“Unusual Interventions”

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Outline

- Introduction
- The use of “Unusual Intervention” methods to resolve complex well bore scenarios.
  - Abrasive Cutting
  - Abrasive Perforating
  - Abrasive Slotting
- Case Histories
- BHA Design used to execute these operations
- Abrasive Job Requirements & Procedures
Abrasive Cutting

- Special Port Positioning for directing an abrasive fluid jet stream into the ID of the pipe to be severed.
- Abrasive fluids combined with a down hole motor create a complete cut of the tubular.
- The abrasive fluids penetrate and sever the tubing where the jet stream makes contact.
- Results in a clean cut without any flaring of the tubular.
Abrasive Cutting

This presentation of new high velocity sand cutting
Abrasive Cutting Case Histories

- Coiled Tubing stuck in hole
  - Cut at surface, rigged in 1-1/2” CT
  - Abrasively Cut 2-3/8” CT down hole – removed string from well.

- Fish Hanging String w/ Internal Capillary Lines
  - Utilize a modified Flat Catch Overshot – capable of cutting CT
    - 2” CT has been tested in OKC, currently working on a test of 1-1/2” CT with 2 x 3/8” internal capillary lines.
Abrasive Cutting Case Histories

- **Cut Hanging String**
  - Currently designing an Abrasive Cutting assembly to cut a 1-1/2” CT hanging string 10-12” below tubing hanger

- **Cut 4-1/2” Non-Magnetic Drill Collar**
  - Passed thru 50.8mm ID Jar
  - Utilizing 1-1/2” CT w/ 1.95” Cutting Head
  - Complete the cut in 60min.
Abrasive Perforating

- The Abrasive Perforating System, allows multiple perforations to be made in the same trip in the hole.
- Custom tool designs available (ie: phasing, length, nozzle size)
- Alternative to conventional methods:
  - Tubing Conveyed Perforating (TCP)
  - Wireline deployed perforating
  - Mechanical Tubing Cutters
  - Chemical & Explosive Tubing Cutters
- Successful in perforating drill collars, drill pipe and multiple casing strings in a single trip.
Abrasive Perforating

Motor Head Assembly

Swivel

Orienting Sub

Abrasive Perforator

Wash Nozzle
Abrasive Perforating
A abrasive Perforating Test

- Perforate thru 114.3mm Casing encased in shale rock and cement
- 27” + Penetration
Abrasive Perforating Case Histories

- Casing Leaks
  - Multiple wells with casing leaks that need to be squeezed off
  - Dual horizontal cuts with a motor followed by perforating multiple setting between the cuts, utilizing a piston perforator.
  - Entire procedure completed in a single trip
The Abrasive Slotting Assembly utilizes a planar perforator
- The # of jets can be altered, allowing a variety in phasing.

Slotting can be completed in multiple stages and various lengths, simply by adjusting your work string in the hole.

The planar perforator can be combined in a BHA with a cutting head to form “Coupon” cut-outs within the tubular of interest
- Beneficial for damaged casing, testing purposes
Abrasive Slotting

Planar Perforator

- Crossover Sub
- Dual Flapper
- Hydraulic Disconnect
- Diverting Circulation Sub
- Planar Perforator w/ 6 Nozzles at 60° Phasing
- High Velocity Wash Nozzle w/ Ball Seat
Abrasive Slotting Case Histories

- **Uranium Mine flooded with water**
  - Relief wells were drilled and cement squeeze performed
  - Subsequent water influx still present – drill 4 wells and install down hole pumps to remove excess water
  - Abrasively Slot casing to accommodate extra volume of water required to operate pumps.

- **Parted Casing in steam injection well**
  - Perform 6 – 48” Vertical cuts between upper and lower radial cuts.
  - Create “coupons” that will fall in and be fished out later.
    - Modified an Abrasive Cutting Head to accommodate the High Tech Rare Earth Magnet – resulting in the “coupons” being retrieved on the same trip.
Abrasive Slotting Case Histories

- **Multilateral Jetting w/ Slotted Windows**
  - Generate 8 x 18” vertical slots
  - Shift piston & Reposition tool string
  - Perform 4 horizontal cuts (upper and lower) between the slotting
    - Create 4 x 2.50” ‘windows’ w/ casing between
      - Maintaining casing integrity
  - Install a whip stock through the window
    - 31.75mm CT out to high pressure jet the formation
Abrasive Slotting

- Resulting in:
  - 4 windows
    - 2.5” Wide
  - Casing Integrity Intact
  - Whipstock Capable
Abrasive Requirements & Procedure

- Coiled Tubing or Threaded Pipe
- Fluid Pump
  - Minimum Pump Rate 80L/min per nozzle
- 100 Mesh Sand Slurry
  - Mixed 100kg/m³ – 120kg/m³

- ID / Weight of tubular will determine cutting time
- # Nozzles per cutting tool – increase flow rate
- Continue pumping sand slurry until cut is complete.

*** Each job scenario is different, we use the above as guidelines***
Questions?