Recommendation against MASD dispensation for HSE risk wells

BACKGROUND

Well collisions are avoided by maintaining suitably conservative separation distances from offset wells. These distances are often referred to as Minimum Allowable Separation Distances or MASDs, and they take into account the measurement uncertainties associated with the well trajectories. Offset wells that could represent a health, safety or environmental (HSE) risk are subject to the most stringent MASDs.

RECOMMENDATION

The Collision Avoidance Work Group recommends that dispensation from MASD rules should not be allowed for HSE risk wells. In particular, the probability of the drilling assembly failing to penetrate the offset well in the event of a collision cannot be reliably quantified and is therefore not a valid justification for allowing contravention of a HSE risk MASD.

RATIONALE

The probability of drilling through an offset well's producing or injecting string can be split into two components:

P1, the probability of contact between the bit and the offset casing, which is a function of well separation and the uncertainty associated with the relative positions of the two wells - normally managed using MASD rules.

P2, the probability of drilling through the casing, which is a function of the casing program, drilling tool type, drilling parameters, formation type, offset well monitoring for early warning of contact, etc.

Since P1 and P2 are independent, the overall probability of penetration is the product of these two probabilities (P1 × P2).

For HSE risk offset wells, it is common practice to specify MASD rules that result in an extremely low P1, often < 0.00001. Where this is the case, the value of P2 is irrelevant in the estimation of overall probability of penetration, since P1×P2 can only result in a value of ≤ P1 and P1 has been set at a tolerably low probability.

The value assigned to P2 becomes more relevant when a higher probability of contact is allowed, such as for non-HSE risk offset wells or if contravention of a HSE MASD rule is authorized. In the latter case, a suitably low probability of drilling through the casing (P2) would have to be reliably achieved to maintain the extremely low overall probability of penetration that is required for HSE risk wells.

Given informed and honest application of the standard methods, it is reasonable to assume that P1, the estimate of probability of contact, is valid or at least appropriately conservative. The ISCWSA has published several papers and internal documents that facilitate the calculation of valid estimates of relative position and safe MASDs.

However, P2 is not quantified in any formal or objective way, and therefore should be assumed to be 1 for HSE risk offset wells. With P2 set to 1, drilling closer to an offset

well than the specified MASD will result in an unacceptable probability of drilling through the production/injection string.

The following are examples of circumstances and actions (sometimes referred to as mitigating actions) that are commonly *assumed* to reduce the probability of penetration:

- Multiple casing strings protecting the tubing
- Jetting instead of drilling
- Rotary drilling instead of motor drilling
- Drilling with a mill-tooth bit instead of a PDC bit
- Drilling with a dull or "shirt tail" bit
- Drilling with low ROP
- Monitoring the shakers for cement/steel
- Monitoring offset wellhead vibration
- Monitoring offset casing annular pressure
- Low angle of incidence between wells
- Soft formation

The consensus of the Group is that such actions and circumstances may reduce P2, but their effectiveness is not predictable and they cannot reliably ensure that penetration will not occur. *We do not recommend their use as justification for dispensation against the MASD criteria applied to HSE risk offset wells.* Their use in allowing a reduced MASD should be restricted to offset wells that do not represent a HSE risk.

The Group also concludes that contact with an offset well represents a risk even if penetration does not occur. The offset casing may be damaged immediately as a direct result of the collision or it may be damaged by subsequent drilling and tripping activities prior to casing being set in the reference well. The extent of this kind of damage is unpredictable, but it can be severe enough to reduce the structural integrity of the offset well and be the cause of failure later. This possibility reinforces our recommendation that the safe separation distance specified for HSE risk wells should not be compromised.

Unlike the examples listed above, magnetic ranging techniques may provide additional information about the relative positions of the offset and reference well, and thereby modify the probability of well-to-well contact (P1), rather than the probability of penetration (P2). Known variations in the lithology may also provide additional information about the relative position of the wells.

For use in HSE risk situations, all such methods must provide a quantification of relative well separation that equates to P1, and allows a determination that the probability of well-to-well contact is acceptably low. The high dependency of a successful outcome on the validity and reliability of the service should be stressed with the supplier. This may provide a useful test of their confidence in the method and the data.