Ballistic Timed Delay Fuse Streamlines CT Perforating with Improved Safety and Reliability

IPS 16-04

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AGENDA/INTRODUCTION

- Ballistic Timed Delay Fuse (BTDF)
- Through Bulkhead Initiator (TBI)
- Module Delay and Output
- BTDF Highlights
- Field Results
- Questions
Ballistic Timed Delay Fuse

A device that will permit individual guns within a gun string to sequentially initiate after a given delay. Providing one trip timed perforating in a multi-zone formation

Drivers:
- Safety
  - None-pressure activated (pressuring up on the deployment stack or lubricator)
  - No firing pin (impact sensitive)
  - No trapped pressure during disassembly at the well site
- Other
  - More accurate delay times
  - Cost of overall assembly

Applications:
- TCP, coiled tubing, slickline, wireline
- Perforate multiple intervals in a single run
- Initiate an on-time delay for DFH instead of HDF
- DUB enhancements
- Gun shock reduction in long perforating strings
- Completion insertion and retrieval under pressure (reverse deployment valve)/SBT
Through Bulkhead Initiator (TBI)

- Booster initiated explosive receptor pellet.
- Shock wave passes through steel bulkhead without breaking it.
- Shock wave initiates explosive on backside of bulkhead.
- Explosive/pyrotechnic propagates to next component.

Ballistic Timed Delay Module

Simulation of TBI

US Pat. No. 6,719,061
US Pat. No. 8,622,149
Delay and Output Module

- Proprietary delay mix provides minimum variation in timing
- Temperature dependent
- 400F/100 hours
- Output – high order detonation

Ballistic Delay Time

TBI Delay Module

TBI

Delay

Output (detonation)

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Highlights

Maintains pressure integrity following detonation transfer

- Safe
  - No firing pin or moving parts
  - Will not initiate due to pressure
  - Requires high-order detonation to transfer
  - Eliminates possibility of trapped pressure
  - Low order or instantaneous flooded guns will not initiate the module/lower guns

- Reliable
  - Fewer parts and therefore fewer leak paths
  - Bottom-hole pressure not required for delay
  - Self-contained unit requiring no field assembly

- Efficient
  - Reduced BHA length and CT Rise Height
  - Time saving for loading
  - Compatible with Industry Standard Guns

- Rating
  - Delay: 6 minutes – temperature dependent
  - 400ºF/25,000psi max. for 100 hours
  - Compact 15-1/2” Long
Field results

Case Study – 2014-1,

- Location: USA
- Horizontal well, Toe initiation
- Temperatures 321-327°F
- Pressures 9,000psi to 16,000psi
- All guns shots as planned
- Maximum recorded timing error 6% out of 10 shots

The delay fuse provides a reliable temperature-dependent delay time, eliminating the use of spacers for positioning guns.
Field Results

Case Study 2014-2

- Location: Ecuador
- BTDF positioned between perforating guns and dynamic underbalance implosion chamber
- Enabled perforating and cleanup in a single run
- Increased well productivity 51% over plan

Patent Pending
QUESTIONS? THANK YOU!