Complexities of a well control response in a marine environment

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Blowouts!

• What is a Blowout?
  – The uncontrolled flow of fluid or gas from a well bore.

• What is the Cause of a Blowout?
  – An unrecognized or uncontrolled kick.
A Well Control Incident

Loss of well control in a marine environment adds a different level of complexities to a well control response.
Complexities

• Does it involve a fixed bottom asset?
• A floating asset?
• Or none of the above?
Complexities

If the incident involves a subsea well, the complexities are compounded.

• How are we going to access the wellbore?
• How are we going to install a capping device?
• Can the pollution be addressed at the source?
• Is capping equipment readily available?
Complexities

- Are there environmental issues?
- Will the surface intervention have to be completed in harmony with an oil spill response?
Complexities

- When a well control incident is in a marine environment, it is most important to immediately start planning and developing a relief well.
- Be prepared should the surface intervention efforts fail.
• Timing is of the essence when responding to a marine well control event.
• The responses (well control, oil spill, relief well, etc.) must be simultaneous and worked in a closely coordinated effort for maximum efficiencies.
• To do so from a well control response standpoint, the response must be supported and developed using advanced engineering tactics.
• Engineered actions and engineered contingencies must be included in every step of the response.
Prospect planning support process

Each stage of the response plan is supported

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Mobilisation – sea-fastening

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Mobilisation – sea-fastening

Excel calculations

Linked to CAD

Quick turnaround

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Exclusion zone ID – for SIMOPS

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Subsea dispersion – Zone 1
Subsea dispersion – Zone 2

\[ D_{b\text{ max}} \propto f(u_0, g, U_c) \]

\[ D_{b\text{ min}} \propto f(\rho, \sigma, \varepsilon) \]

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Subsea dispersion – Zone 2

Dispersant effects?

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JOINT INDUSTRY PROJECT FOR ADVANCED MODELLING IN SUBSEA GAS RELEASE
JIP Members

- The project is organized as a JIP and supported by Wild Well Control, Shell, BP, Statoil, Total, Gassco, DNV, Safetec and the PSA
Experimental Campaign

Full Scale Test - Location - Høvringen, outside Trondheim, May 2014
Experimental Campaign

- 30 m water depth
- Gas Rate 5Kg/s 21mmscfd
- Video 1Kg/s

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Zone 3 - gas dispersion
Zone 3 - gas dispersion

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CAN WE CAP IT?
Will surface boil be a problem?

Wellhead to upstream extend of current reversal: 8 m

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Capping analysis – how it works

Fluid-structure Interaction
6 DOF model

Current Direction

Gravity

Plume jet forces

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Capping stack landing

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OTHER CONSIDERATIONS
Debris clearance

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Radiant heat

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CAN WE KILL IT?
Can we kill the well?

- Killing the well usually involves pumping heavy mud into the wellbore – WWC use Olga ABC to model well kill
- Mud weight requirements mean the fluid is extremely erosive
- Can we pump enough mud for long enough without damaging the equipment used?
- Is erosion a major concern?
Erosion prediction

- API 14E
- DNV RP O501
- CFD

\[ v_e = \frac{c}{\sqrt{\rho m}} \]

Increasing complexity

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Erosion models

Angle $\alpha$

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Erosion prediction

\[ e_r = C(BH)^{-0.59} F_s V_p^n f(\alpha) \]

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Erosion validation – 5D bend

Normalized Erosion Rate

Angle round bend (Degrees)

0 10 20 30 40 50 60 70 80 90 100

Normalized Erosion Rate

Angle round bend (Degrees)

Test

CFD

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Erosion risks

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Erosion risks

- Initial particle trajectory
- Particle trajectory for eroded wall

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Practice makes perfect!
ANY QUESTIONS
Thank you.

Please visit wildwell.com