

# Using Reduced Emission Completions (RECs) to Minimize Emissions During Flow-back of Hydraulically Fractured Gas Wells



Global Methane Initiative All-Partnership Meeting

Oil and Gas Subcommittee –  
Technical and Policy Sessions

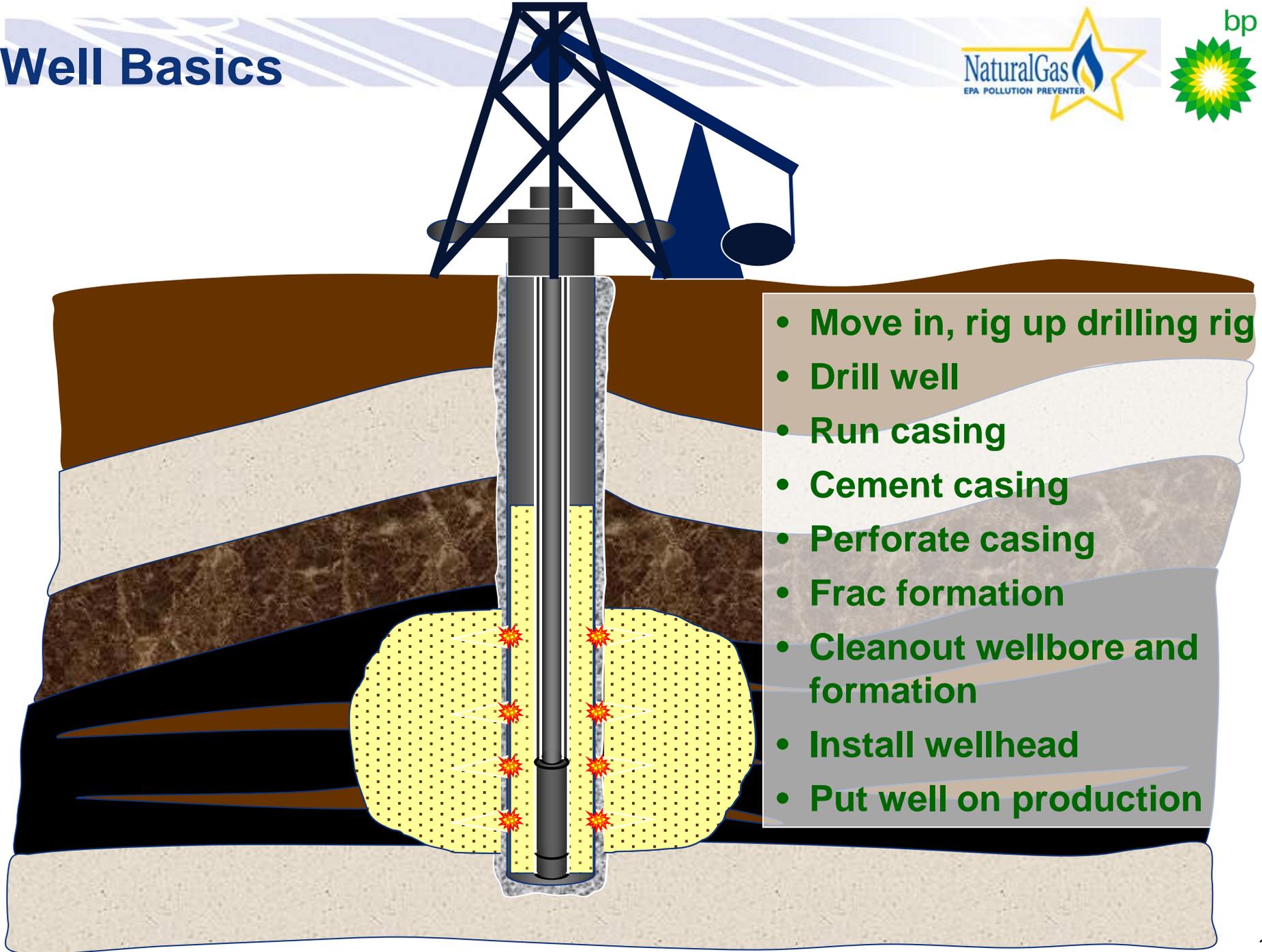
October 14, 2011  
Krakow, Poland

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# Well Basics



- Move in, rig up drilling rig
- Drill well
- Run casing
- Cement casing
- Perforate casing
- Frac formation
- Cleanout wellbore and formation
- Install wellhead
- Put well on production

# Well Clean Out

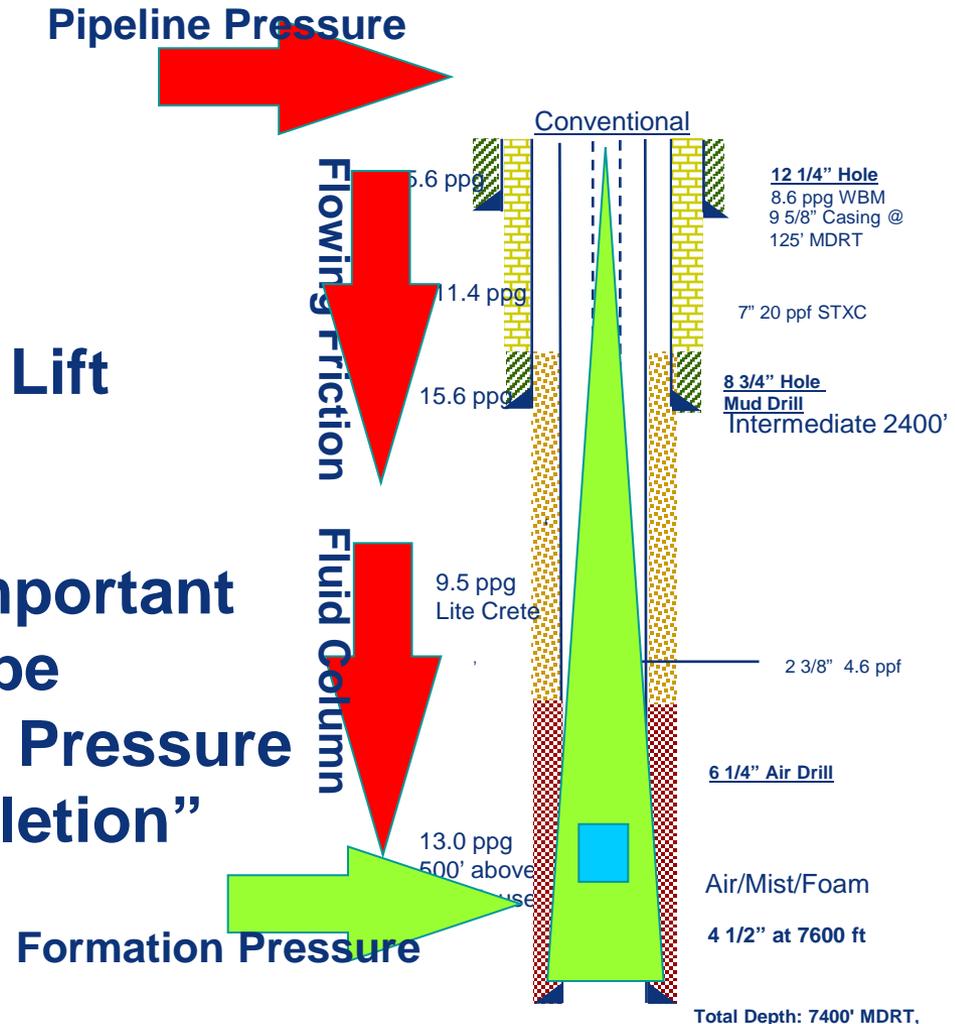


## Well Flow:

- Depends on Delta P
- Flow Rate is a f of Delta P
- Rate Determines Velocity
- Velocity Determines Fluid Lift

## Formations:

- Recovery of Frac Fluids Important
- Formation Pressure Must be Greater Than Sum of Back Pressure
- “Reduced Emission Completion” Adds Back Pressure



# Reduced Emission Completions - ??



- 💧 Flow-back and Clean-up of a Gas Well Following Fracture Stimulation With Most Gas Recovered
  - 💧 Both new completions and re-completion/work-over post hydraulic fracturing
  - 💧 Traditional completions - flowed to pit or surface tanks - gas vented or flared - Can be a significant source of methane and other pollutants
- 💧 “Reduced Emission” Cleanouts – Pros and Cons

## Pros

- 💧 Reduce emissions
- 💧 Sell gas instead of venting / flaring
- 💧 No visible flares
- 💧 No mixing of air and gas

## Cons

- 💧 Requires a great deal of specialized equipment
- 💧 Can be Expensive – Especially in low pressure reservoirs
- 💧 Cleanouts not as effective (back-pressure from the pipeline)
- 💧 Low pressure cost - approximately 30% more than a conventional cleanout unit Value of gas sold - roughly equal to the additional cost

# Basic Requirements

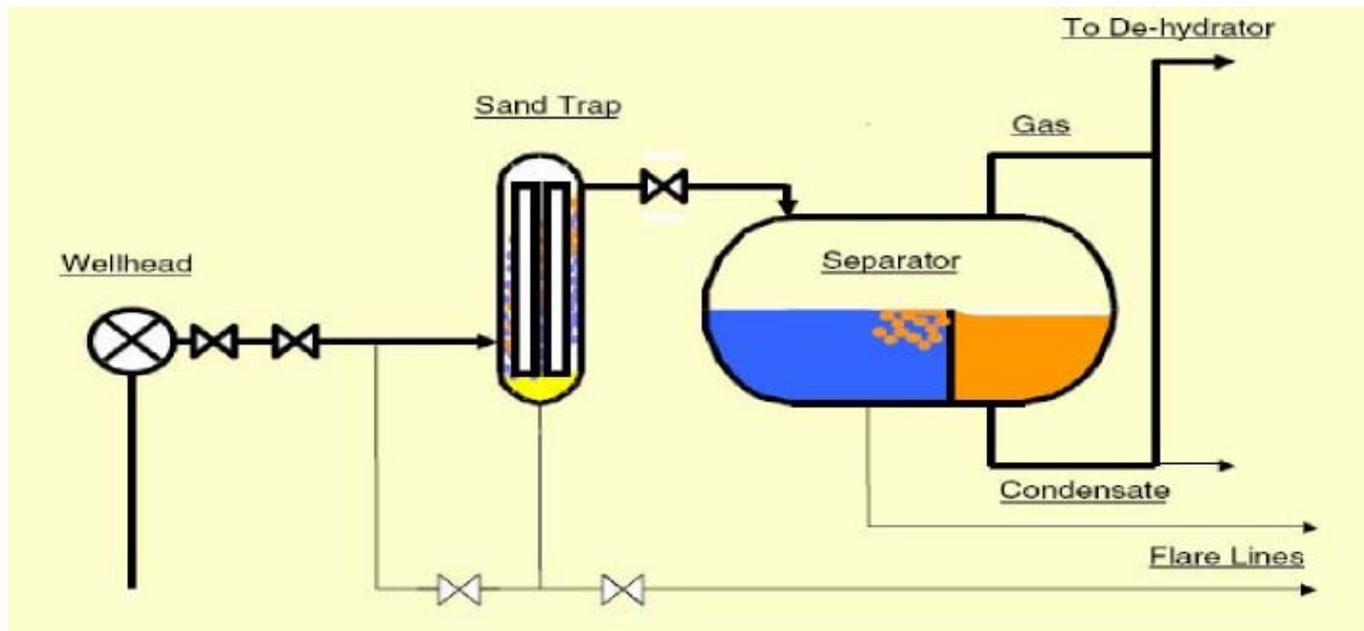


- 🔥 Must have an operational pipeline
- 🔥 Gas must meet sales specifications
- 🔥 Must be able to adequately clean-up well and avoid permanent reservoir damage and lower productivity
  - 🔥 Sufficient reservoir energy, flow, and characteristics to clean-up against pipeline backpressure –or–
  - 🔥 Much more equipment and complexity to enable clean-up of low pressure/energy reservoirs
- 🔥 Surface equipment must be in place to dry and meter gas into sales line

# REC Equipment - High Pressure



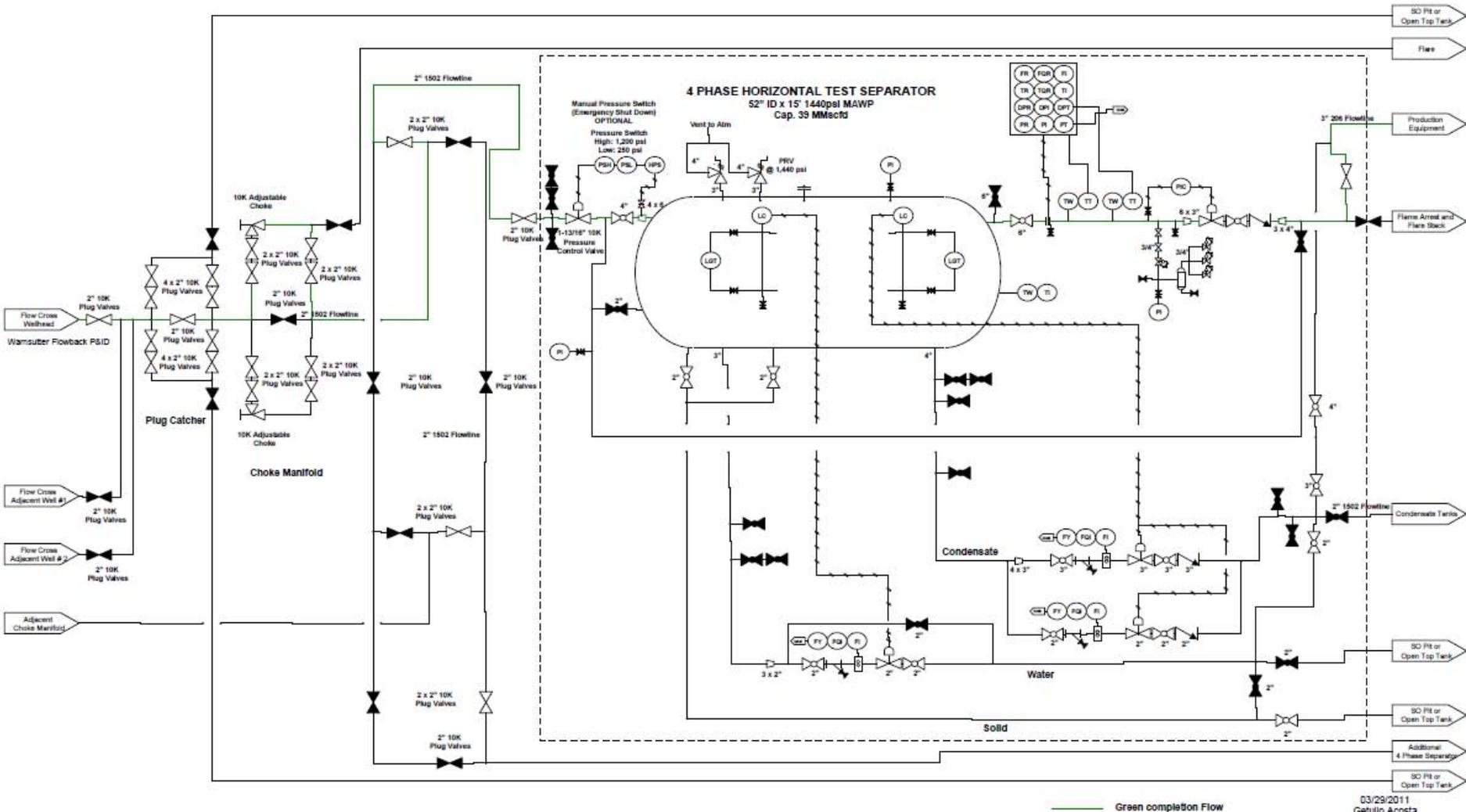
- 🔥 Truck, trailer, or skid mounted equipment to capture gas during cleanup
- 🔥 Sand trap
- 🔥 Specially Designed Three – phase separator
- 🔥 Portable or permanent dehydrator







# WAMSUTTER GREEN COMPLETION P&ID



# Wellhead, sand trap and sand separator



Wellhead

Separator  
Skid

Sand Trap



# Sand Separator



# BP – SW Wyoming Experience



- 🔥 Began program in 2001
- 🔥 Commissioned 6 sets of REC equipment
  - 🔥 18 sand traps; 6 large separators
  - 🔥 Cost ~ \$1.4 MM (2002 US\$)
- 🔥 Moved to rental equipment ~2008
- 🔥 ~1,391 RECs to Date
- 🔥 ~12.5 BCF of Gas Sold (14.8 MM SM<sup>3</sup>)
- 🔥 ~228,300 Bbls Condensate Sold
- 🔥 State of Wyoming made RECs mandatory in 2011
- 🔥 EPA is moving to make RECs mandatory

# Low Pressure Reservoirs



- 🔥 RECS much more difficult, complex, expensive
- 🔥 Requires added energy
  - 🔥 Compression on flow-back –or–
  - 🔥 Gas lift “reverse circulation



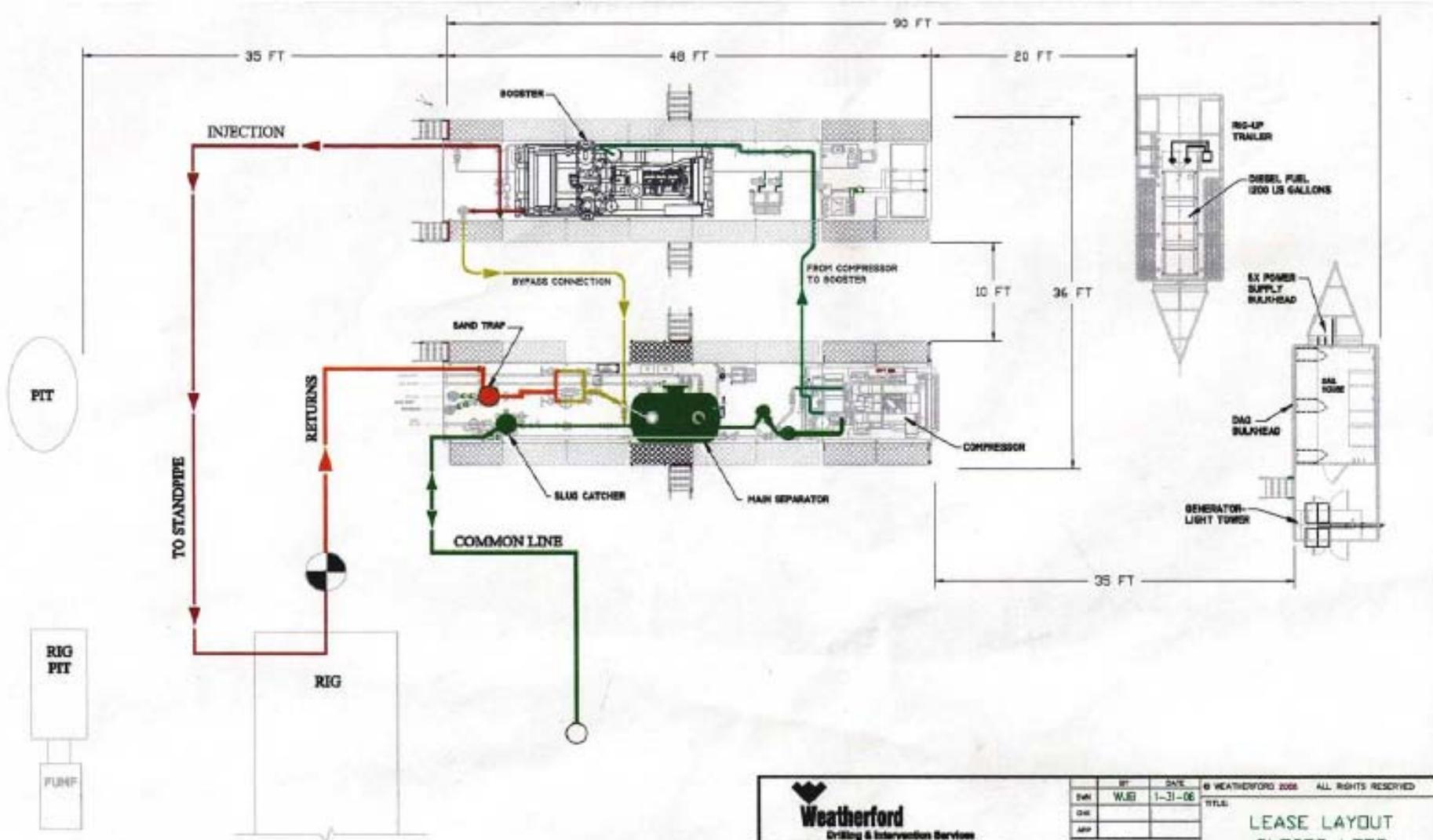
Source:  
Weatherford

# Weatherford Green Completions



- Use pipeline gas with proprietary foaming agent as compressible fluid to initiate cleanout
- System includes
  - Wet screw compressor when well pressure is less than 80 psig
  - Booster compressor, three phase separator and sand trap
- Estimate cleanup pressure of 300 to 400 psig at a well depth of 8000 feet

Source: EPA



REV.	DESCRIPTION	BY	APP.	DATE
0	ISSUED FOR INFORMATION		DCH	
	REVISIONS			

**Weatherford**  
Drilling & Intervention Services

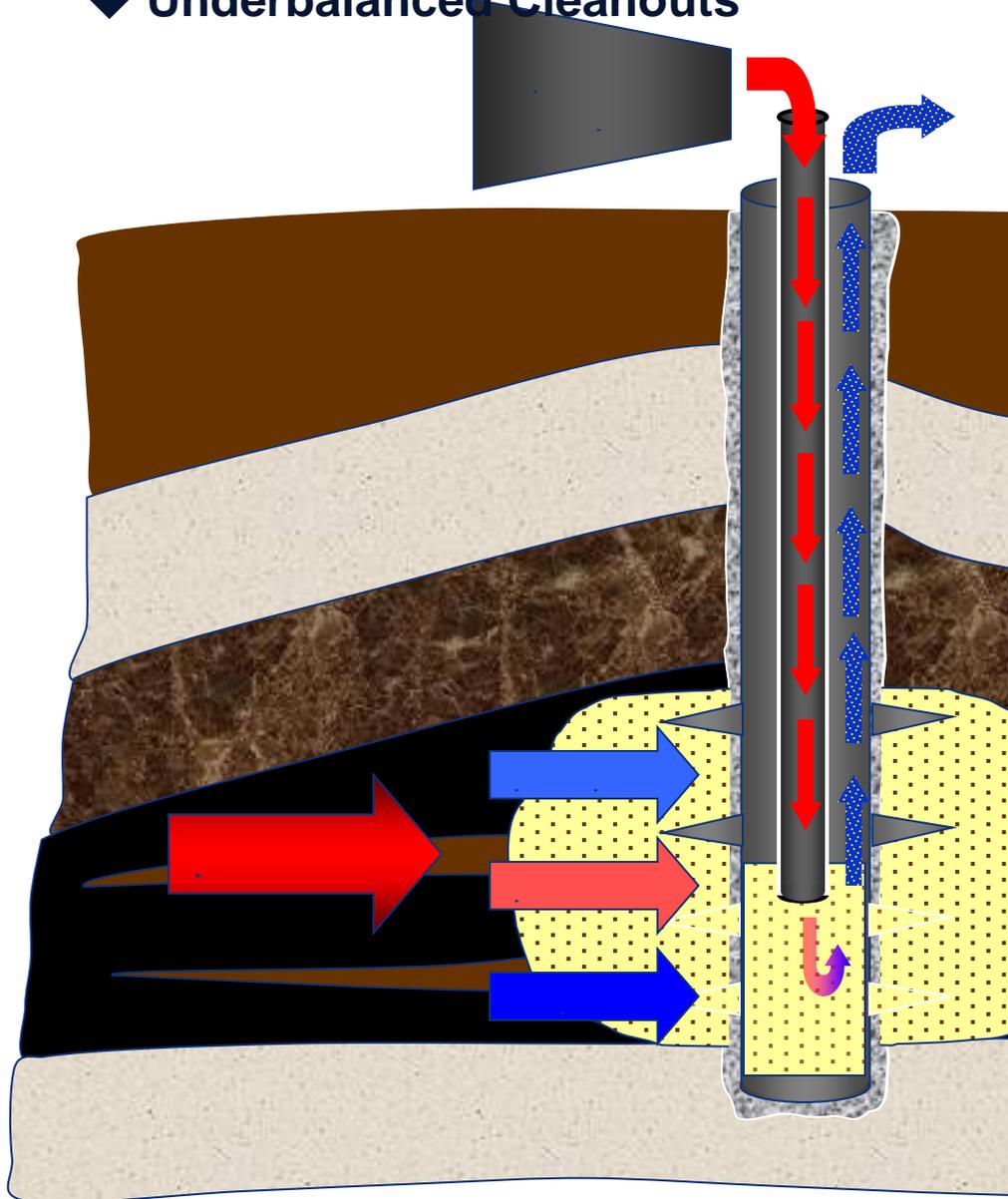
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# “Green” Completion Unit



## ◆ Underbalanced Cleanouts

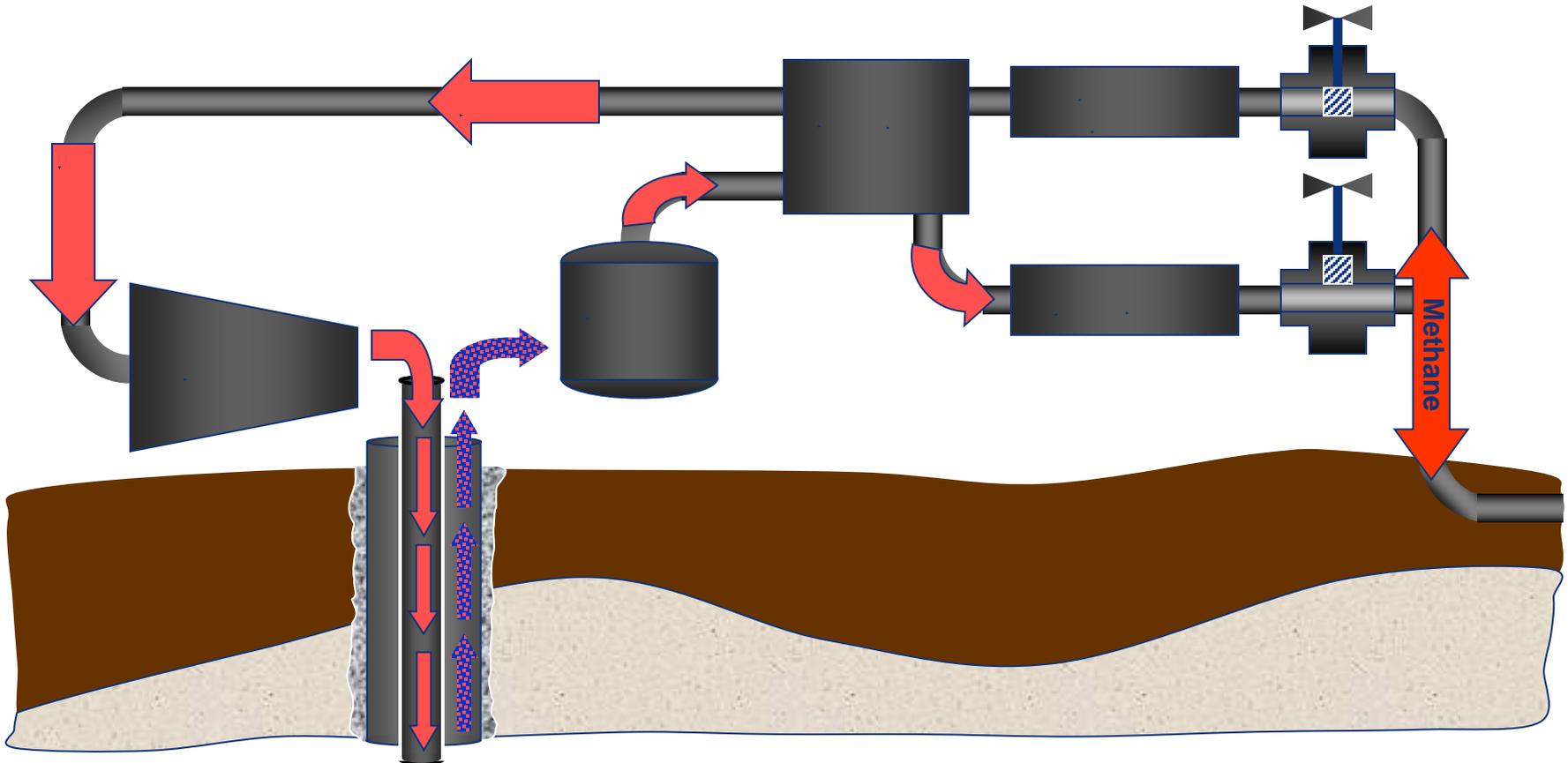


- Compressor / pump is used to pump high-pressure fluid down the wellbore to wash the frac sand out.
- Tubing is run into the wellbore to provide separate paths for the fluid entering the wellbore and the fluid / sand leaving the wellbore.
- Fluid used can be a gas (air, nitrogen, natural gas) or a liquid (water).
- Using a gas results in an “underbalanced” situation (pressure in the wellbore is less than reservoir pressure).
- Consequently, fluid (frac gel, water and natural gas) will flow from the reservoir into the wellbore and then out of the well.

# Basics of low energy Post-frac RECs



- **Must have:**
  - **Pipeline for sales gas and initial fuel/injection gas**
- **Eventually, the well begins making gas and the excess can be sold back to the pipeline.**





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