

IPS 2024



IPS 24-6.4

Ultra High Pressure Considerations for Perforating Systems

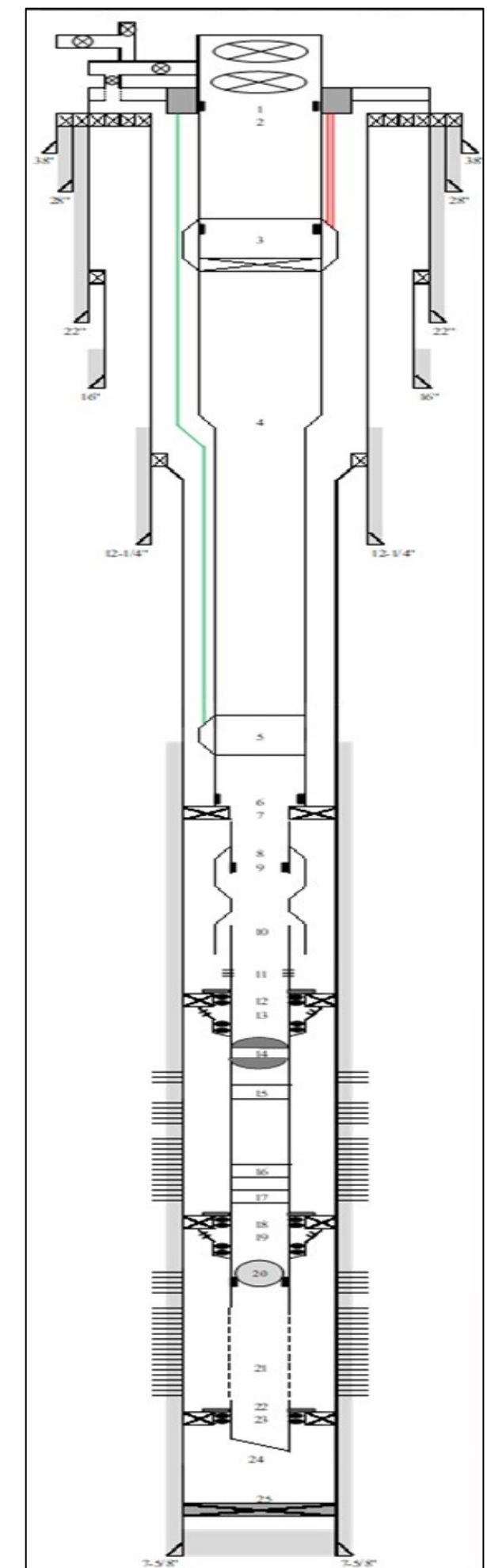
**Presented by:
Gregory Neal - Shell**

AUTHORS: Matthew Nguyen - HES, Alexander Patalakha - Shell, Cam Le - Shell, Gregory Neal - Shell, Tim Glenn - Starboard Innovations, John Rodgers - Starboard Innovations

Completion Overview

Dual-Zone Cased Hole & Perforated

- Three well campaign
- Production Casing
 - 7-5/8" 47.1# Q-125 Liner across the reservoir (6.25" Drift)
- Production Tubing
 - 5-1/2" 26.0# SM130CY x 4-1/2" 18.9# SM130CY
- 7-5/8" Production Packer
- 7 5/8" Gravel Pack System
 - Stacked completion CH&P (No Frac Pack)
 - Interval segmented into two zones
 - 4 3/4" Zinc Deep Penetrating, Reactive Liner Charges
 - 5 SPF (12 SPF on bottom of each zone)
- Fluids: 14.8 to 15.2 ppg ZnBr₂ completion fluid

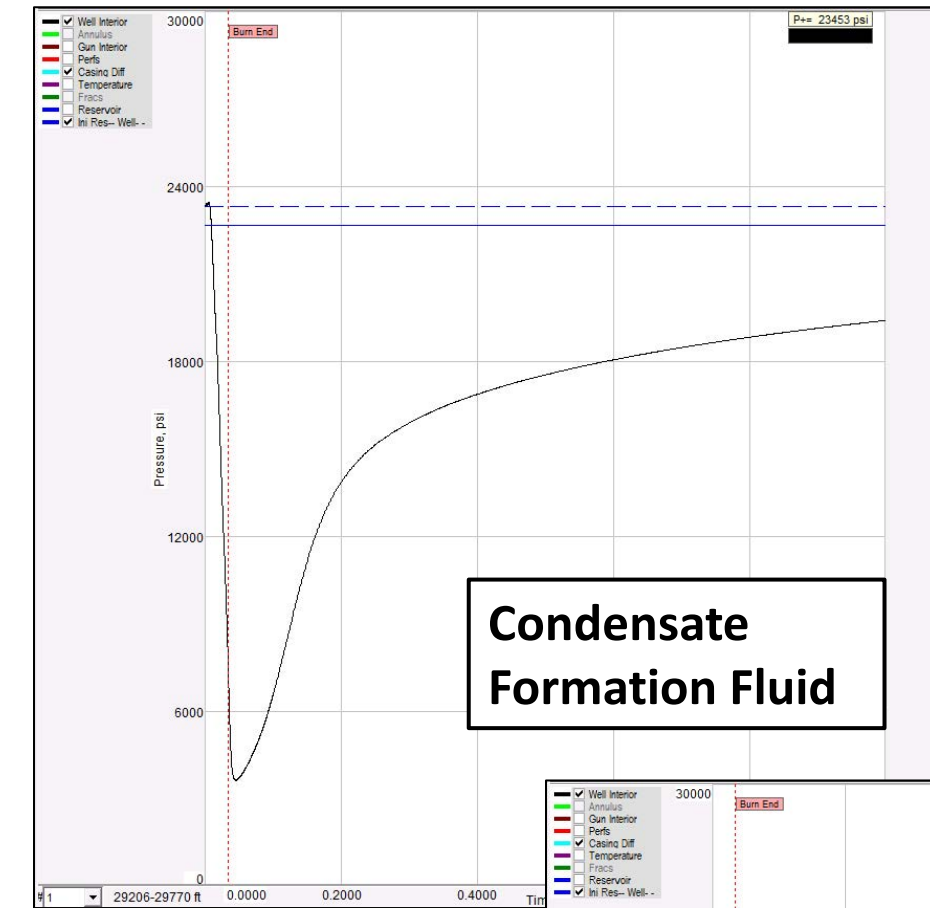


Extreme High Pressure perforating environment in 6.25" Drift

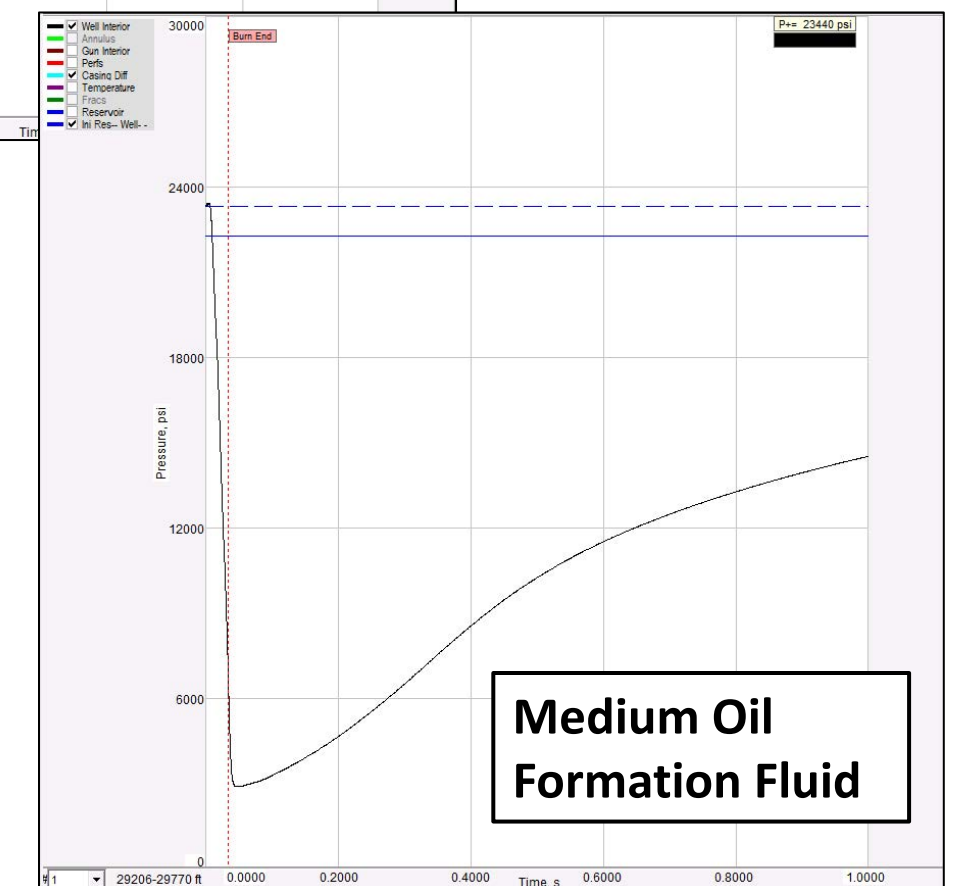
- Perforating options limited by high bottom-hole pressure rating required
- Overcoming expected drilling damage
- Mitigating dynamic underbalance/shock response
 - Dynamic Modeling
 - Pressure Isolation Devices
 - High Pressure Rated Spacer Guns
 - High Shot Density Zinc system

Pre-Job Model – Dynamic Modeling

- Initial Fluid Assumptions (Condensate vs. Oil)
- Steel gun system DUB exceeded equipment w/Oil
- Severity & Duration
- Higher DUB findings led to revision of charge type, SPF, etc.
- Criticality of results drove the need for 3D Modeling

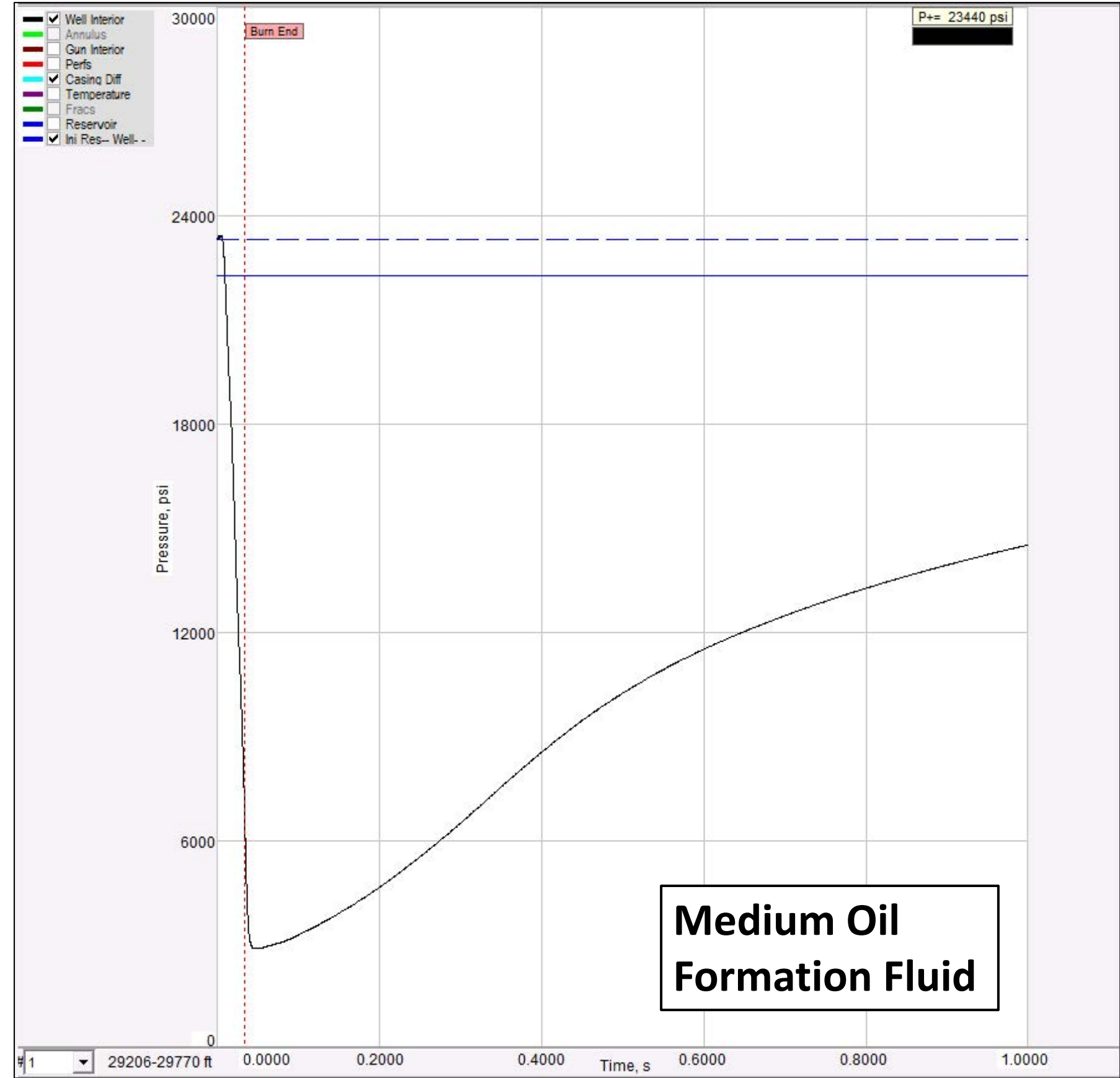
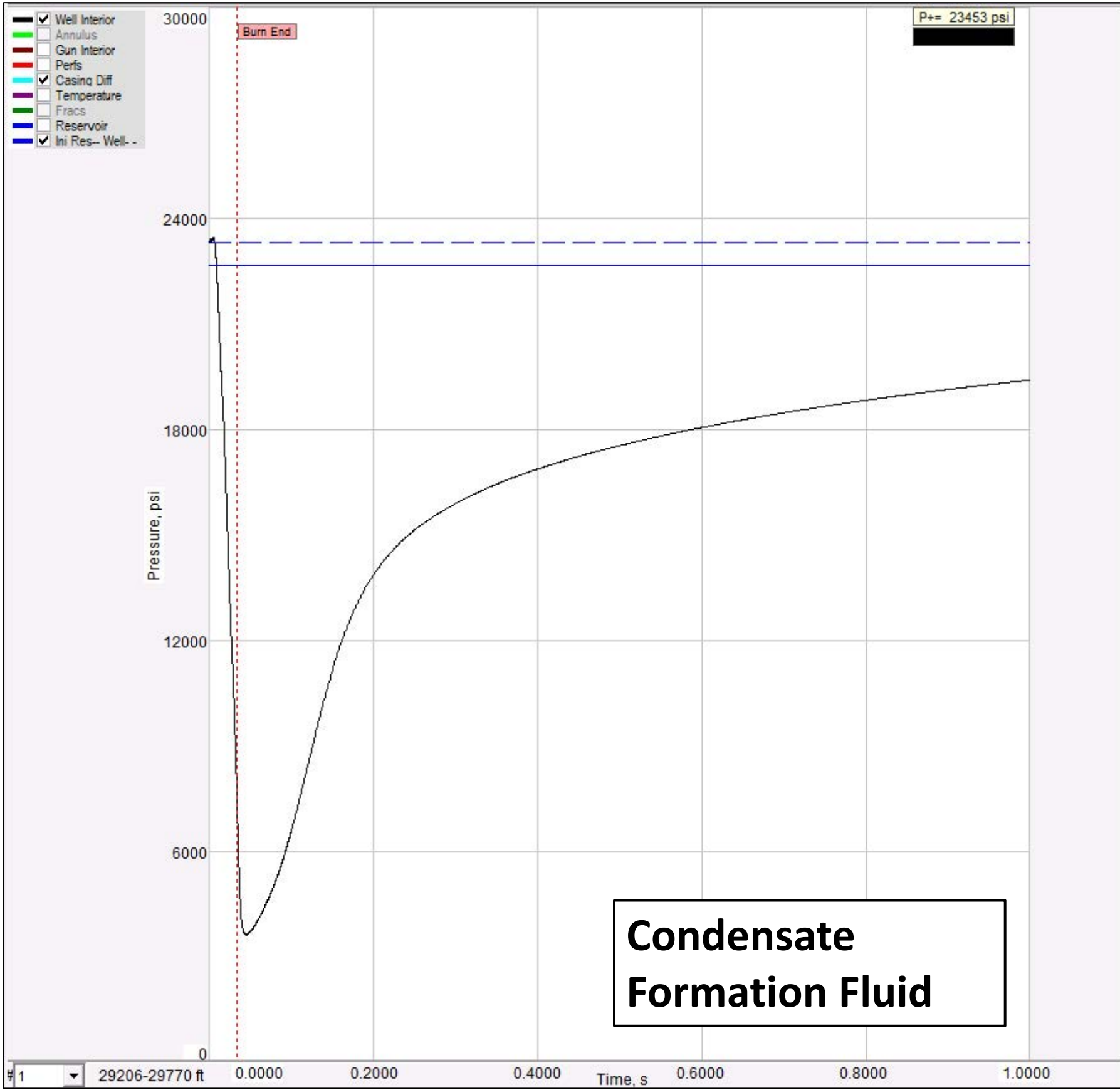


**Condensate
Formation Fluid**



**Medium Oil
Formation Fluid**

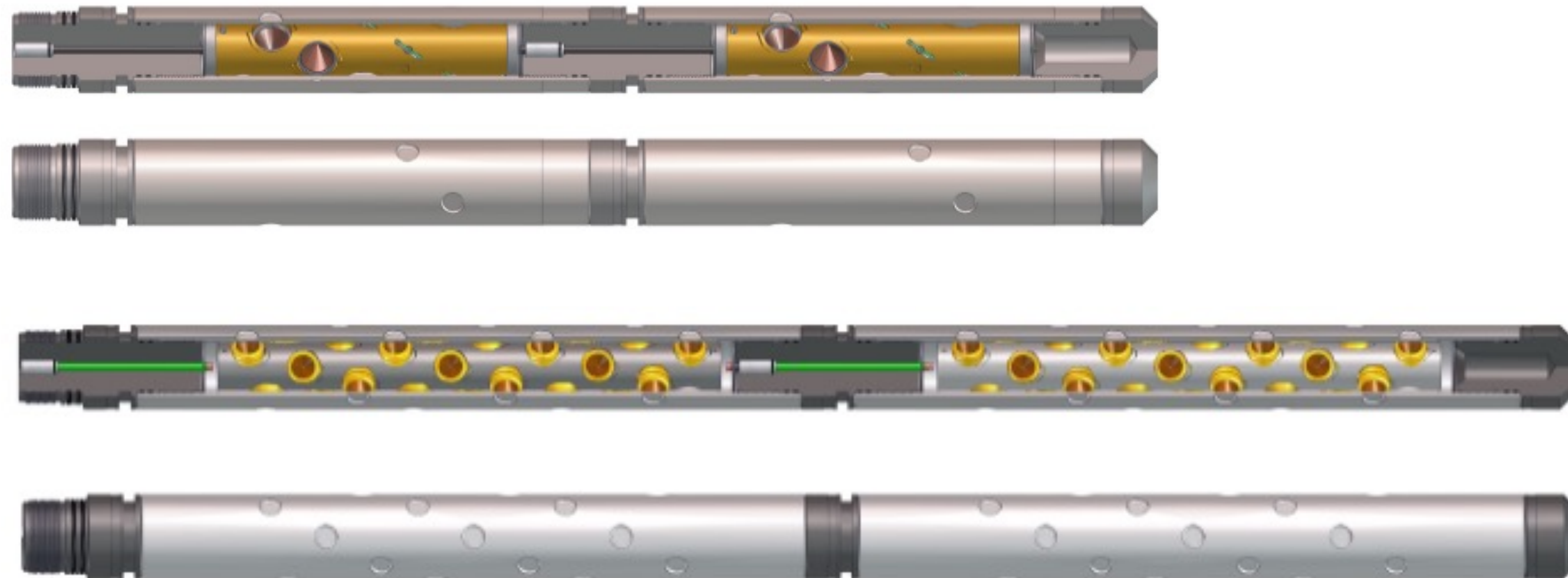
Dynamic Modeling – Pre-job



Gun System Optimizations

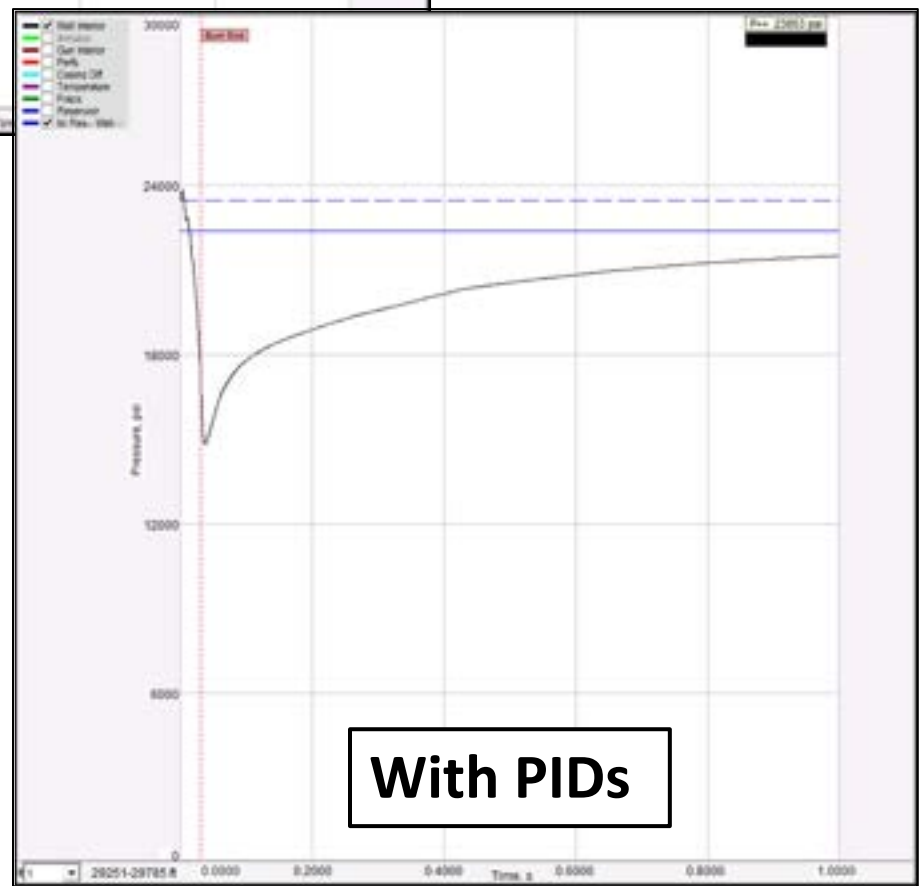
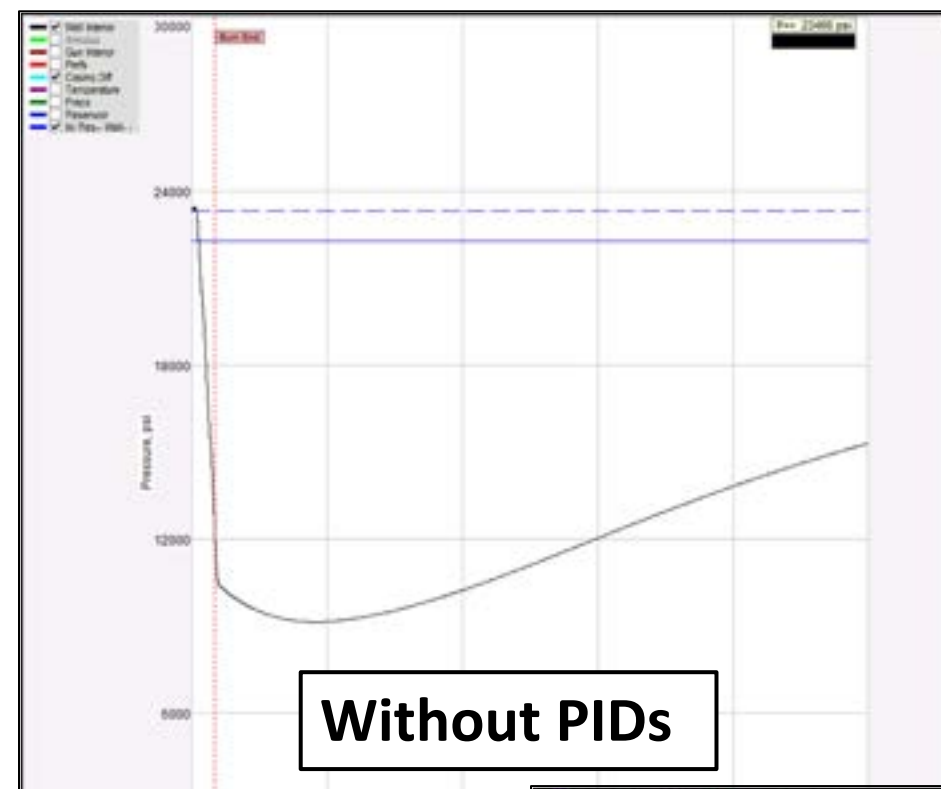
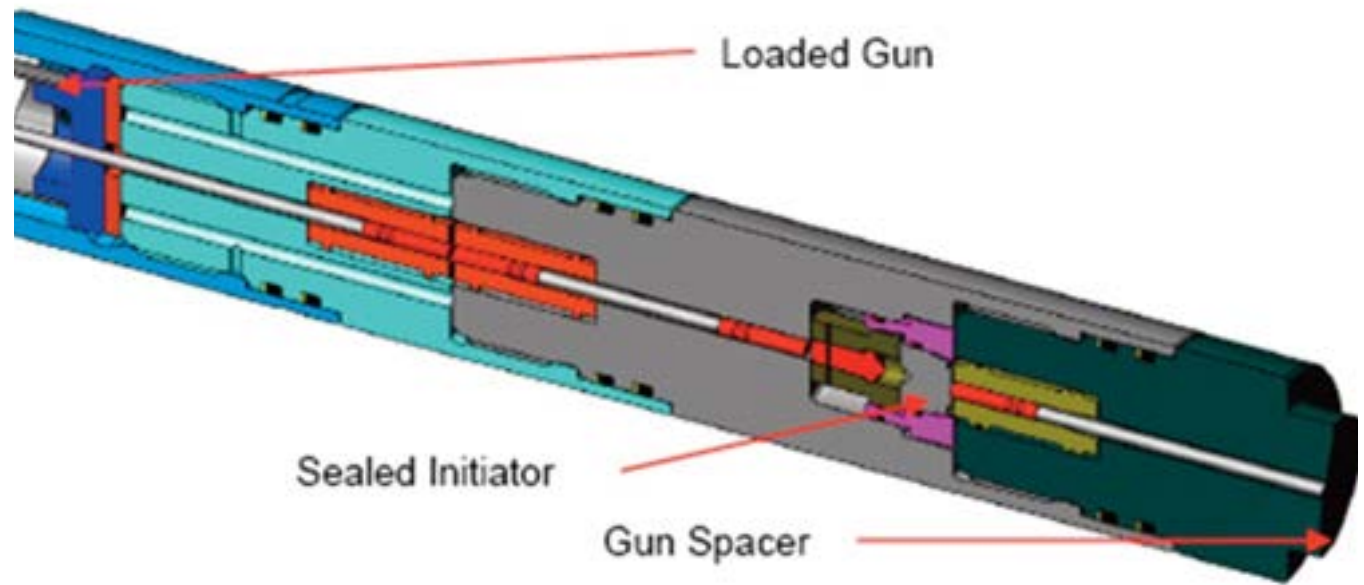
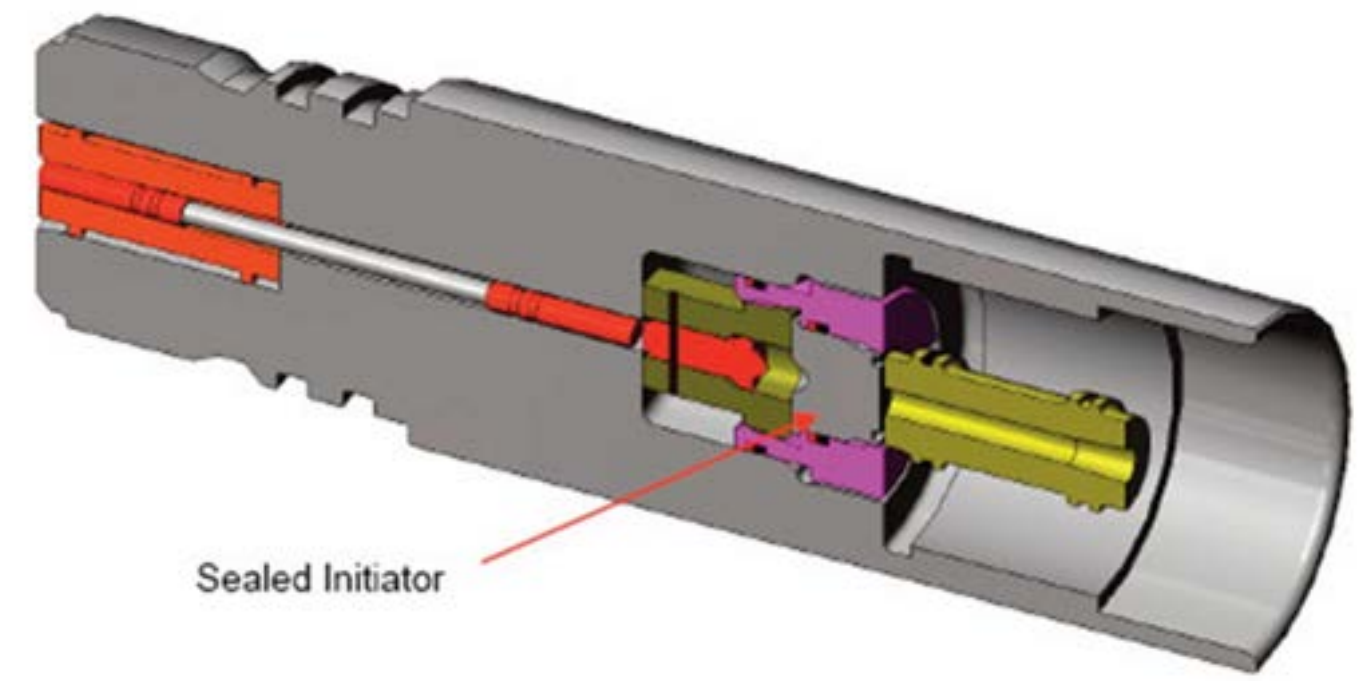
4 3/4" Gun System Modifications

- Changed to a Zinc system to reduce DUB response
- Added 12 SPF guns (bottom section, both zones) for increased Zinc density
- Switched to 4-3/4" Slickwall Spacer – High differential pressure across spacers

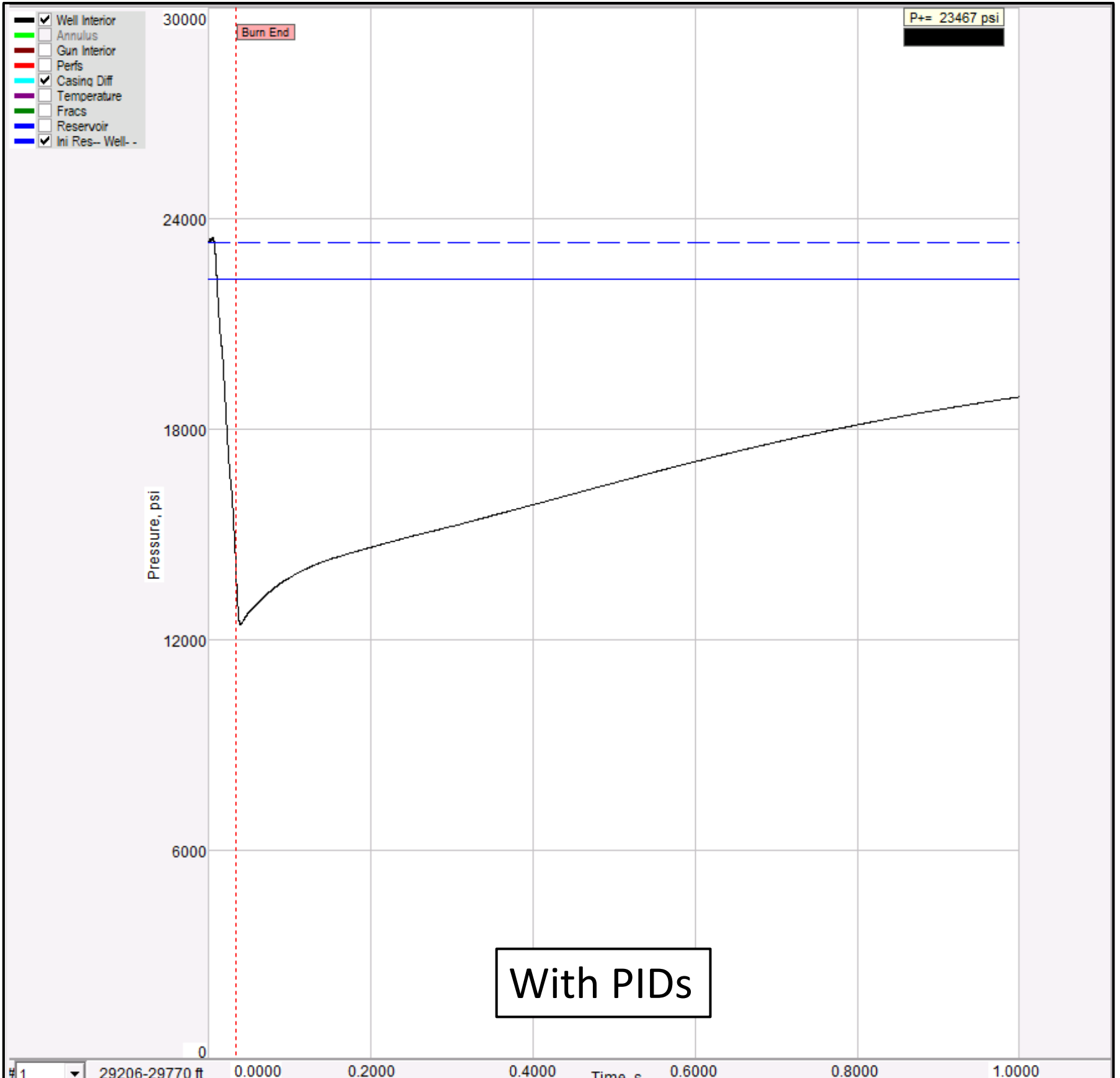
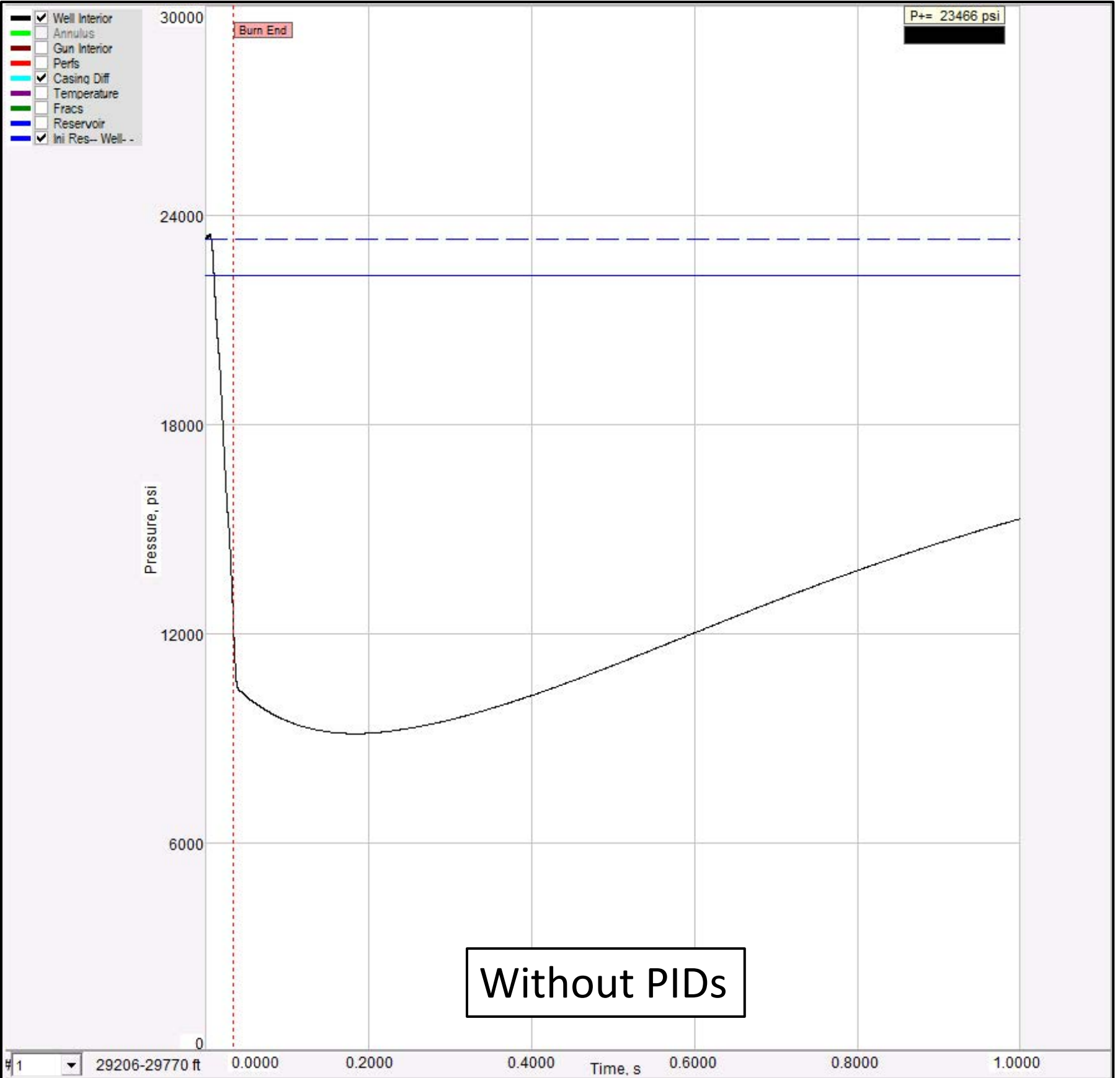


Mitigating Dynamic Underbalance Response

Pressure Isolation Device

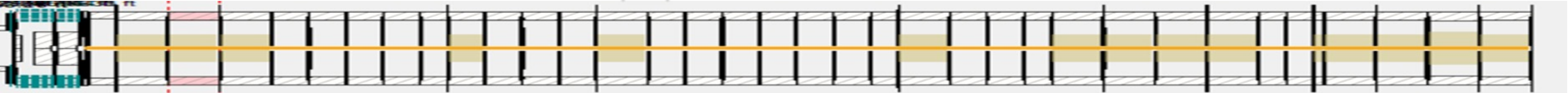
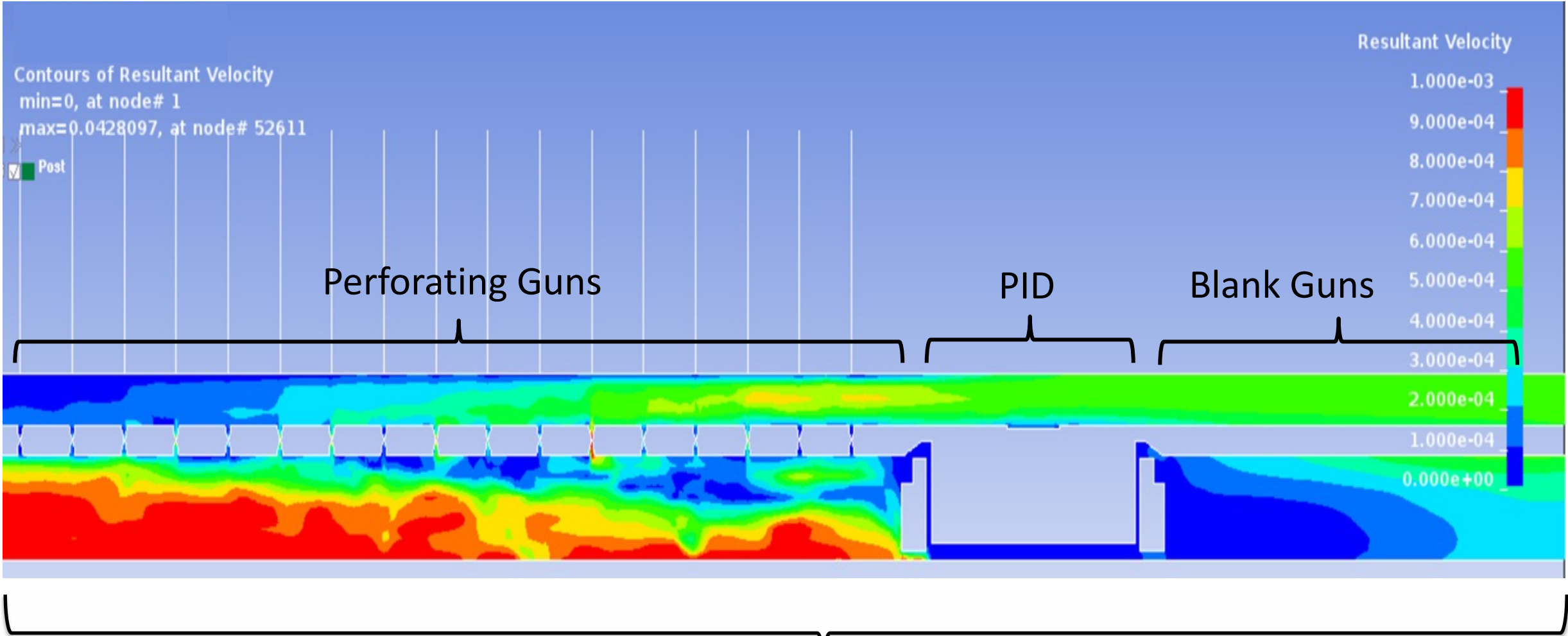


Mitigating Dynamic Underbalance Response

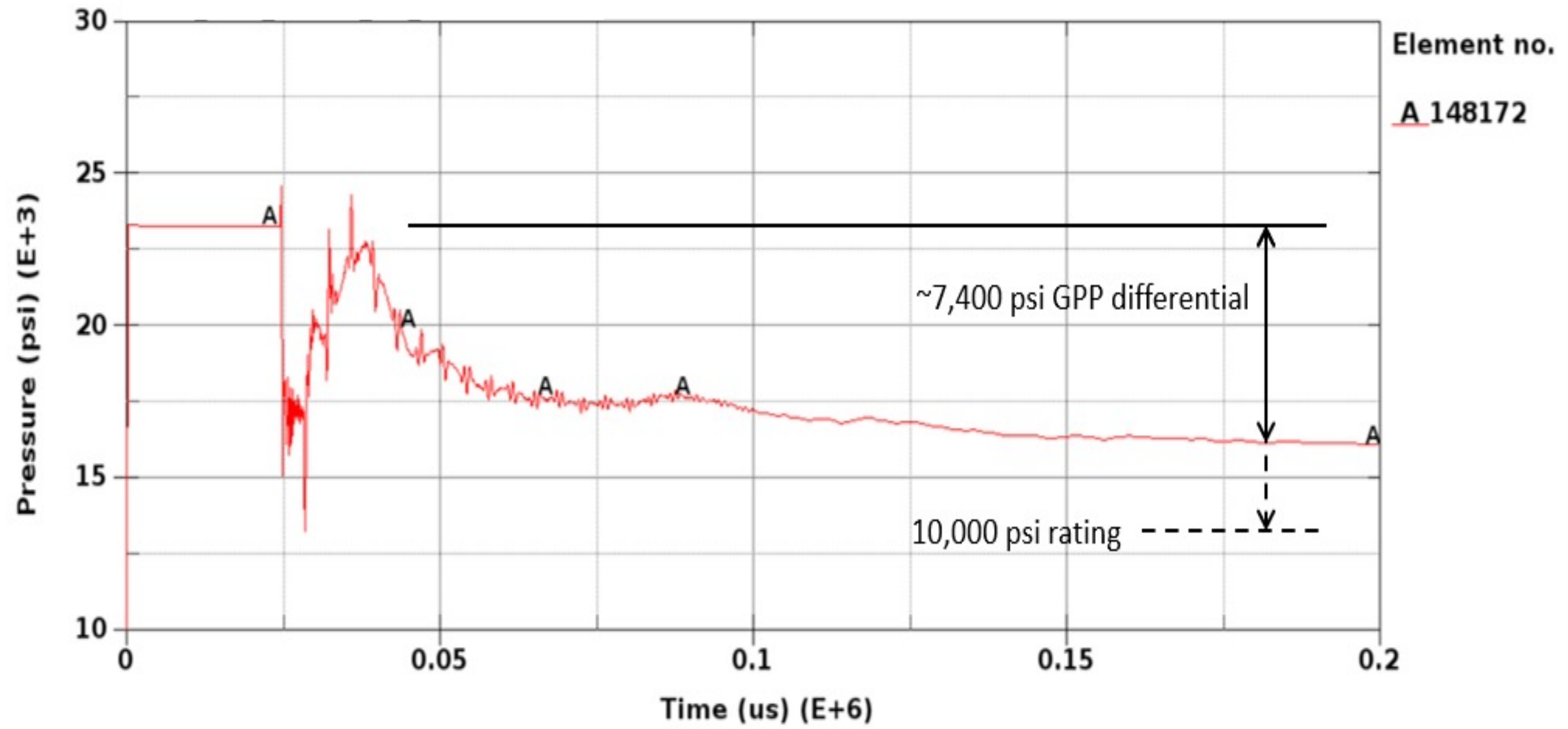


Modeling Challenges

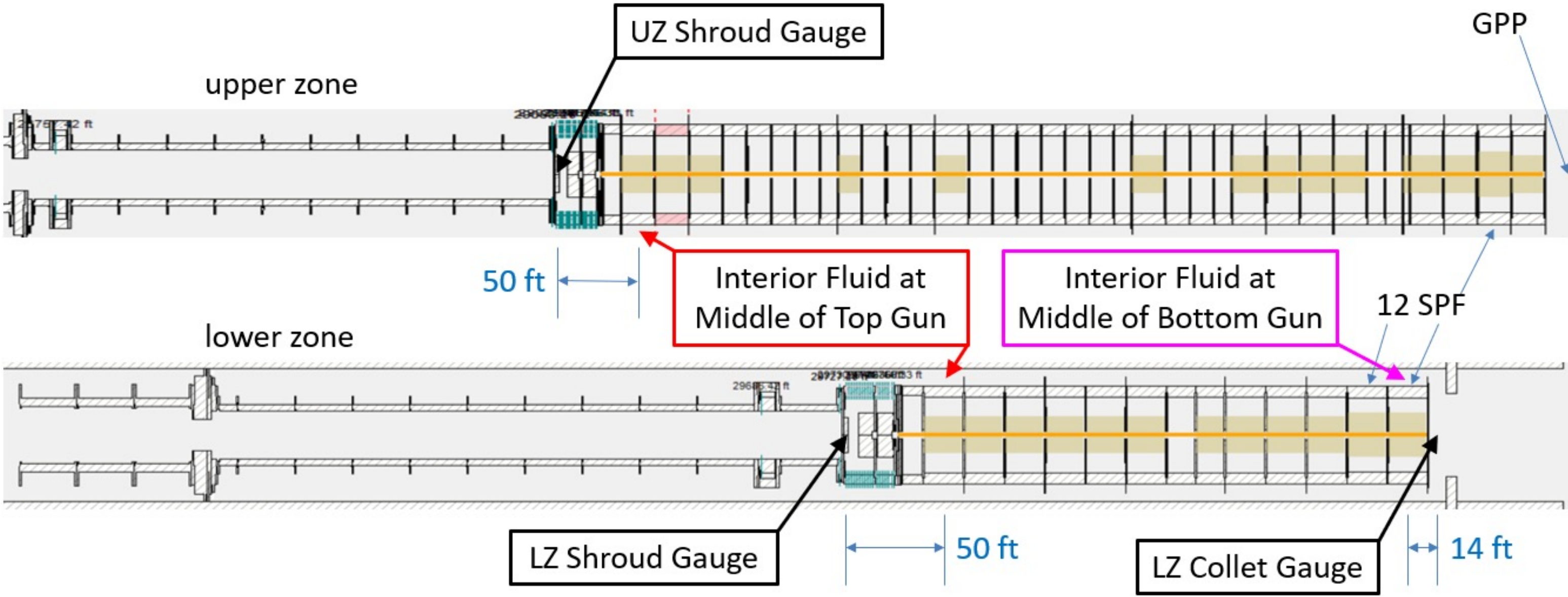
- New Zinc Gun System
- Pressure Isolation Devices
- Large Intervals
- Lower Zone Isolation Plug



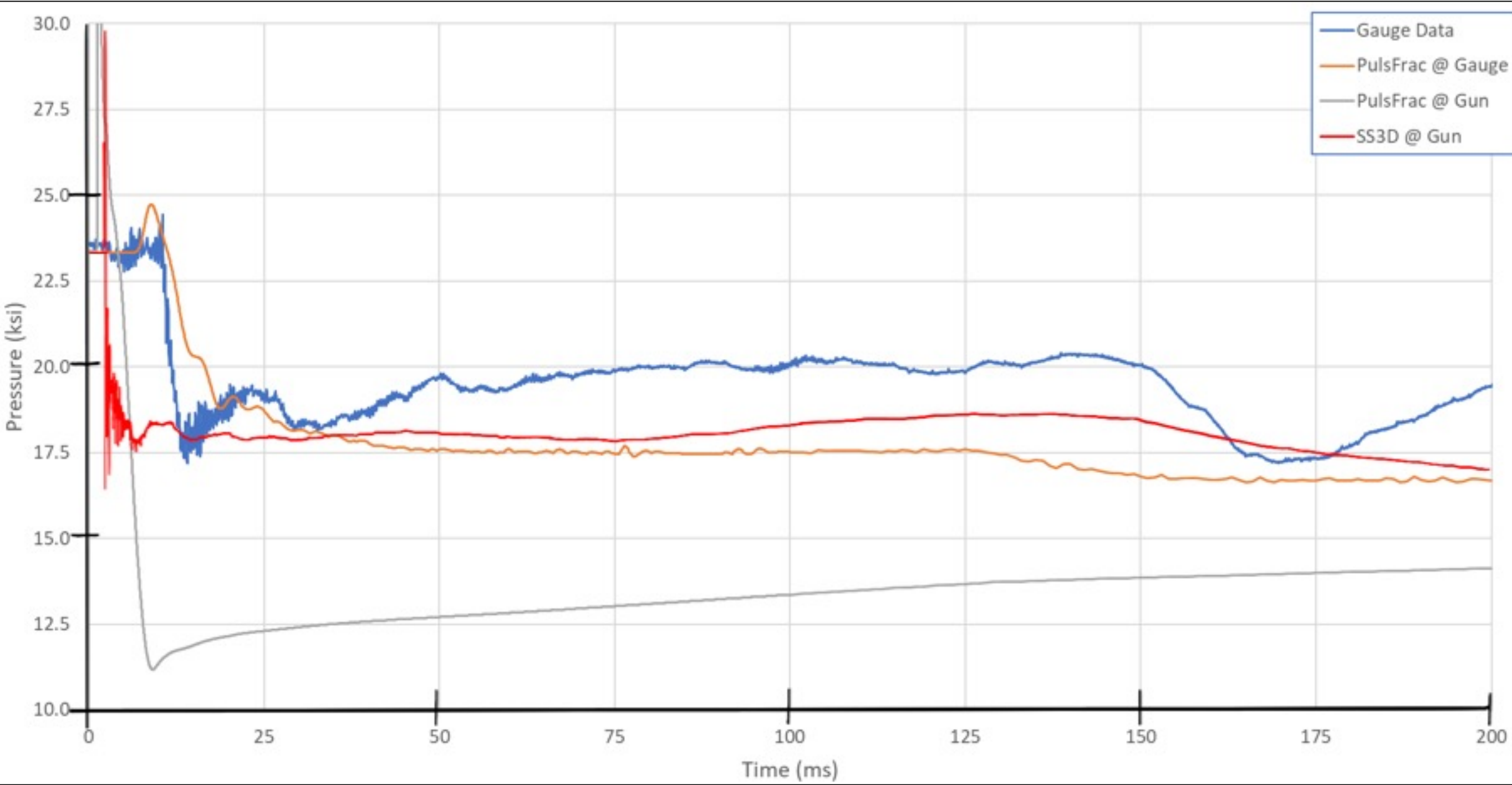
LZ Isolation Plug Differential Concerns



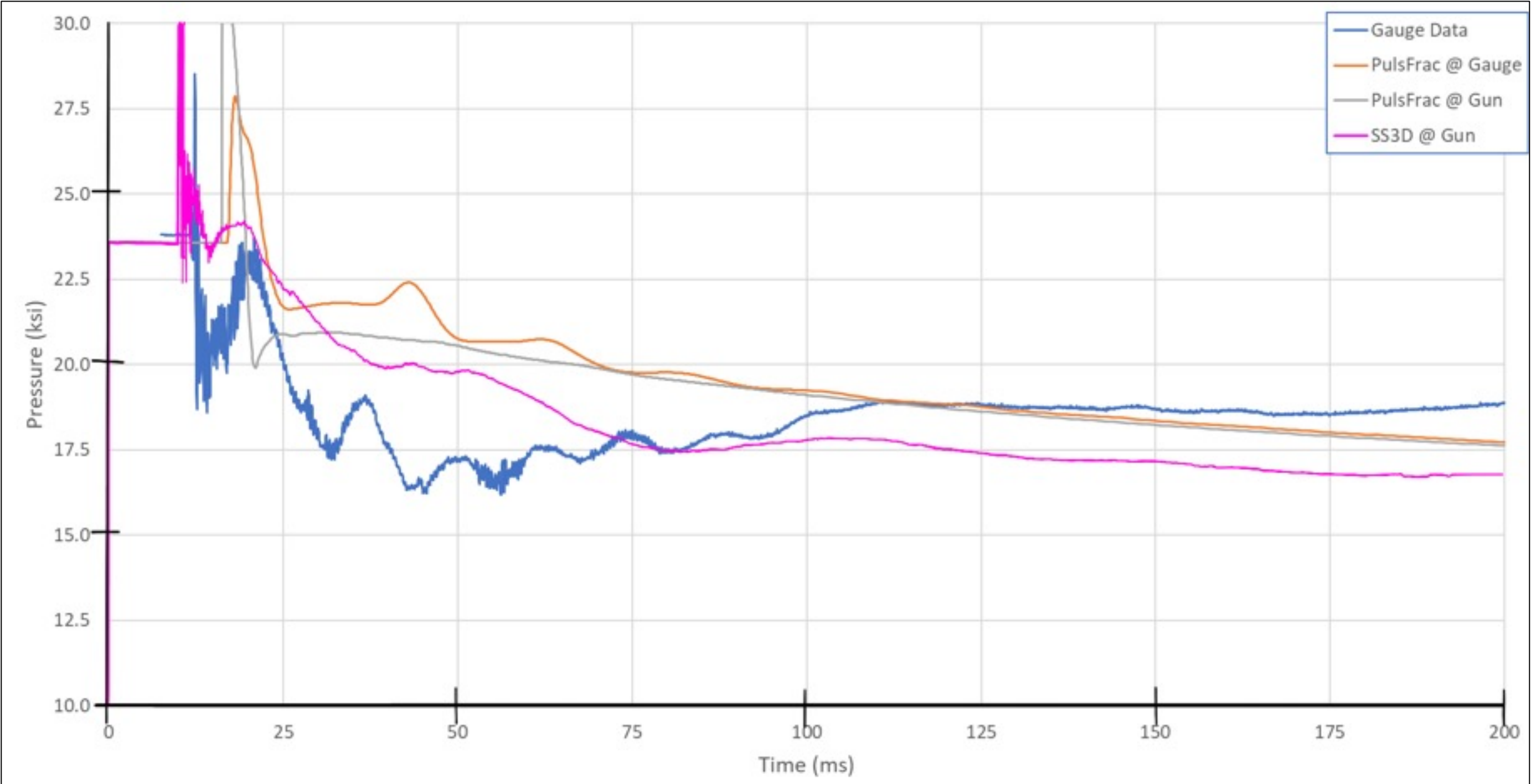
High-Speed Data Match – Gauge Location



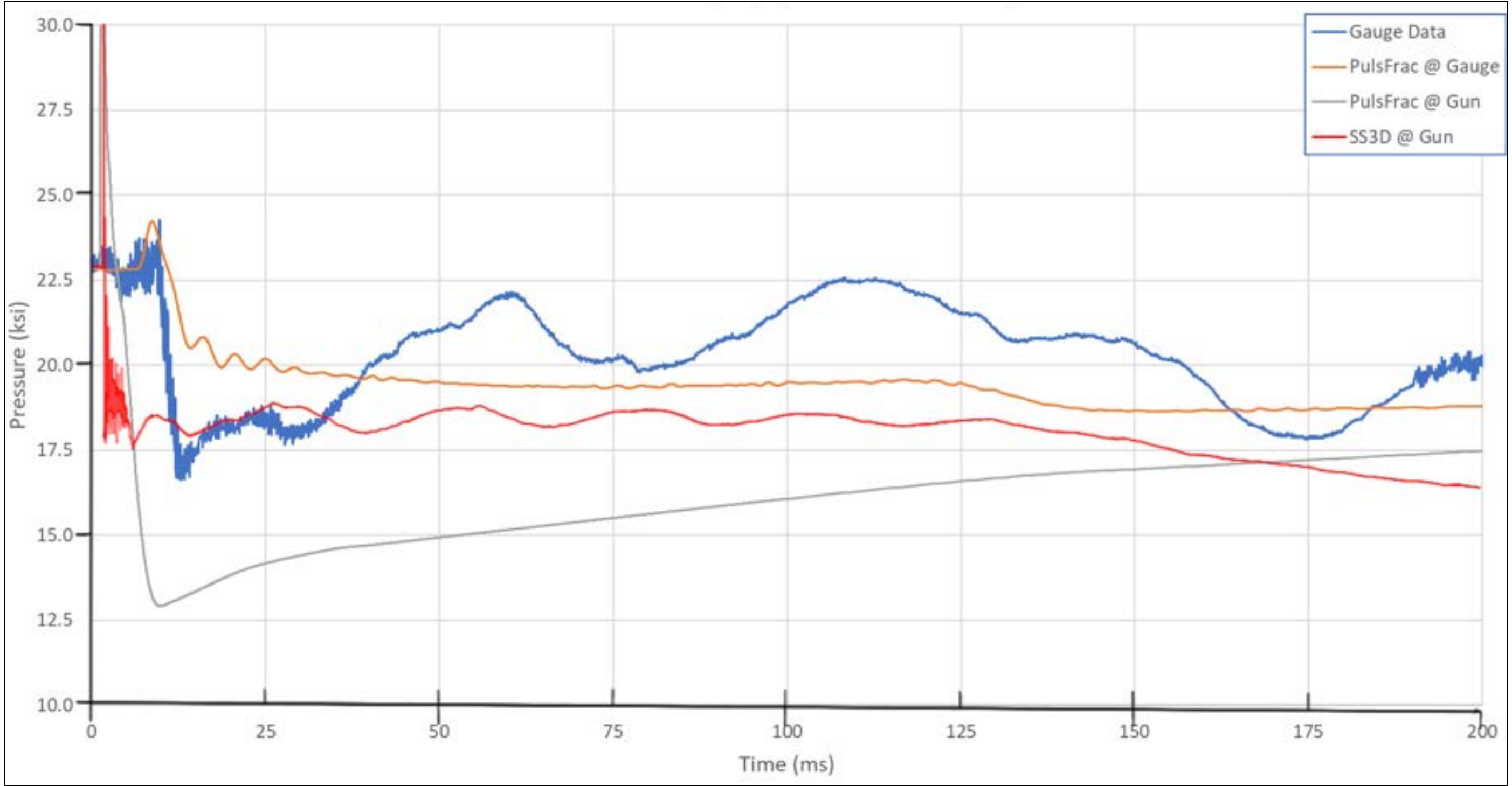
High-Speed Data Match – Overlay @ LZ Shroud



High-Speed Data Match – Overlay @ LZ Collet



High-Speed Data Match – Overlay @ UZ Shroud



Conclusions/Learnings

- Perforated first completion in July 2023
- One of the highest hydrostatic perforating campaigns performed by vendor and customer in GOM (23,600 psi)
- All shots fired successfully in both zones (all three wells)
- Modeled job using Dynamic 3D Modeling successfully mitigating gun failures & understanding dynamic responses with downhole tools
- Successful characterization of new gun system

QUESTIONS?

MAY 13-15



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