

**HALLIBURTON**

# AI in the Frac Space

Des Murphy

Business Development Technology Manager

Canonsburg, PA



# “We Move At The Speed Of Safety”

Did you know efficiency doesn't mean speed or cutting corners?

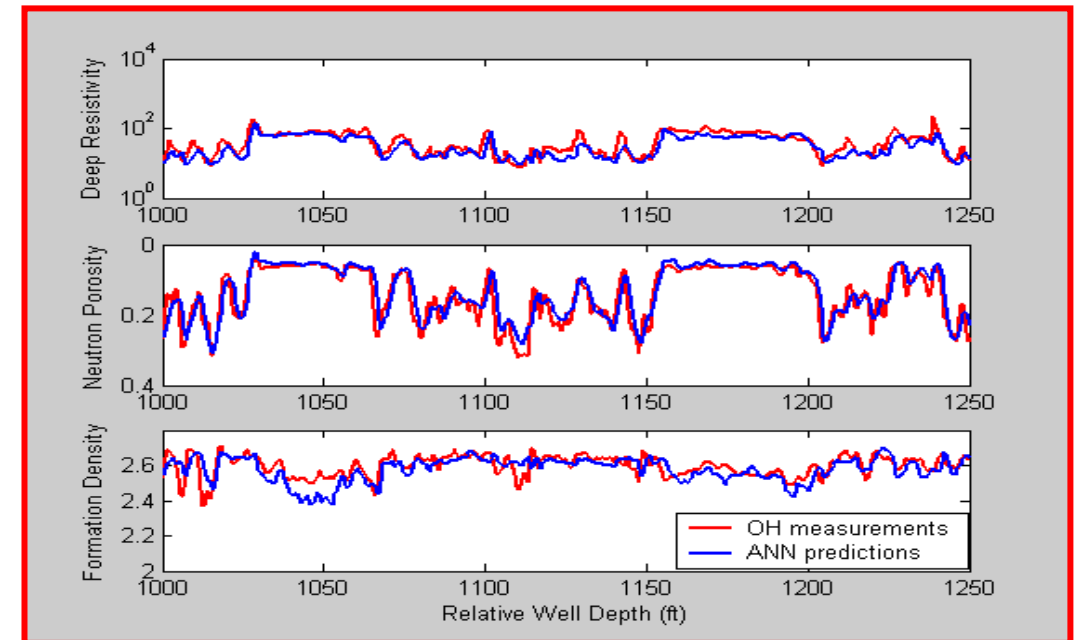
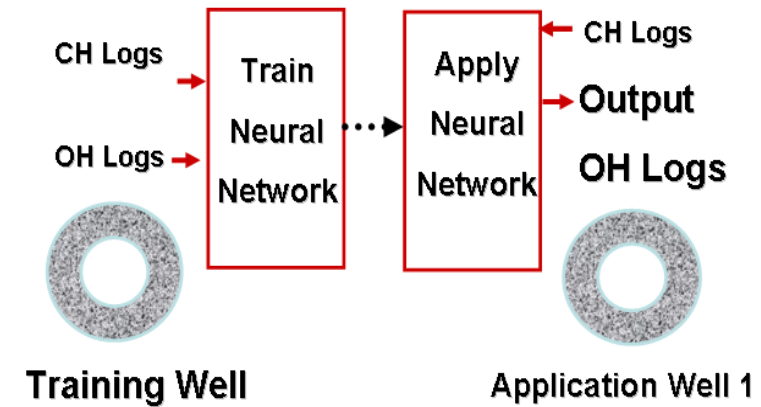
- Efficiency is **planning** for the next task
- The more the task is planned, the smoother the task goes, the more efficient the task is completed
- Never skip process or compromise safety to save time
- When in doubt use **stop work authority**



# Initial forays into AI/ML

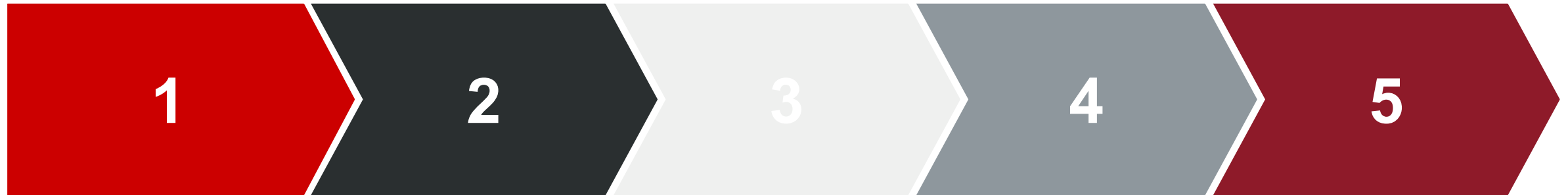
## ■ CHI MODELLING

- Predict Open Hole Data
- Hazardous Open Hole Logging Environment
- Identify bypassed Pay Zones
- Reconstruction for Missing and/or Bad Data
- Need For Accurate Porosity & Resistivity



# Survey

- How well do you know frac?



- Never heard of it

- “Hydraulic fracturing is a well stimulation technique in which rock is fractured by a pressurized liquid

- Some frac-related work experience
- Walked around a frac location

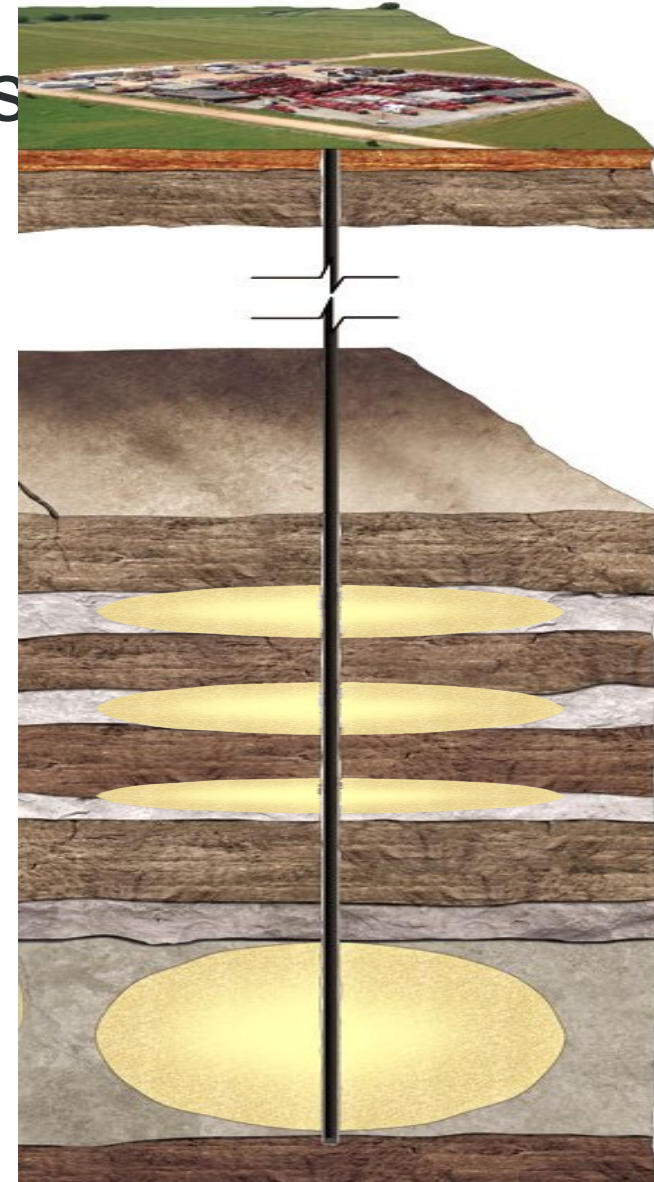
- Direct frac engineering or operations experience

- “SME”
- Technical Papers



# Conventional Fracturing: 1960's – 1990's

- Widespread use in US onshore wells
- Larger jobs continued to yield production gains
- Low permeability (<0.1 mD) gas-saturated sandstones required large jobs to be economical
- Bi-wing fracture

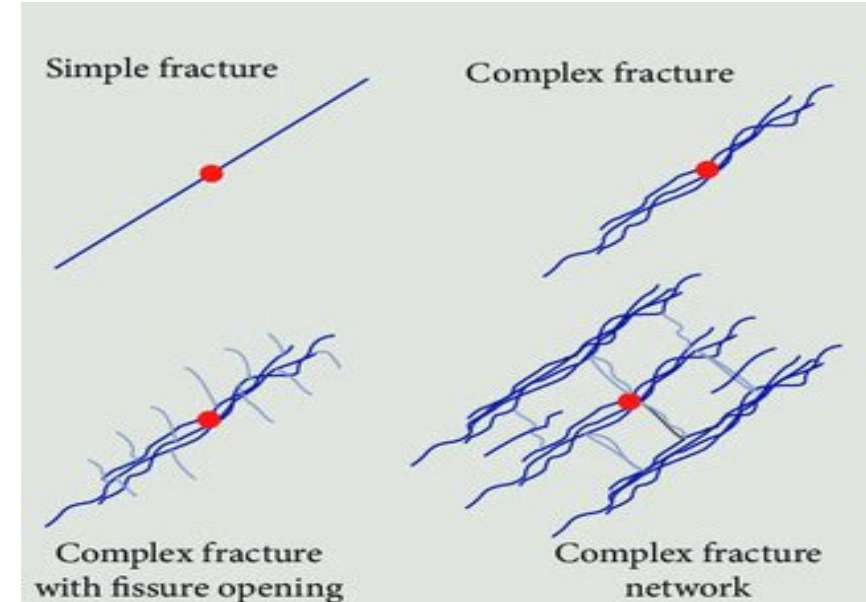
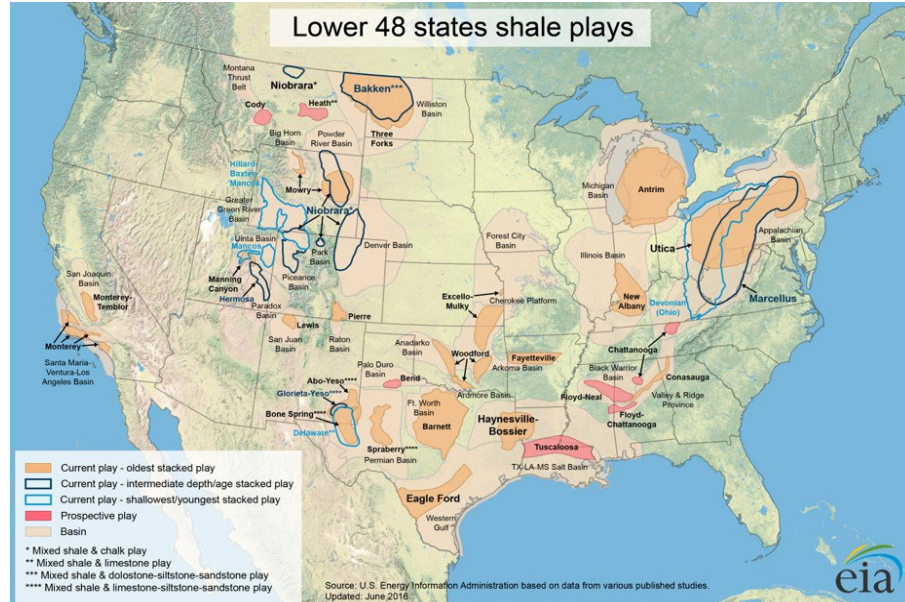


# The Shale Revolution: 2000's - Now

- Horizontal drilling and multi-stage hydraulic fracturing
- Mitchell Energy in the Barnett Shale
- New take on frac theory
- New approach adopted in multiple basins



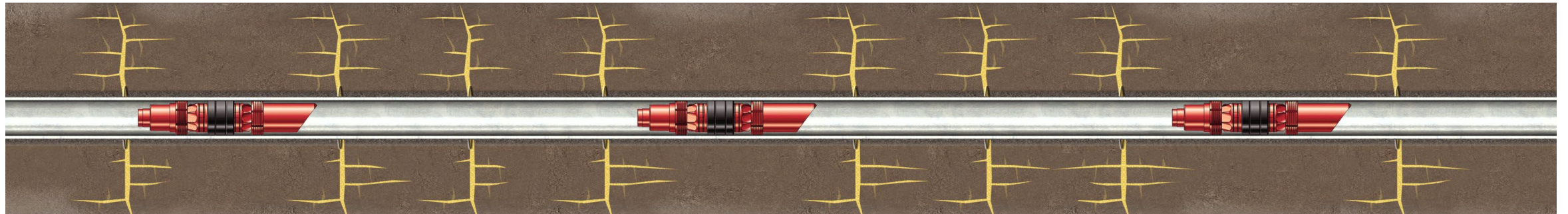
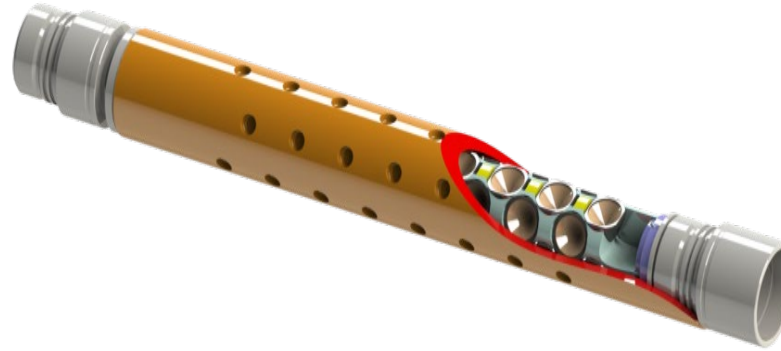
Source: Fort Worth Star-Telegram





# Plug & Perforating Process

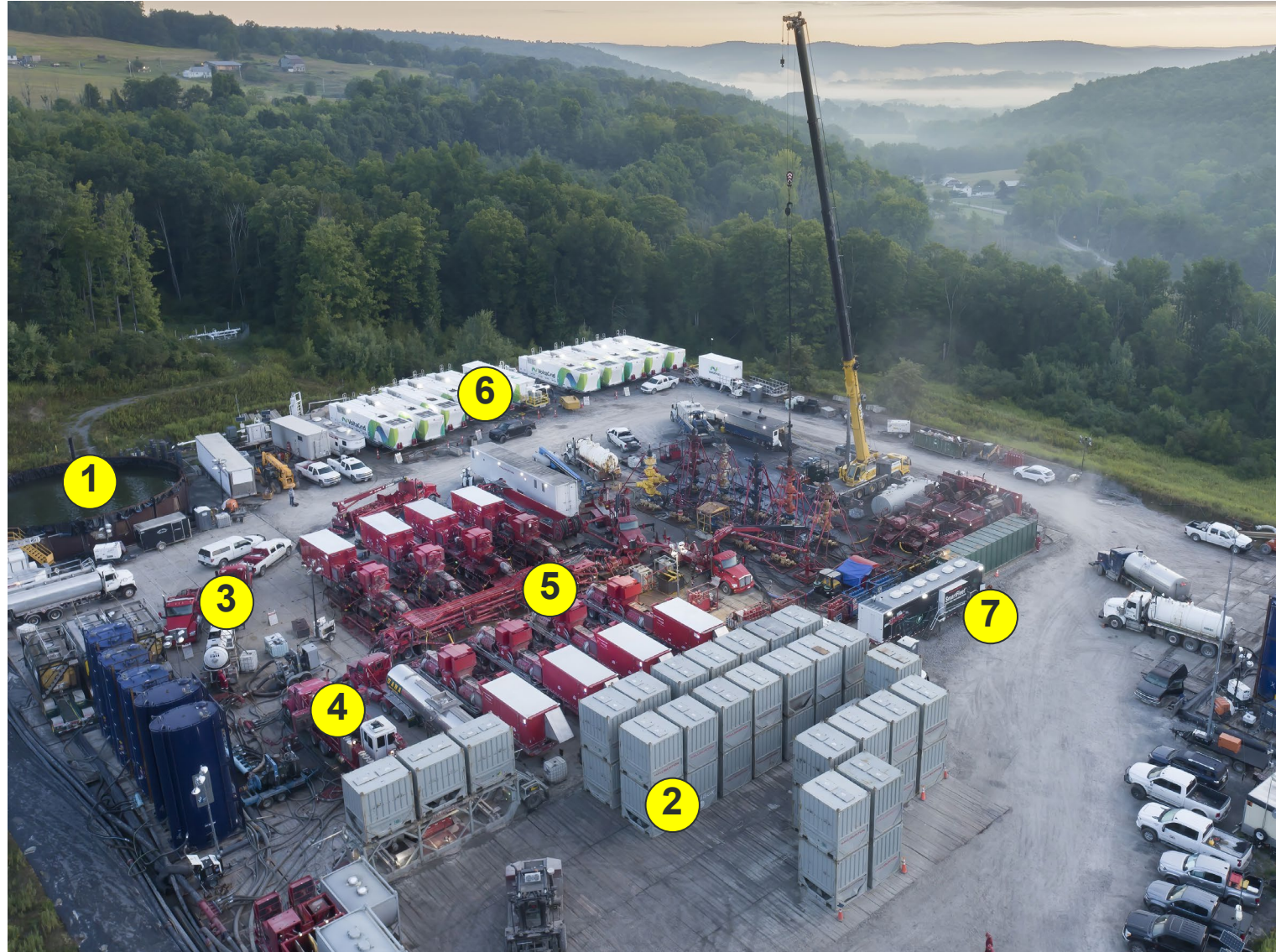
- 1) Pump Down Plug & Gun Assembly
- 2) Set Plug on Depth
- 3) Pull Back to Perforation Depth
- 4) Fire Perforation Cluster
- 5) Perforate at Additional Cluster Depths
- 6) Pull Out of the Hole
- 7) Pump Treatment & Repeat





# Hydraulic Fracturing – At the Surface

1. Water Storage
2. Proppant/Sand Storage
3. Chemical Storage
4. Blending Plant
5. Hydraulic Horsepower
6. Power Generation
7. Technical Command Center



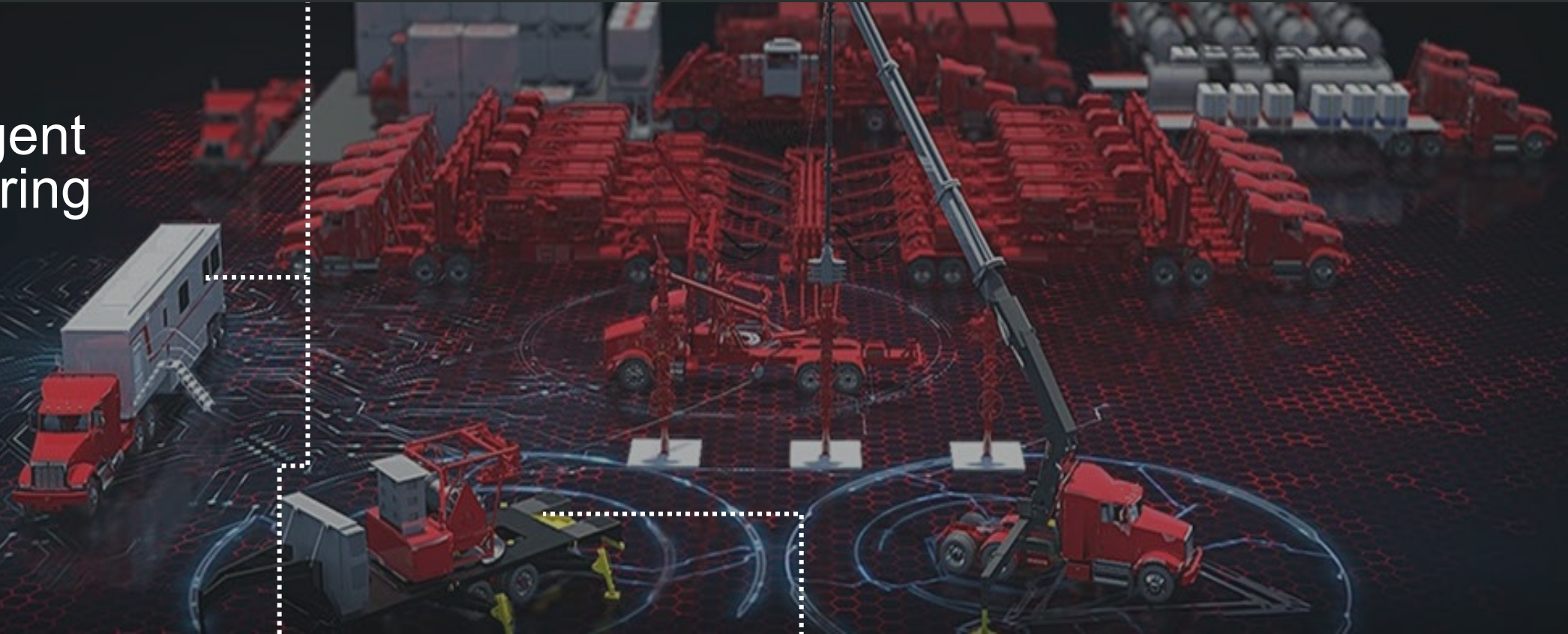


**Standard**



**Octiv Controls**  
Supervised Equipment Controls

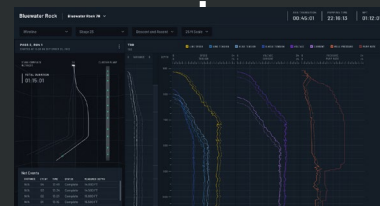
**Intelligent  
Fracturing**



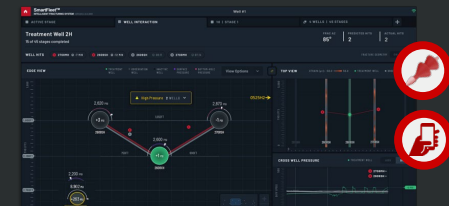
**Plus**



**Octiv Autofrac**  
Automated Job Delivery

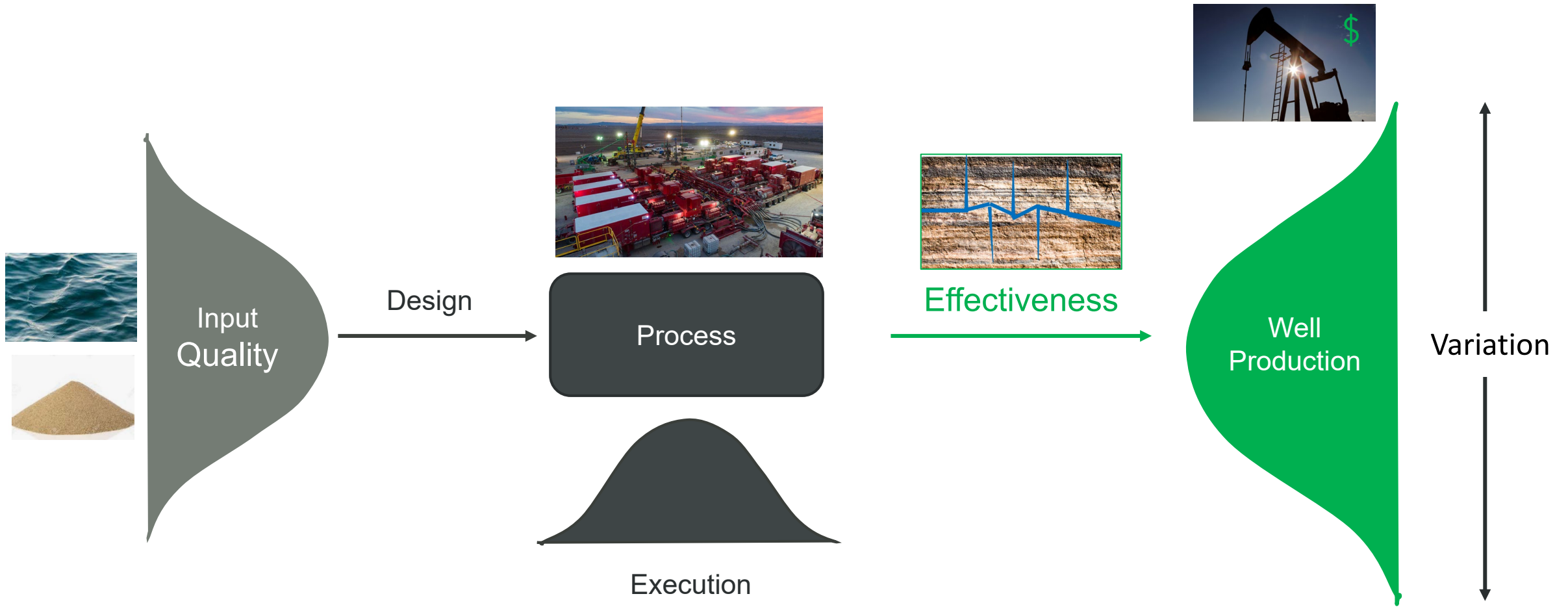


**Octiv Auto Pump Down**  
Automated Gun Delivery



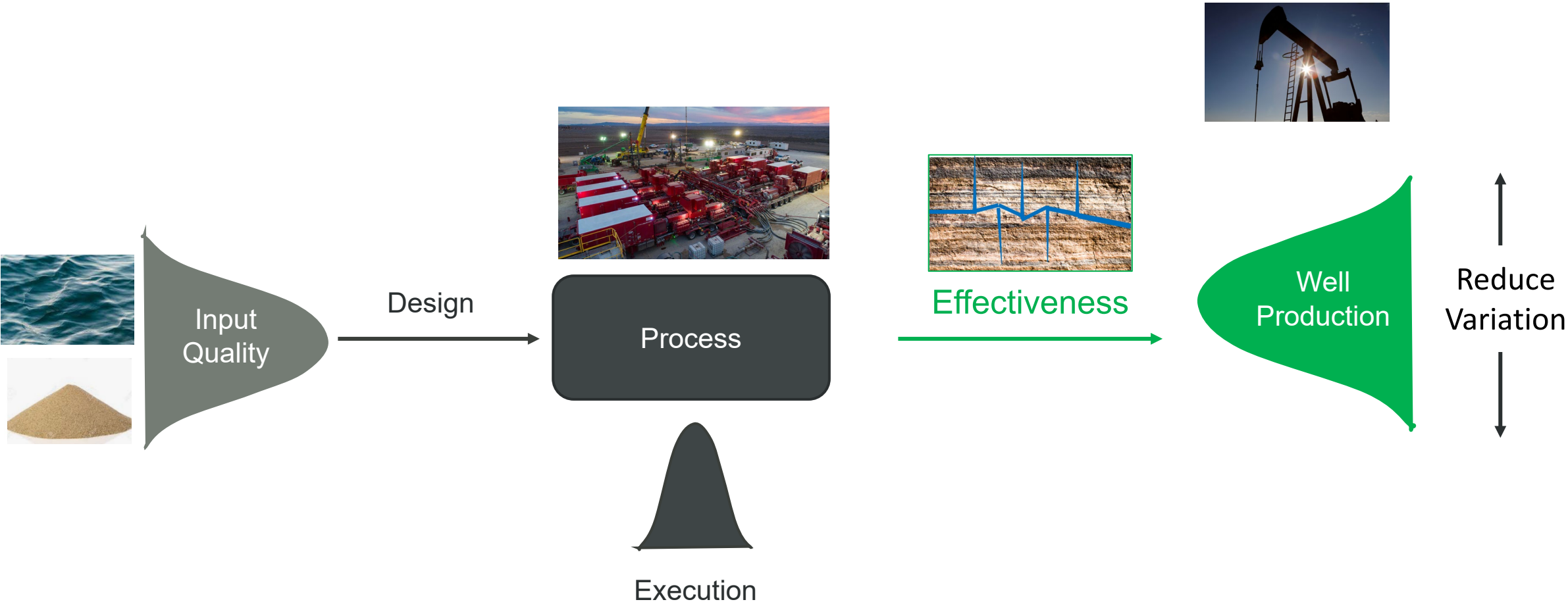
**Sensori**  
Automated Fracture Monitoring

# Hypothesis

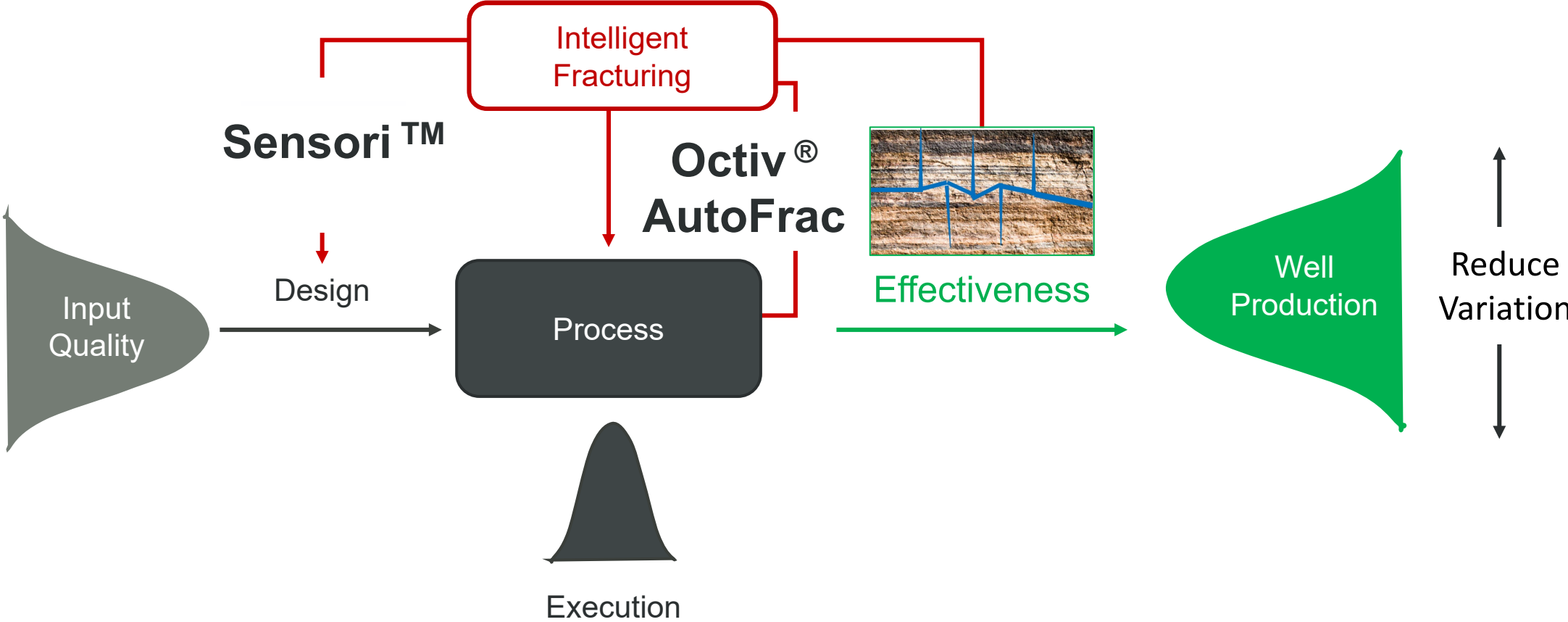




# Hypothesis



# What can we do about it?





# Octiv® Auto Frac Settings - Demo

**Octiv® Connect**  
REMOTE OPERATIONS PORTAL

Operations Tracking Analytics

NE-MON\_NAL FLEX CREW | ... COVERED BRIDGE NE-MON\_NAL FLEX CREW | AUTOFRACTEST

**AutoFracTest** ⓘ

HALLIBURTON | NE-MON\_NAL FLEX CREW Overview Timeline Frac View Design Auto Frac

3 OF 39 TOTAL STAGES COMPLETED (8%) Download

## Auto Frac Settings

Select the well/stages, then modify the automation settings. [Open Guided Tutorial](#) [View in Demo Mode](#)

### Select asset

Select the well/stages you wish to modify. Stages that took place in the past cannot be modified.

- Well\_1 Lexington
- Well\_2 Lexington

### Review settings

The tiles below are currently displaying settings that can be configured for wells/stages. Hover over a tile to see where it maps to the Auto Frac plot.

<b>Pressure Target</b> 12.5K PSI	<b>Rate Ramp</b> Balanced	<b>Screenout Detection</b> Send alert: 0.85 Hold stage: 0.90 Cut screws: 0.95	
<b>Start Proppant</b> 60 BPM	<b>Stage to Flush</b> ≤ 0.2 PPG	<b>Overflush</b> 200 BBLs	<b>Rate Drop</b> 20 sec

**Edit configuration**

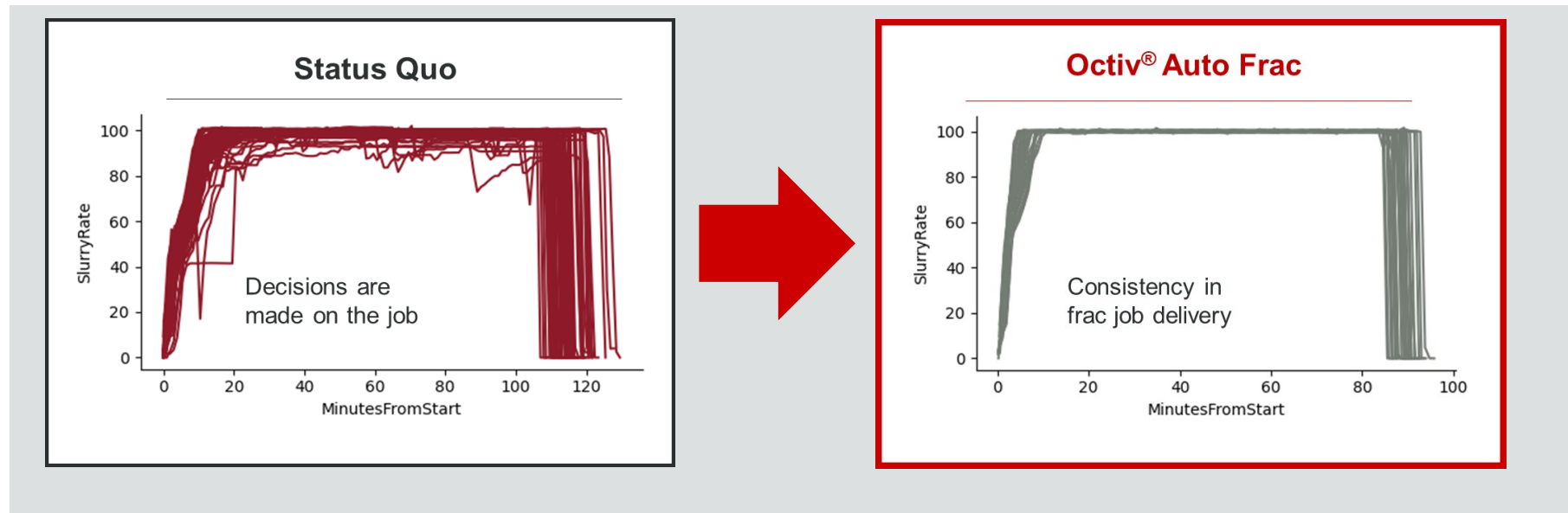
Cancel Send update

# Octiv<sup>®</sup> Auto Frac

Automated Job Delivery

## Consistency in frac job delivery.

- **Eliminate variability** between jobs by remotely managing in the web.
- **Customize to your asset** by configuring automation sequences to your desire.
- **Reduce downtime risk** with automated control responses, custom thresholds and real time alerts.





# Initial results – Northeast

## Trial KPIs

**85%**

Reduction in manual rate setpoints  
(90 → 13 per stage)

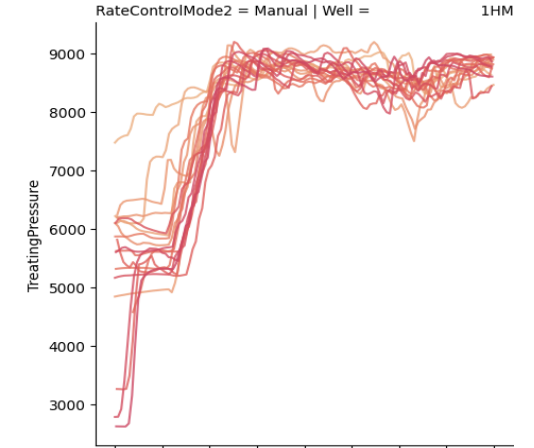
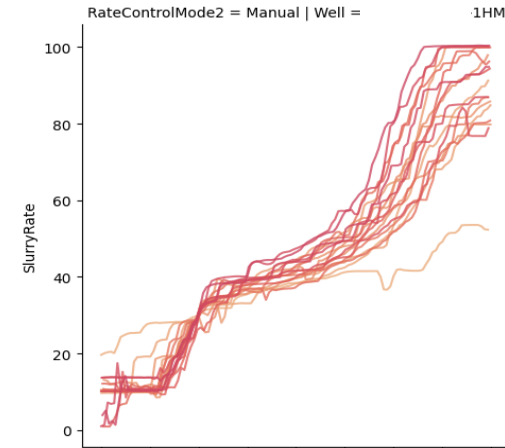
**115 bbls**

Fluid savings per stage

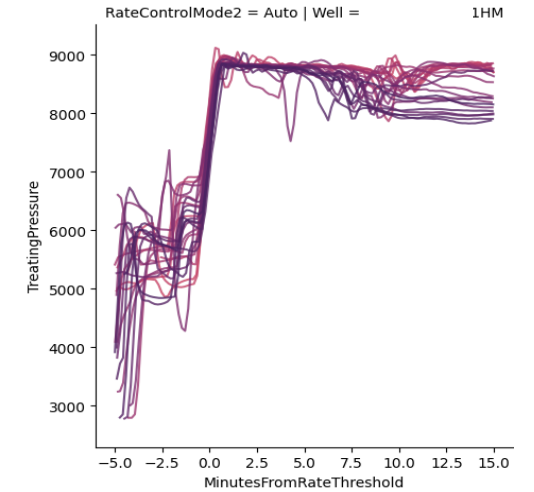
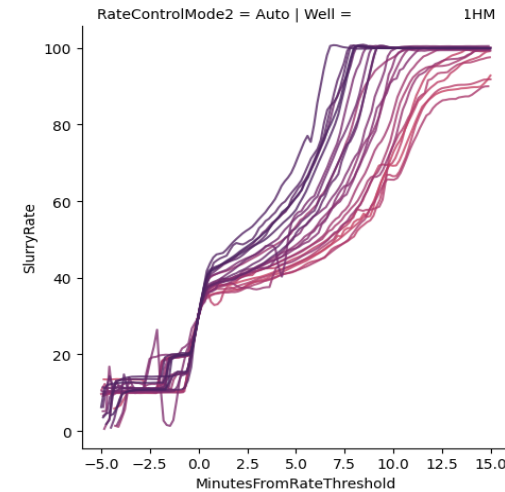
**3.8 min**

Pump time savings per stage

Manual Rate Control



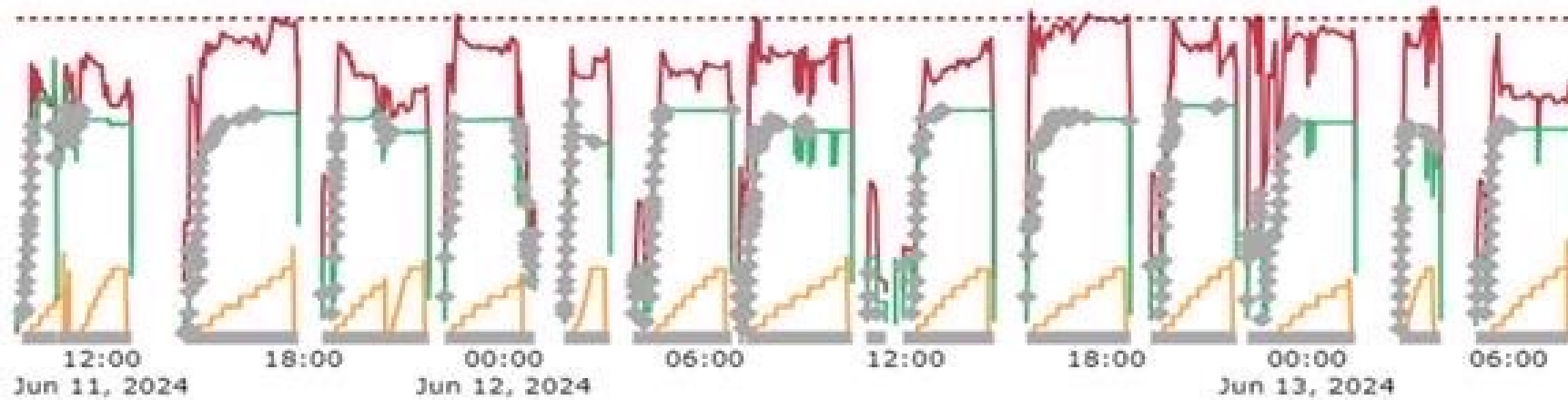
Auto Rate Control



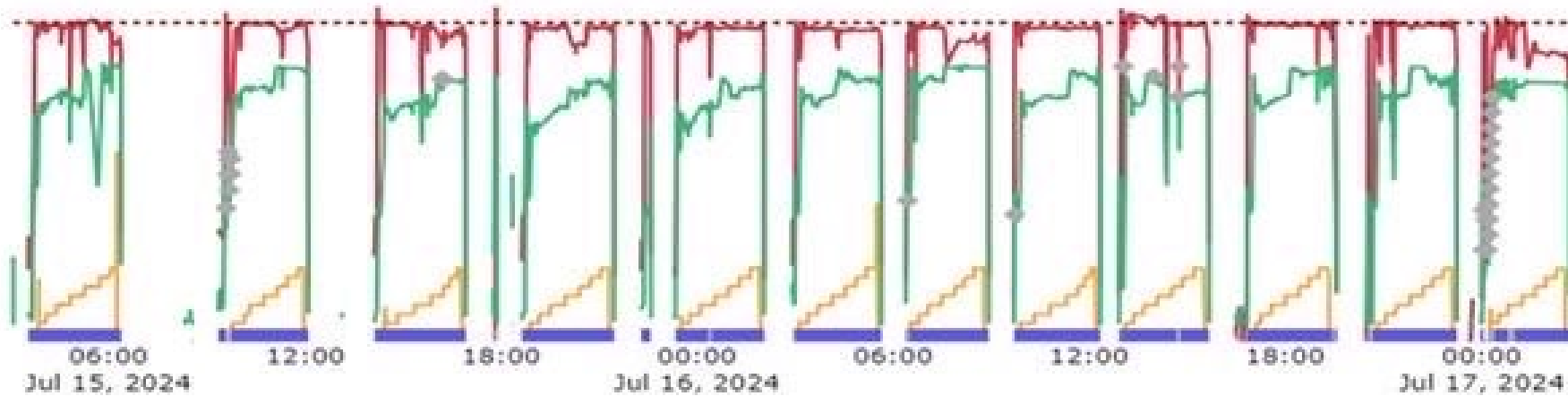
# Turning the frac spread into a factory

— Rate — Pressure - - - - PressureSetpoint — Pconc ■ Auto ■ Manual

Standard Control



Octiv® Auto Frac





# Sensori

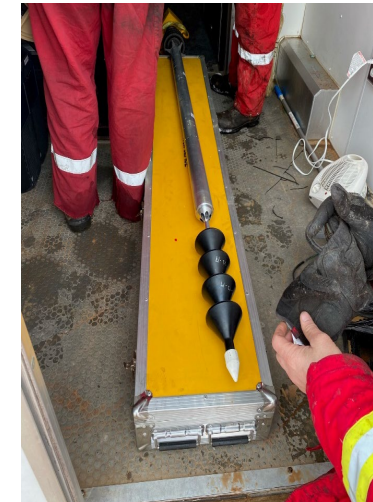
## Sensori™ Near-Well

- Fleet generates a “pulse” at the end of each stage.
- Provides a Stage Efficiency Index, quantitative number telling you the relative openness of the stage.



## Sensori™ Cross-Well

- Offset disposable fibers.
- Identify fracture communication and growth.



# Sensori™ Cross-Well

disposable fiber service

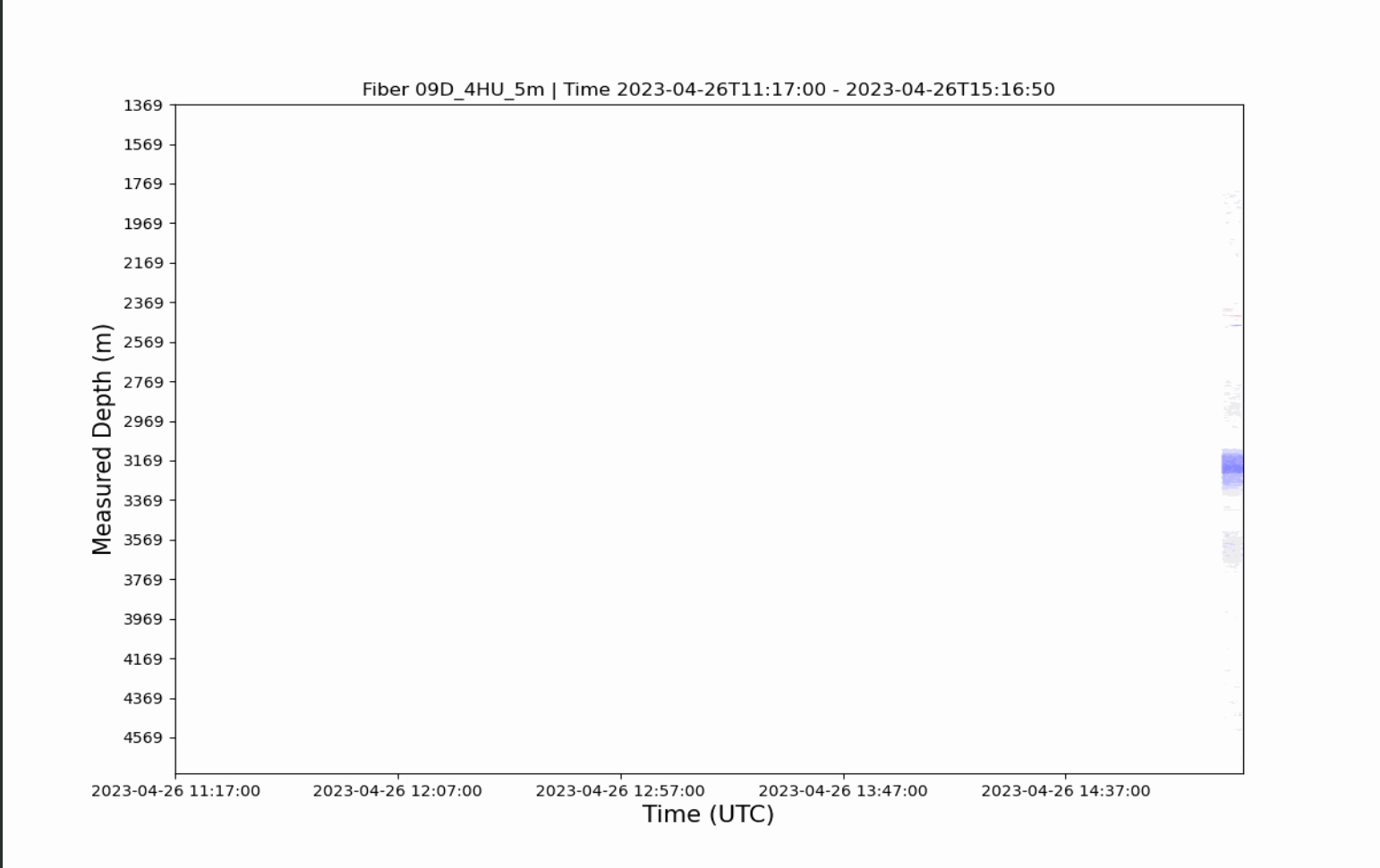
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Economic, low-risk diagnostic  
for cross-well monitoring:

- Provides a direct measurement of well interference.
- Run in offset wells to acquire direct measurements of DAS microseismic, strain and temperature.



# Automating Cross-well Data – Strain



Wells Map View

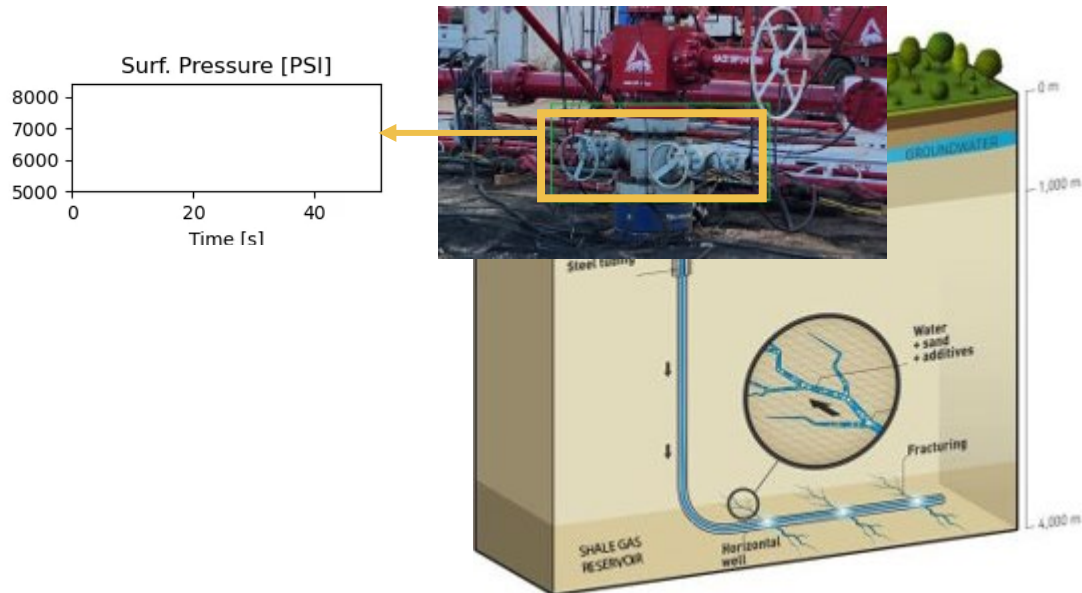




# Sensori™ Pulse

near well monitoring service

- Utilizes existing HHP on well site to generate pulse.
- Provides a quantitative metric.
- Automated processing for real time feedback.



Generates a pressure wave that travels down the wellbore, interacting with fractures to generate a pressure response.



Sensori™ Pulse

pressure pulse service

Pressure response is analyzed and processed in real time to calculate a measurement of stage efficiency.



Stage 47 of 0 | Stage Efficiency Index: 61 | Start Time: 08/16/24 20:34 | End Time: 08/16/24 21:46

Color By: Stage Efficiency

STAGE EFFICIENCY INDEX STAGE EFFICIENCY INDEX: 100 0



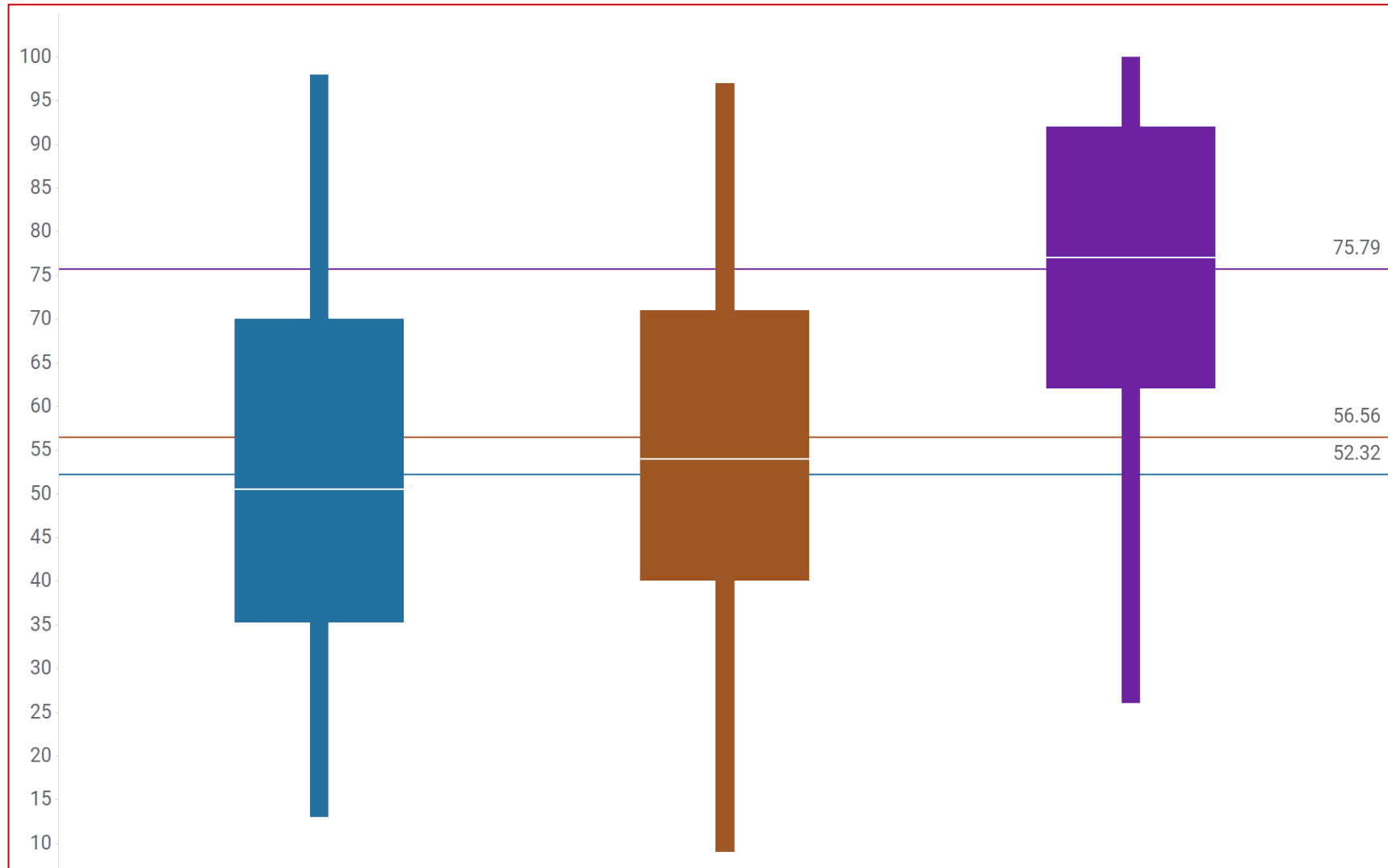
TREATMENT DATA

- TREATING PRESSURE (PSI)
- SLURRY RATE (BPM)
- SURFACE PROPPANT CONCENTRATION (PPG)
- BOTTOM HOLE PROPPANT CONCENTRATION (PPG)





# Northeast Results by Well and Design



# Who to Contact, Where to Get More Information



**Des Murphy**

Business Development Technology Manager

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[des.murphy2@halliburton.com](mailto:des.murphy2@halliburton.com)

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Phone: (724) 207-0453

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[www.halliburton.com/](http://www.halliburton.com/)

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