Multistage Annular Fracturing

BHI OptiPort combined with Optifrac SureSet enables 49 frac stages, with over 3 million pounds of proppant placed in record time!
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• Agenda:
  • Optifrac/SureSet Overview (Video)
  • Challenges of annular fracturing
  • 49 Stage Barnett Shale frac obstacles
  • Questions?
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• BHI Optifrac SureSet BHA
  • Coiled Tubing Conveyed Annular Fracturing BHA
    • Features include:
      • Hi clearance BHA - 0.4” (10mm) on diameter
      • On board abrasive perforator
      • Mechanical CCL
      • Hydraulic operation, fail safe design
      • Multiple casing sizes/weights
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- BHI OptiPort
  - Sliding sleeve frac port
  - Run with the casing/completion by the drilling rig
  - Can be used with external casing packers, or cemented liners
  - “Defines” frac initiation point
  - Provides full bore ID of casing
  - Equal pressure rating to casing
  - Functioned (opened) with properly placed frac tool or packer
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- Challenges of annular fracturing
  - Getting Stuck! High clearance helps!
  - Available WOB to set Packer element (horizontal)
  - Packer design to withstand hi pressure @ temp
  - Ability to accurately locate, especially with OptiPort
  - Tool reliability/longevity in erosive environments
  - Speed, to reposition and operate BHA
  - The number of intervals/well is increasing!
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- 49 Stage Barnett Shale frac obstacles:
  - Speed! Optiport/SureSet combo < 10 min between fracs
  - Long horizontal wellbore provides less than 2k # WOB
  - Downhole temp in excess of 85C
  - High Breakdown pressures (tight formation)
  - Challenging recovery from screen out with 2” CT
  - High rate frac/erosion of BHA at perforations
  - Daylight pumping only- trip BHA-RIH to depth/penetrate sand in wellbore
  - Tool reliability
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• Long horizontal wellbore provides less than 2k # WOB!
  • Carefully modeled using BHI Circa TFA software
  • Proprietary “low activation force” packer element utilized
  • Horizontal length will become a limitation
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- **Speed! Less than 10 min between fracs!**
  - By using the Optiport system, abrasive perforating is eliminated
  - Fluid savings of approx 10 cubic meters of fluid/stage
  - First stage can be SJ perforated or use “P” sleeve
  - Mechanical CCL provides accurate first time locating feedback
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- Downhole temp in excess of 85C
  - Conventional elastomer elements will begin to flow
  - BHI proprietary unconventional element will withstand high temp @ high pressure with repeated pressure/temp cycles, while still being high clearance
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- High Breakdown pressures (tight formation)
  - Barnet shale formation may require isolation differentials up to 7000 PSI (48 MPA)
  - Not only challenging for the packer element, but all down-hole sealing devices; aggravated by high temp
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- Challenging recovery from screen out with 2” CT
  - With 2” CT in 5.5” completion, annular velocity required to clean out proppant is generally limited by friction from the CT itself
  - BHI CIRCA modelling software is used to tailor the cleanout to reduce the recovery time to a minimum
  - Clean out times can range from 1-10 hours, optimization is critical
  - Sand placement in the wellbore is critical to promote fracture growth/initiation, sand in the wellbore can simply cause a screenout shortly into the pad!
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- High rate frac/erosion of BHA at perforations
  - Shale formation = high rate slickwater frac
  - Major erosion can occur at the transition of fluid velocity from the annulus, around the corner, into the perforations/formation
  - Over 3 million pounds of proppant pumped past the BHA!
  - Extremely hard surfaced BHA components provide tool longevity.
- Goal is to provide up to 50 stages per BHA deployment.
- To date max stages per BHA is 27
- BHA failure in this case was worn/rounded anchor slip teeth
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• Daylight pumping- trip BHA-RIH to depth/penetrate sand in wellbore
  • Operations dictate the BHA/CT must be brought to the vertical section of the wellbore overnight
  • Proppant migration into the well bore will restrict entrance, 10% full?
  • BHA flow through capability allows this proppant to be fluidized, and be penetrated.
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• Tool reliability
  • Ever increasing number of stages/wellbore
  • Optiport can be SJ perforated in the event of malfunction
  • Ultra reliability by using high end materials/components saves the customer $$
  • Each faulty tool string can cost up to $50K in standby/tripping!
  • Especially important in Daylight only areas!
Questions?