlled with more conventional

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methods (BOP equipment, weighted drilling muds or cement placement in the well). No relief wells were required.

In an actual blowout event, well capping operations would commence with activation of the WELLCALL Alliance and mobilization of key personnel and equipment. Conventional well control methods will continue to be attempted, if safe to do so. If the well capping option is selected, safe reentry to the wellhead area must be established and rig equipment must be moved to allow safe access. If the rig moving system is unavailable or inactive, heavy bulldozers, block and tackle and/or cranes will be used to remove the rig from the wellhead area. Once safe access is regained, capping operations can commence.

Cost

In 1997, BPXA - Shared Services Drilling invested $995M for a spread of emergency fire fighting equipment to permanently station on the north slope. This equipment includes two 6,500 gpm fire pumps, four fire fighting monitor shacks, athey wagon and boom, associated specialized nozzles, associated piping and specialized hand tools. This equipment is maintained on the north slope and can be mobilized immediately. Some of the larger equipment may need to be dismantled (into smaller pieces) to enable helicopter transport to remote sites.

Other than the initial investment above, maintaining an open contract with WELLCALL is a minimal annual cost. Any costs incurred during an actual response would be at previously agreed rates.

Age and Condition

Immediately following the Iraq-Kuwait war, well capping techniques were widely utilized to regain control of blowouts all across the central Middle East. Well capping techniques proved beneficial in regaining control of damaged wells and eliminating environmental impacts. Significant techniques and experiences were developed by a variety of well control specialist companies from around the world during this era. Currently, well capping technology and expertise is widely available from a variety of global companies. BPXA maintains an operating agreement with WELLCALL, a well control alliance team comprised of well control specialists, high pressure pumping, drilling fluids and cementing services, wireline and downhole tool providers. Specialized well capping personnel and equipment via WELLCALL remain on call around the world and can be on any North Slope location during a well control event within 24-48 hours.

Compatibility

Well capping is compatible with all drilling operations as the technology is applied at surface. There are no sensitivities to well types (ERD, horizontal, etc) or location (remote, island, etc). Well capping techniques have been applied both on land and offshore locations and have historically proven successful in regaining well control very short durations (Scandpower Report 27.83.01 states that 97% of all blowouts have durations of less than 15 days).

Feasibility

Well capping is feasible with all well types as the technology is applied at surface. In remote locations (offshore islands, etc) where geographic access may be limited, the shorter durations of well capping techniques would be preferred over the lengthy alternative of a relief well.

Environmental Impacts

Industry data indicate that well capping technologies provide the shortest duration alternative of effectively regaining well control and minimizing environmental impacts. The Scandpower Report (No. 27.83.01) indicates that 97% of all blowouts have durations less than 15 days. Conservative estimates of blowout durations on the North Slope range from 18-30 days and do not take into account the likelihood of formation bridging. Short well capping durations reduce spill volumes by regaining well control as quickly as possible.

If involuntary ignition has not occurred, voluntary ignition of the blowout may also be considered as a method to reduce spill volumes. The timing of voluntary ignition must be a carefully considered option as it can impact safe access to the wellhead area and further delay response operations.

Relief Well Drilling

Availability
Relief well drilling has historically been accepted as the blowout mitigation method that would be applied on the North Slope. Although an often proposed blowout response method, it has been attempted only once as a mitigation measure to control blowouts on the North Slope (ARCO Cirque blowout, 1992). Well control was regained on the 1992 Cirque well before the relief well reached total depth.

Transferability
Multiple drilling rigs are under contract on the North Slope. Downhole and surface equipment (tubulars, wellheads, etc) are also available. Rig-sharing agreements are in place between North Slope operators to facilitate optimum response times.

Effectiveness
Industry data (Scandpower Report 27.83.01) indicates that of the 117 total North Sea/Gulf of Mexico blowouts between 1980-1999 (~28,000 total wells), only 4 relief wells were drilled to regain control. For the 28 "deep" blowouts (below surface casing) during the same time period, no relief wells were required or even attempted. In each of the "deep" blowouts, well control was regained through conventional measures (including well capping) or by natural means (formation bridging). In the one North Slope event where a relief well was actually drilled (ARCO Cirque blowout, 1992), well control on the blowout well was regained before the relief well reached the target formation. During the 1992 Cirque blowout, well control was regained by a combination of conventional well control efforts although formation bridging is suspected to have contributed significantly to the overall success.

Selecting an appropriate surface location is critical to relief well placement. If surface locations are not near to the blowout location, the relief well can often face significant challenges (tortuous directional drilling or extended reach) to reach the target formations in the blowout well. Optimum surface locations are rarely available on the North Slope and as such relief well drilling is often the least desirable option.

Cost
Relief well drilling to a "deep" zone blowout (below surface casing) can be a time consuming and costly process. If access to the blowout location is unavailable, alternative locations must be sourced and/or constructed (gravel pads in the summer, ice pads in the winter). After permitting, site construction (if necessary), well planning and rig mobilization, the relief well must still be drilled. Onshore North Slope relief well durations are often estimated in the 60-90 day range. Offshore relief well durations could be significantly longer (up to 180 days) depending on the season and any weather restrictions. These lengthy timelines add undesirably to the overall environmental impact (spill volume) of the blowout well. Based on industry data (Scandpower Report 27.83.01), it is estimated that 97% of blowouts would be under control by the time the relief well drilling rig could even be mobilized.

Age and Condition
Relief well drilling is similar to current methods used to drill and complete North Slope wells today and advances in directional drilling technology allow precise wellbore placement. Relief well techniques may be sensitive to blowout well locations and/or blowout well types. For extended reach wells or remote locations with limited geographical access, relief well drilling will be both challenging and very time consuming thereby adding undesirably to the overall environmental impact (spill volume) of the blowout well. In the single instance a relief well was attempted on the North Slope (1992 Cirque blowout), well control was regained before the relief well reached it's intended target depth.

Compatibility
Relief well drilling technology is compatible to North Slope drilling operations although it may be sensitive to both the well location and well types.

Feasibility

Relief well drilling success is dependent on geographical access to an area near the blowout well and directional drilling techniques to ensure blowout well intersection. Lack of year round access significantly impacts estimated relief well timelines. Additionally, if a relief well is needed to control a remote or offshore blowout, there are only two large ERD capable rigs on the North Slope (Parker 245 and Nabors/Pool 7) and mobilization of these large rigs may be seasonally limited. There is minimal industry evidence of successful application of relief well drilling as the primary mitigation measure for well control (Scandpower Report 27.83.01 indicates only 4 relief wells were successfully utilized – on 117 blowouts – between 1980 and 1999 in Gulf of Mexico and North Sea operations).

Environmental Impacts

With durations estimated at 60-90 days, relief wells provide the longest duration alternative of effectively regaining well control and maximize potential environmental impacts. In addition to the longer blowout duration, the relief well itself introduces additional environmental risks. If geographical access to a site near the blowout well is limited, a new gravel site must be quickly constructed (tundra impacts). During equipment mobilization and/or relief well drilling operations, additional risks of spills and tundra impacts are possible. During the drilling of the relief well itself, the risk for a second well control event (blowout) is introduced.

Conclusion

The attached table summarizes Well Capping as BAT for a worse case drilling blowout response scenario. Shorter Well Capping response times potentially account for an additional ~50% reduction in potential blowout durations. Additionally, limitations on North Slope relief well surface locations potentially add significant response time to relief well drilling as a potential blowout mitigation measure. Potential lost production is excluded from the estimated durations and/or impacts.

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