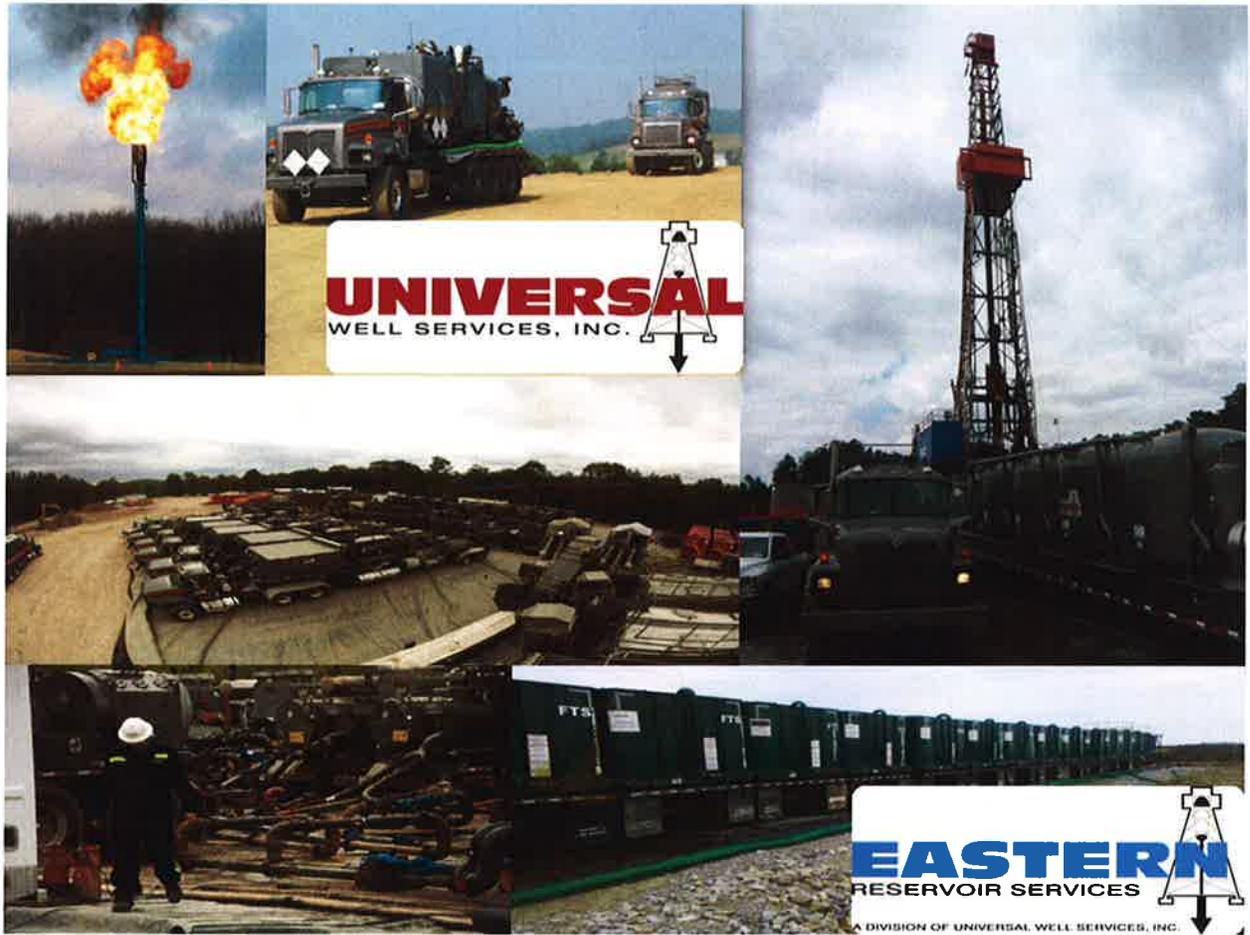


An Overview of Hydraulic Fracturing



Presented by:

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Staff Engineer

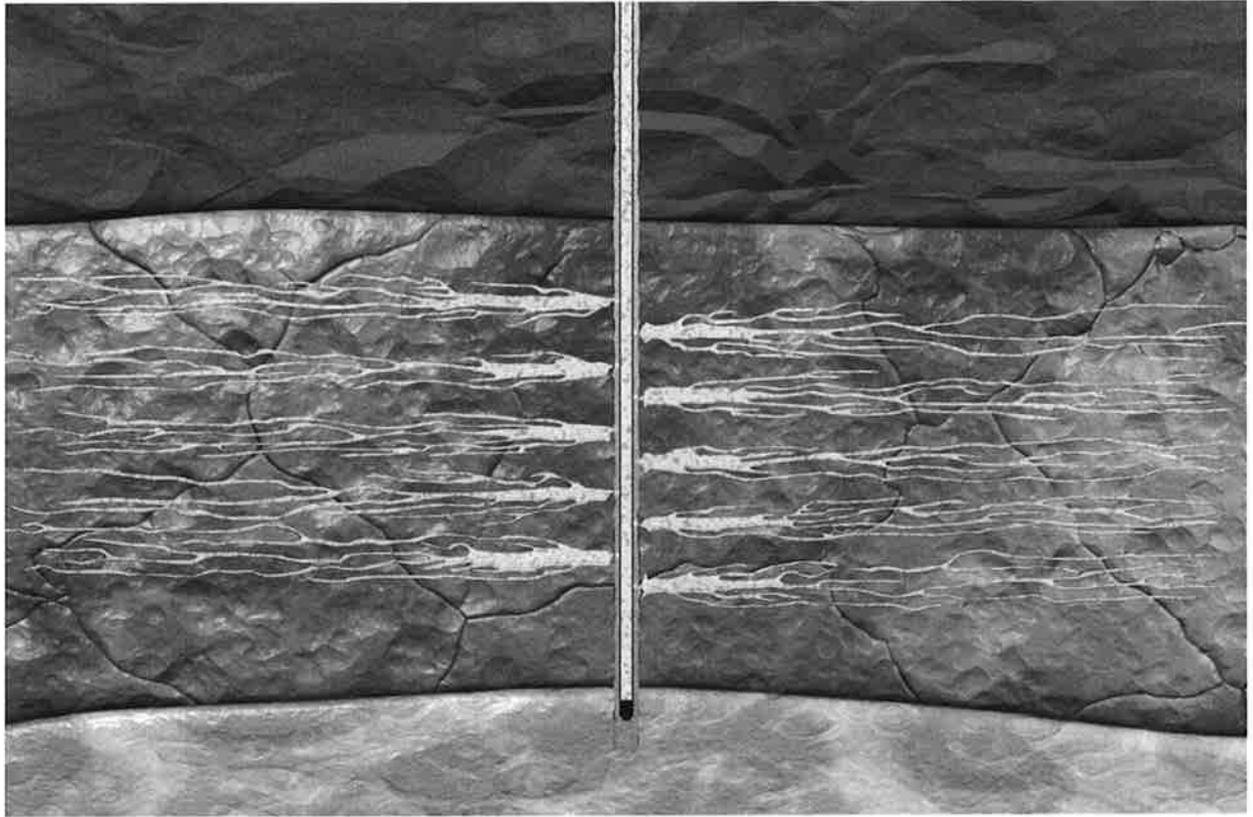
Universal Well Services

Major Topics:



- Hydraulic Fracturing: Definition
- Marcellus Fracturing Operations
- Equipment on Location
- Personnel on Location
- Hazards: What they are & how we deal with them

What is Hydraulic Fracturing?



- A procedure in which fluid is pumped at specific rates and pressures. This procedure strategically cracks rock that contains natural gas or oil.
- Fluid types: Gas, Liquid, or Foam.
- Goal: Create a “superhighway” for gas or oil to the wellbore.
- Result: Improved early production, improved total recovery over the life of the well.

Appalachia – Old Work vs. New Work

Traditional Fracturing

- Upper Devonian Sands
- 1000 - 5000 ft. deep
- Less equipment
- Less people
- Less materials
- Less time

Marcellus Fracturing

- Marcellus Shale
- 5000 - 8000 ft. deep
- More equipment
- More people
- More materials
- More time

Old Job Site



New Job Site



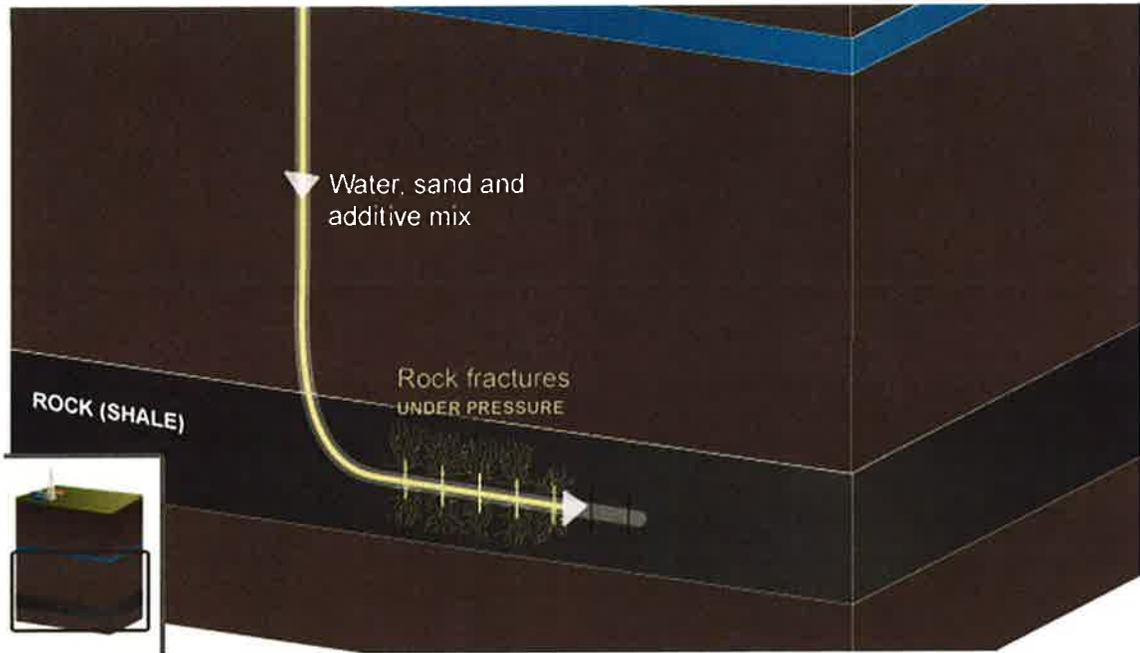
New Job Site



up to 10,000 psi

Zipper Fracking - Perforations & Hydraulic Fracture Pumpers
work at same time
Well A - prepare pump stage 1
Well A - Perforated while Well B Stage 1
Well A - Stage 2 while Well B Perforated

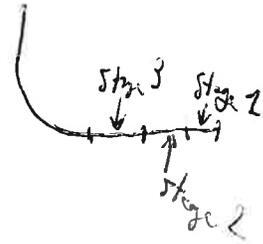
The Marcellus Fracturing Challenge



- Dealing with Horizontal wells
- Possibly more than one well on location
"Pad Well Drilling"
- 24 Hour Operations
- Method: "Plug and Perf"

*Bent sub w/ mud motor
to where they want to bore out
horizontally.
String stationary use
mud to push bit*

Plug and Perf Process



Pump the stage (UWS)

- Acid
dissolves perforations, cement, exposes rock
can then pressure up formation, drop in pressure makes fracture occur
- Break Formation
- Pad
what you pump before sand is added
20-30% of total volume
- Sand stages
begin at 1/4 lb/gallon and increase to 3-4 lb/gallon
- Gel Slug
20-30 lb gear gum, ^{potential stabilizer} pushes sand out
- Flush

Frac Focus
Brookside =
Does not seem
aware of what
is in it.

Pump down for next stage (UWS and Perforators)

Push gun down, lower to kick off (last part of vertical)
Push water past the gun, pushes gun to horizontal
Shut down pump
Shut guns
then remove

Perforate and set plug for next stage (Perforators)

Plug isolates previous stage from what is to be pumped next
Plastic or hard rubber

Fracture plug has a hole
that is filled with a ball

UWS Equipment On Location

Iron Truck



Facts:

- Side Racks hold iron and other connections
- 10,000 lb. extendible overhead crane
- Useful for location setups and tear-downs

One

Sand Dump



Facts:

- 400-500 sacks capacity (40,000 – 50,000 lbs)
- Aluminum bed is lifted with hydraulics via a lever near the hinge
- Red levers open chutes to deliver sand



Field Sand Storage Trailer

"sand hog"



Facts

- 2500-3000 sacks capacity (250,000 – 300,000 lbs)
- Stores and dispenses sand on location (always moved while empty)
- Chutes and a conveyor deliver the sand to a main conveyor.
- Four separate bins which are loaded pneumatically.
- Stairway and Railing to access the top.

Sand Conveyor



Facts

- Large hydraulic powered conveyor belt
- Accepts sand from Field Sand Storage Trailer and delivers it to the blenders
- Two chutes – one for each side
- Can and will stall out if overloaded

Sand Conveyor



Blender

Each line connected to a pump that adds additives



Facts

- The most complex machine on site
- Mixes water, sand, and additives (liquid and dry) on the fly
- Low pressure/high rate – delivers fluid to manifold trailer and pumps
- Delivers all data to the frac van
- Operated from the “float” on top
- Top pumping rate: 140 Bbl./min. (5,880 Gal/min.)
- Mostly computer automated, but has manual operation capability

Small Blender



Older version, smaller, 60 bbl/mi.
Facts

Chem-Add Unit



Facts

- Works in conjunction with the blender
- Delivers liquid additives to the blender
- Larger totes means less material transfer and better QC
- 6 totes, pumps, and flow meters

Quintuplex Pump Truck

5 plungers on pump section



Facts

- Pressurizes slurry and pumps it down the well
- 20 or more pump trucks on site
- Low rate but high pressure
- 2000 HHP diesel engine hooked to a positive displacement pump
- 5 plungers
- Top pressure: 10,000 to 12,400 psi depending on plunger size
- Controlled via a remote control box up to 300 feet away

Triplex Pump Truck *"older style"*



Facts

- Same concept as the Quintuplex but on a smaller scale
- 1000 HP diesel engine hooked to a positive displacement pump
- 3 plungers
- Top pressure: 6,800 psi to 12,400 psi depending on plunger size

Acid Transport



Facts

- Delivers hydrochloric acid to location
- Capacity: 3,000 gal between 2 tanks
- Hooks to a pump truck via low pressure hose

Go up to
load acid (w/30%)
at shop; sometimes one needs
to visually gauge the contents
by looking directly into it.

Manifold Trailer



low pressure hoses

Facts

- Pre-fabricated portable section of low and high pressure lines.
- Low pressure lines on the top, high pressure iron on the bottom.
- Delivers slurry to pump trucks, then accepts pressurized slurry.

Swing

high pressure "iron"



- Cuts down on labor and setup time.

Frac Vans – The Evolution



Facts

- Still occasionally used for traditional work
- Outdated technology for the Marcellus



Facts

- Updated technology and instrumentation – Marcellus worthy
- Used for small Marcellus jobs where less time is spent on location
- Satellite uplink, remote monitoring, more comfortable seating

Comment to
blender:
additive rate
sand rate
clean rate
downhole rate
pressure rate

Operator = Customer = Company Man



Facts

- More work stations
- More computers
- More comfort



Marcellus Fracture Location



Take an extra blender

Key People On Location (UWS)

Job Operator

aka: Treater, White Hat, Frac Operator, etc.

- Responsible for all UWS personnel on location
- Located in the frac van
- Calls all of the shots via radio
- *works closely with customer*

Groundsman

aka: Ground Boss

- Operator's right hand man
- Located outside of the frac van
- Oversees all operations, spots and fixes problems

Frac Engineer

- Quality Assurance and Quality Control driven
- Located in the frac van
- **Handles Inventory, Reporting, and Monitors Real-Time Data**

*Monitors every delivery of chemicals leaving the location
Keep track of all items and reports*

Primary Operational Hazards

$$\begin{array}{l} \text{Sand rate} \\ \downarrow \\ \text{NAP} = \frac{110.5 \times 8803 \text{ psi}}{40.5} \end{array}$$

HIGH PRESSURES!

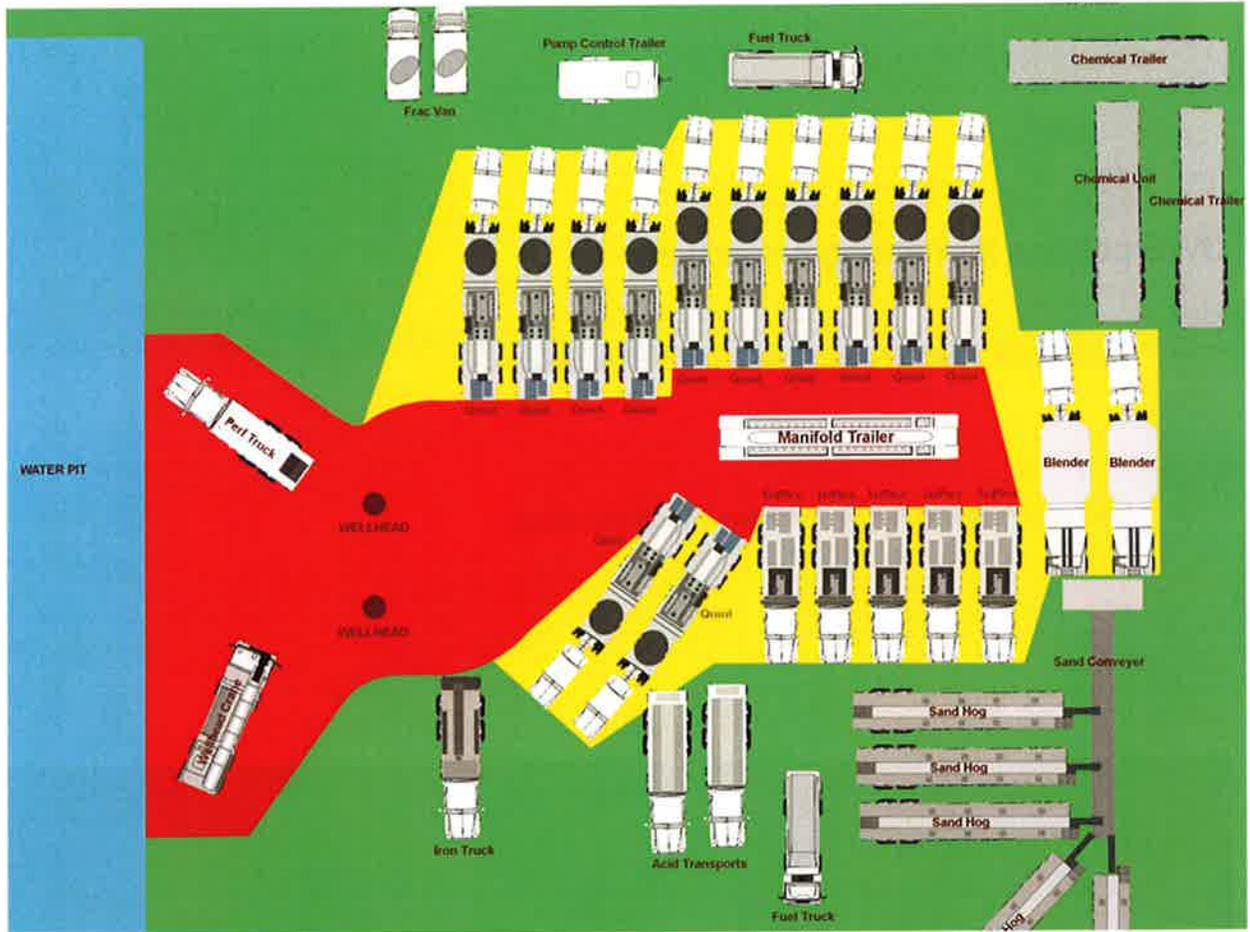
- Operating at constant pressures up to 10,000 psi

UWS policies for working under pressure:

- No one gets near pressurized iron
- No one hammers on pressurized iron
- All iron is pressure tested on site prior to use
- All iron is inspected every 6 months or sooner
- Red zone, Yellow zone, Green zone

VERY UNIQUE!

Red Zone, Yellow Zone, Green Zone



Red Zone - no one enters during operation
Yellow Zone - water can only go to authorized location

Red Zone - pressurized iron

LOUD EQUIPMENT

UWS policies for hearing protection:

- Equipment operators must wear muffled headsets
- Everyone else on the ground must wear ear plugs



FLAMMABLE GAS

UWS PPE Policy for Burn Prevention:

- All UWS on-site personnel **MUST** wear NOMEX flame retardant coveralls





SILICA DUST:

- Could lead to Silicosis

UWS PPE Policy for Silicosis Prevention:

- Blender Tenders, Field Sand Storage Trailer Operators, Conveyor Operators, and Sand Coordinators must wear respirators

WE ARE A WORKING FACTORY ON WHEELS...



- Confined Space Entry

- clean inside tanks

- Working at Height

- L.O.T.O.

*Slips, Trips, & Falls
Hear Me*

UWS Minimum PPE requirements:

- FR Coveralls
- Steel Toed boots
- Hard Hat
- Safety Glasses
- Radio headset or ear plugs
- Work Gloves



• Job Specific
- Aerial Gear
- Respirator

OSHA Training – Hydraulic Fracturing Post-Test



1. Why is it necessary to perform a frac job on a well? What do you gain?
2. What are some operational safety hazards associated with hydraulic fracturing?
3. Name 3 required pieces of PPE on a frac job.
4. Name 5 pieces of equipment found on a frac job.
5. What are some new operational challenges associated with fracturing a Marcellus well vs. a traditional Upper Devonian well?

