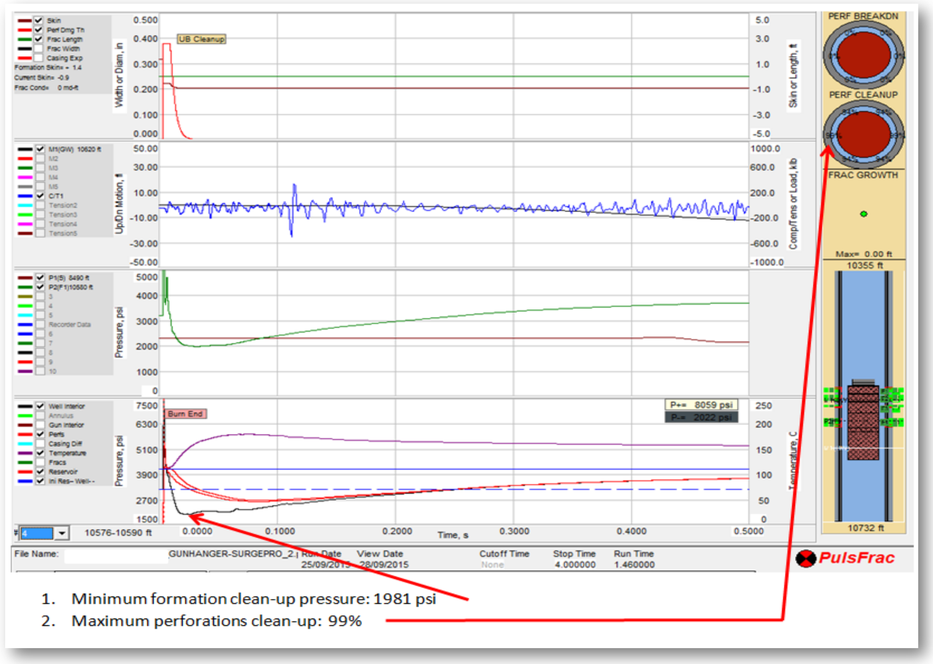
SLAP 16-26

Dynamic Underbalance Applied with Gun Hanger in ESP Completions

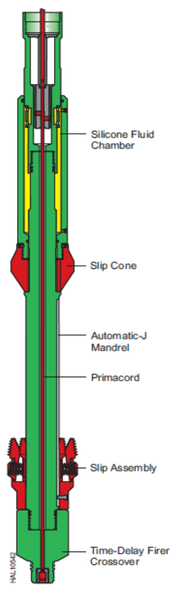
ABSTRACT:
Optimal production from perforated zones is always the goal, however minimizing formation damage, during a perforation event, can present challenges. This poster presents a case study in which an operator utilized a holistic approach with the use of a Auto Release Gun Hanger (ARGH) in conjunction with Electric Submersible Pump (ESP) artificial lift completion solution to address formation fluid compatibility challenges while optimizing perforation tunnel cleanup. This solution incorporates an advanced technical design using both static underbalance (UB) and dynamic underbalance (DUB) to achieve oil production with minimal fluid invasion to prevent formation/skin damage. and marrying this solution with gun hanger technology in an artificial lift completion.
Immediately after gun detonation, the DUB created down hole with atmospheric surge chambers and vents, deliver the required free volume for well bore and reservoir fluids to surge into after vents opening, regardless of the wellbore pressure. This creates the DUB that helps improve perforation cleanup and maximizes effectiveness removing the fluidized crushed zone out of the perforation tunnels. This dynamic event is followed by a static UB pressure event with hydrostatic pressure in the well bore below the reservoir pore pressure, allowing formation fluid to enter the well bore for a more prolonged flow period.
In addition to the hardware and explosive components there are software applications to model gun performance, perforation cleanup efficiency and dynamic shock loading due to gun detonation.

Objectives
Abandon the original well due to debris in the wellbore.
Drill a new side-track well to the interest zone.
Perforate the producing interval with minimal perforation damage
Minimize formation damage generated during drilling and completion stages
Obtain the best production possible with technologies available

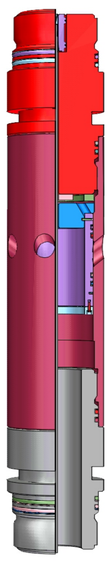
Challenges
Run accurate simulations to determine conveyance method, atmospheric chamber volumes for DUB, shock loading, gun performance and static underbalance.
Apply dynamic under balance (DUB) for enhanced perforation clean up
Perforate using static underbalance in favor of the formation for prolonged cleanup flow
Use the Gun Hanger system with electronic programmable firing head due to its flexible capabilities
Recover hydrocarbons with artificial lift using an electric submersible pump (ESP) designed for this well
Avoid damaging ESP with gun detonation shock load.



Simulation predicting a dynamic pressure drop to 1981psi leading to a 99% perforation cleanup



ARGH

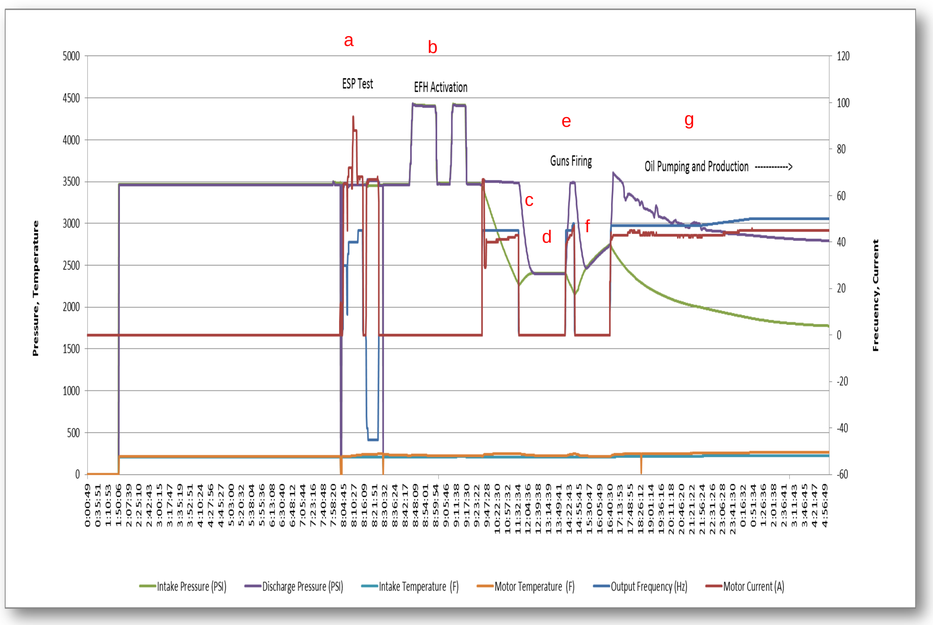


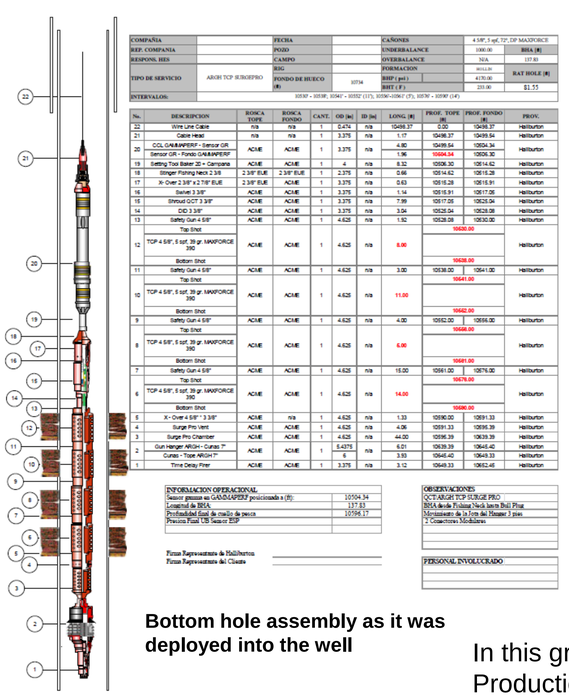
SurgePro Vent

SurgePro Chamber

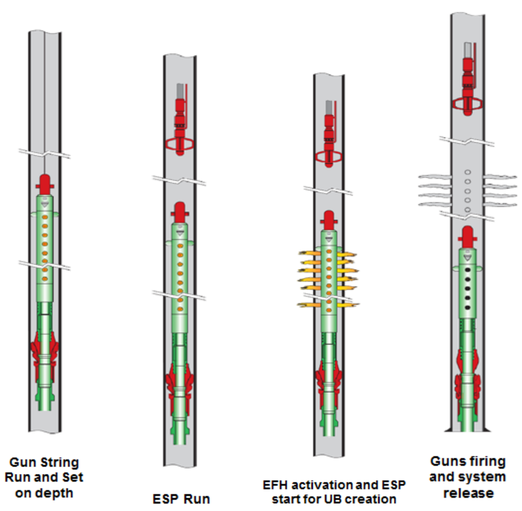
This technique consists of two primary components:

- **Software** that is physics-driven and relies on measurable or estimated actual input parameters.
- **Hardware** consisting of a programmable electronic trigger device, vents and chambers that enable the dynamic fluid surges in milliseconds.



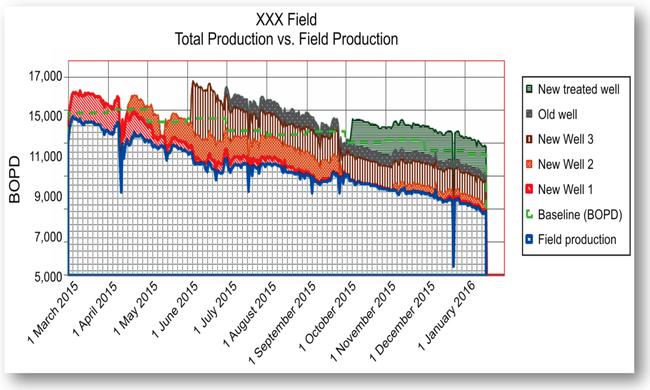


Bottom hole assembly as it was deployed into the well



Results-
ESP sensor log showing the operational sequence:
a. ESP test when it was at design depth
b. The two EFH activation pulses
c. Fluid evacuation with the ESP
d. Waiting time for EFH activation
e. The guns firing and surging effect taking place
f. Wait time for solids decantation
g. Well production with the ESP

In this graph we can see the field production with its natural declination (blue).
Production base line defined by the NOC (green dash line).
The light brown shade represent production performance after a hydro jetting completion.
The other colored areas represent different well production performances after completed using standard overbalance wireline perforating.
The dark green area corresponds to the production profile after using this completion technique.
A more consistent and stable flow during the period shown.
As of August 2016 the well was producing 1680 BOPD without any water (initial production was 1750 BOPD zero water).



Conclusion-
- Prejob planning helped define technologies to be used.
- Torque and drag simulation confirmed BHA deployment with cable.
- Programmable EFH completed operation within scheduled time.
- Post job results were similar to pre job simulations.
- Production results evidenced DUB perforation clean up.
- Applied technologies reduced rig time and costs by allowing anticipated production.
- The proper combination of technologies can minimize skin damage in production wells.
- Well completions using proper technologies can provide a quicker ROI.

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