Advancing Reservoir Performance

StimGun®

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Propellants in the Completions Process

- Black powder and nitroglycerine were used in the 1860’s
  - Copper tube filled w/ gunpowder
- Technical development and commercialization of hydraulic fracturing in the 1950’s
- “Modern” oil-field propellants first came into use in the 1960’s
  - Energy release rate less than perforating event – no crushing
- US Department of Energy field work started in the 1980’s
- Modern work has led to refinements in product and process

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StimGun® Products

A family of products based upon propellant technology designed to maximize near-wellbore conductivity

Includes the propellant tools, as well as the pre-job modeling package and high speed downhole recorders

Propellant Applications

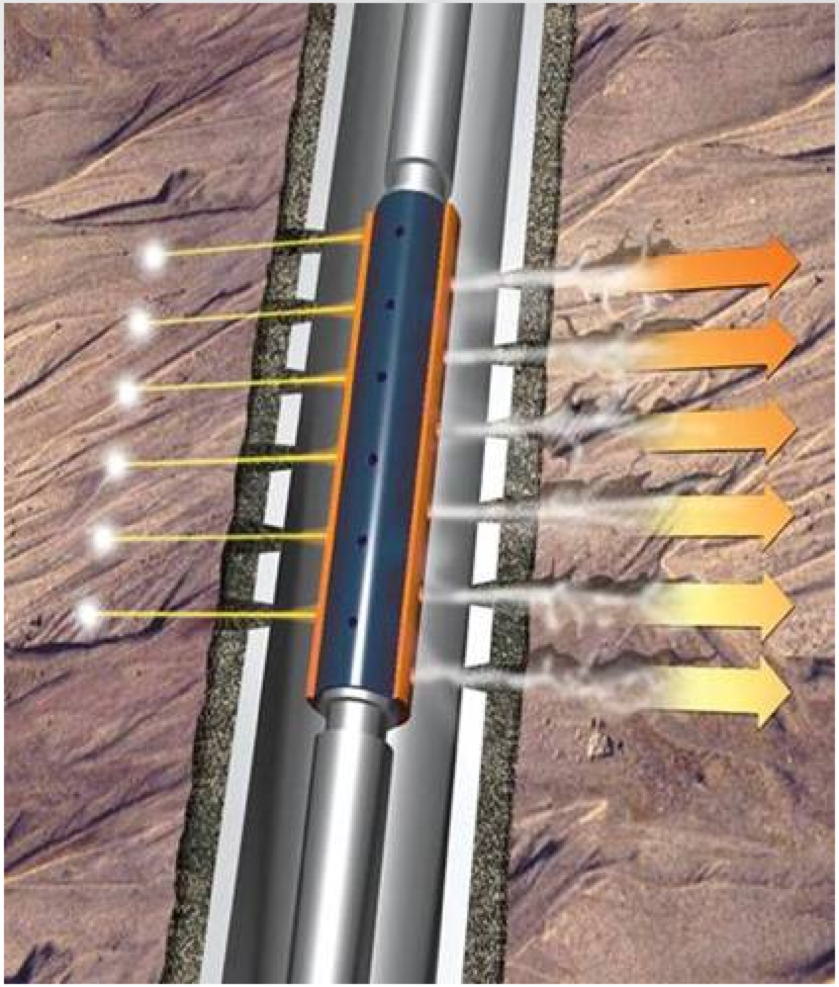
Perforation Breakdown for high injection rates and low tortuosity

- Pre-frac
- Pre-acid
- Pre frac-pack
- Injector Wells

Wells with extensive near wellbore damage

Wells with close water-oil contact, where hydraulic fracturing is not feasible

Wireline or Tubing Conveyed Perforating applications



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* Registered trade mark of the Marathon Oil Company

Not Likely Candidates

Depleted gas wells

- <1500 psi formation pressure

Wells that have been previously acidized or multiple re-perfs already

- The well is a "dog" to begin with

Old wells of unknown history or documentation

Wells with bad cement or poor casing

Wells that cannot support the needed fluid column

Oriented perforations (applies to the StimGun® assembly only)

Small tubing/ big casing (for through-tubing applications)

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PulsFrac™ Software

Physics-based, finite difference modeling software package

Simulates dynamic downhole events and reservoir activity during the perforation event

Field tested and optimized over a 15 year period

Verified using high speed gauges

Purchased by Baker Hughes 2008

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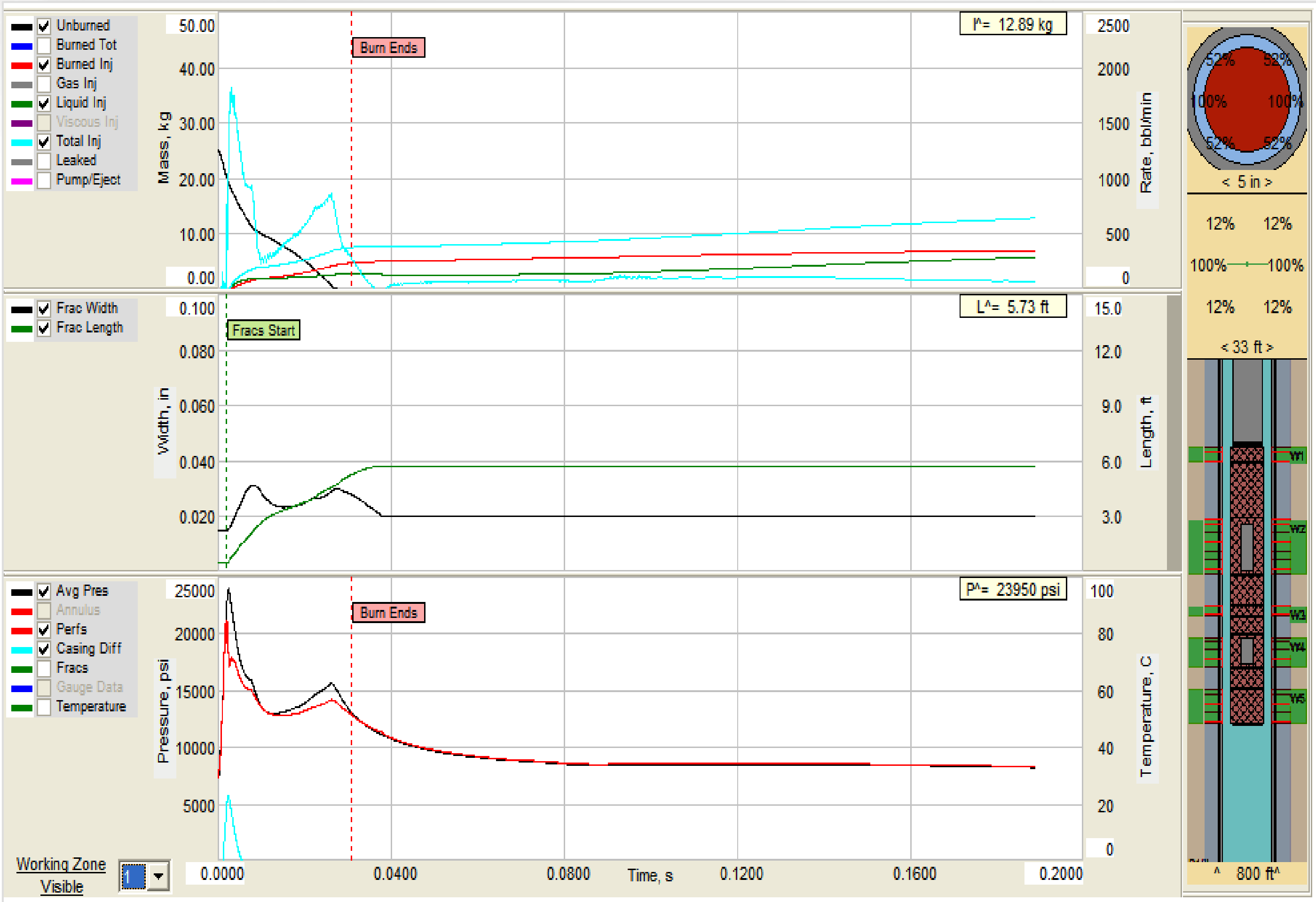
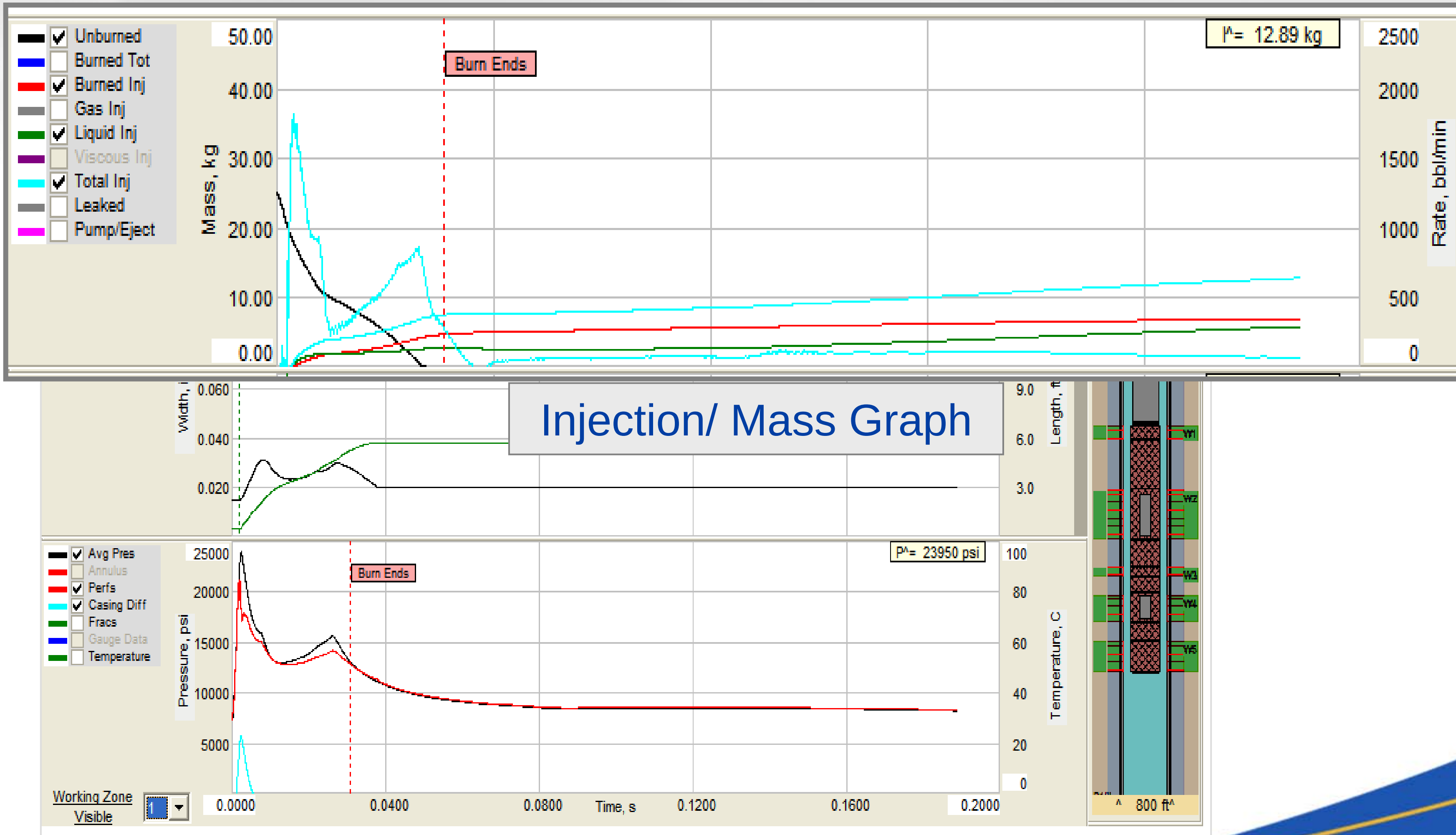
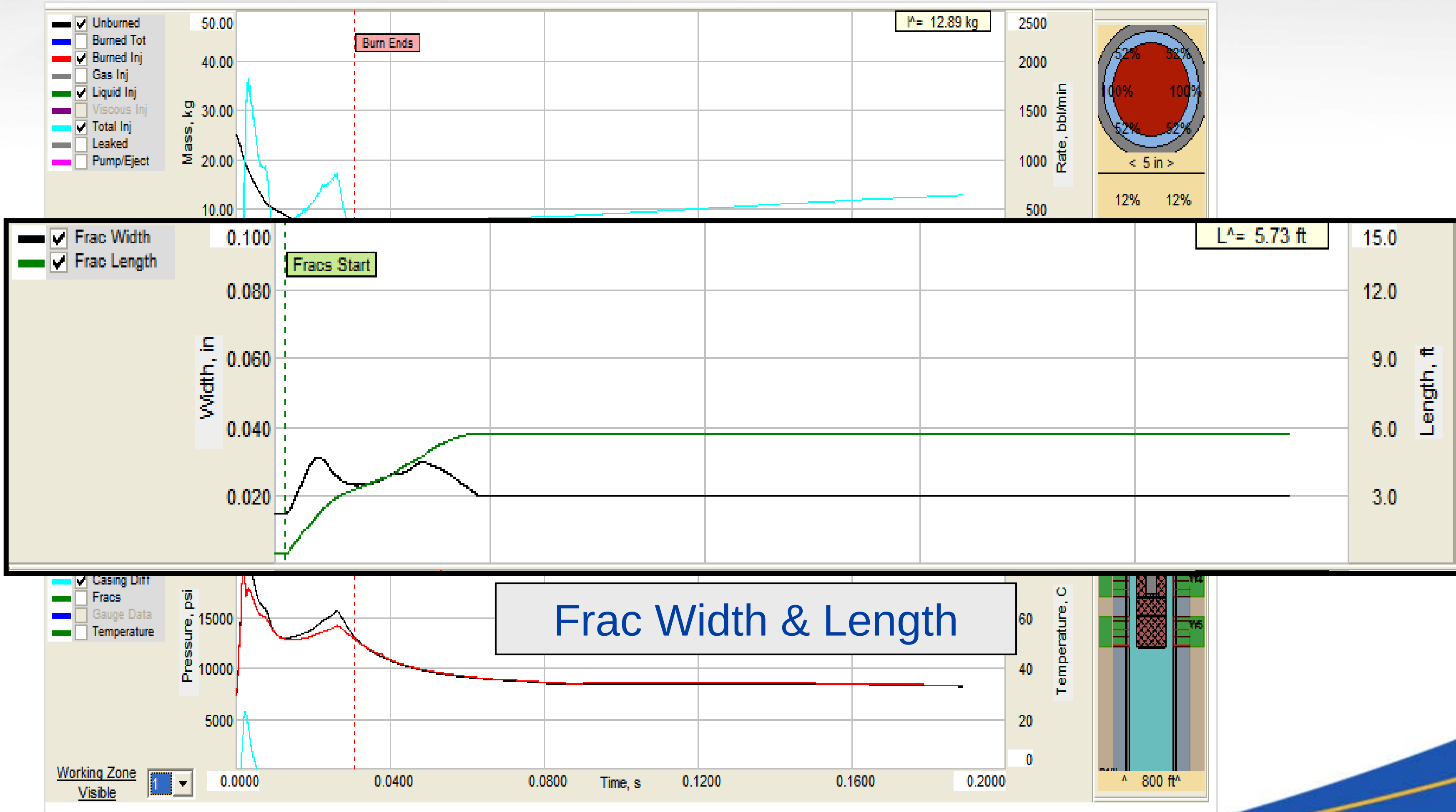
PulsFrac Report



PulsFrac Report



PulsFrac Report



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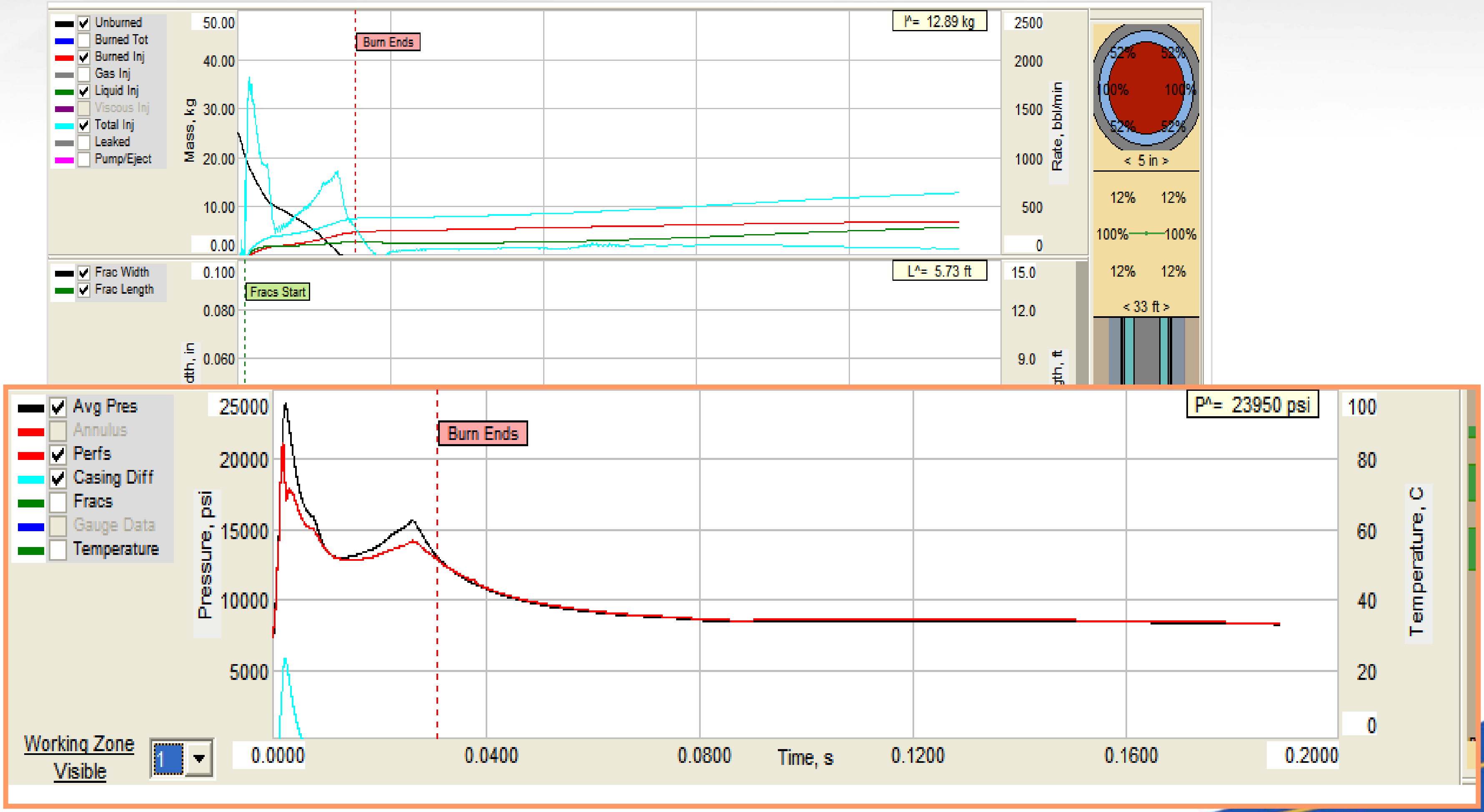
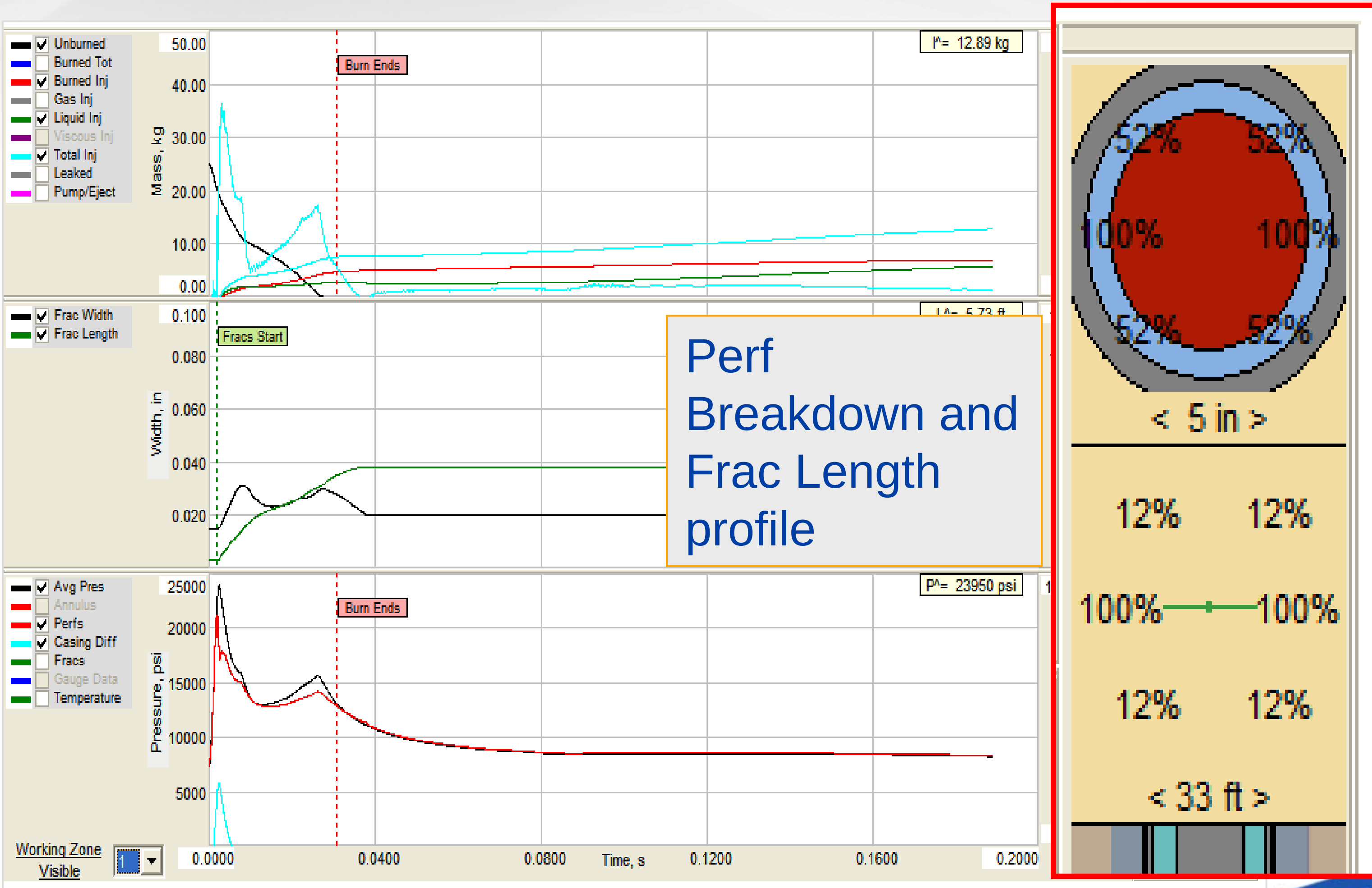


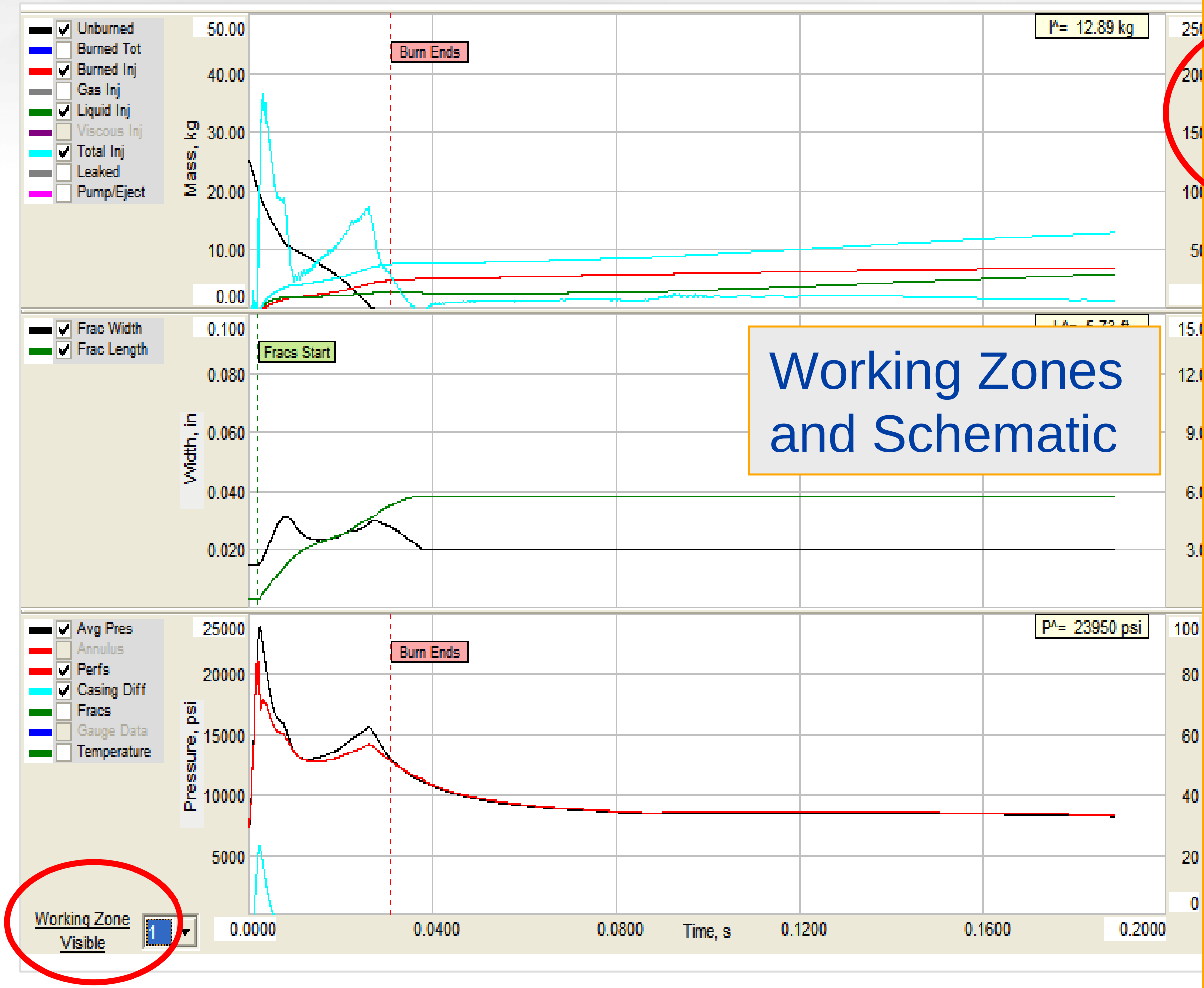
Wellbore Pressure

PulsFrac Report

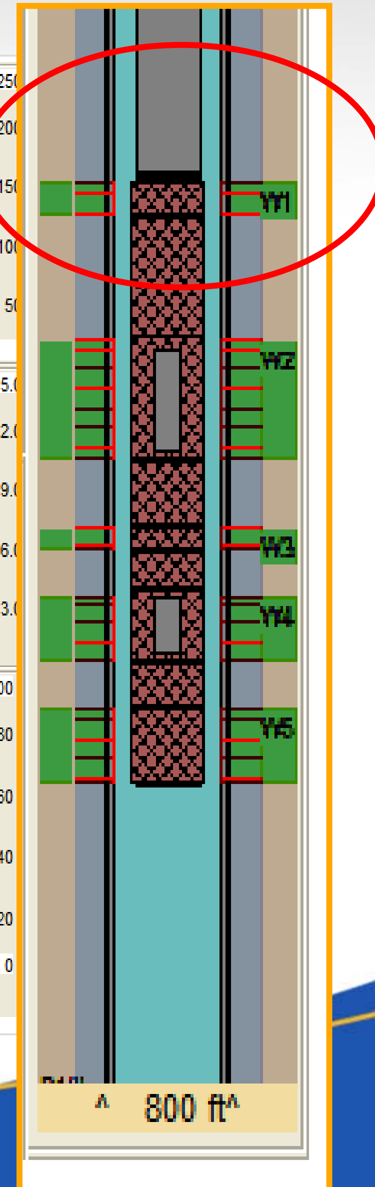


Perf Breakdown and Frac Length profile

PulsFrac Report



Working Zones and Schematic



Why Use PulsFrac?

Dynamic behavior is NOT intuitive

- For example, peak pressure almost always occurs well before burns end

Job design using software allows rapid job optimization and more reliable risk reduction

- Select tool type, size, and location for best breakdown and fracturing results
- Optimize liquid type and level
- Avoid excessive casing loads
- Avoid excessive equipment loading and motion

Job results interpretation allows for better future planning

- Especially if high-speed recorder data are available

The quality of calculated results, however, is no better than the quality of input (GIGO)

Best Practices and Requirements

Applicable to the StimGun Products

RIH max 200 feet per minute

Min 4 SPF spiral type pattern

Must have fluid around the propellant assembly

- +/- 750 psi hydrostatic

Best practices regarding distances:

- 100 foot air cap below wellhead
- Min 15 foot distance from PBTD
- 20 foot cement on top of BP
- Min 80 foot distance below packer

Use at least N-80 tubulars (recommend P-110) for TCP applications

Each job must be modeled before running

- Extensive field experience similar StimGun Assemblies may be acceptable

Subs must have centralizing fins

StimTube® and Wellbore Stimulation Tool® (WST) not practical for TCP applications

- Wireline applications only

StimGun Products

Thank you for your attention!

