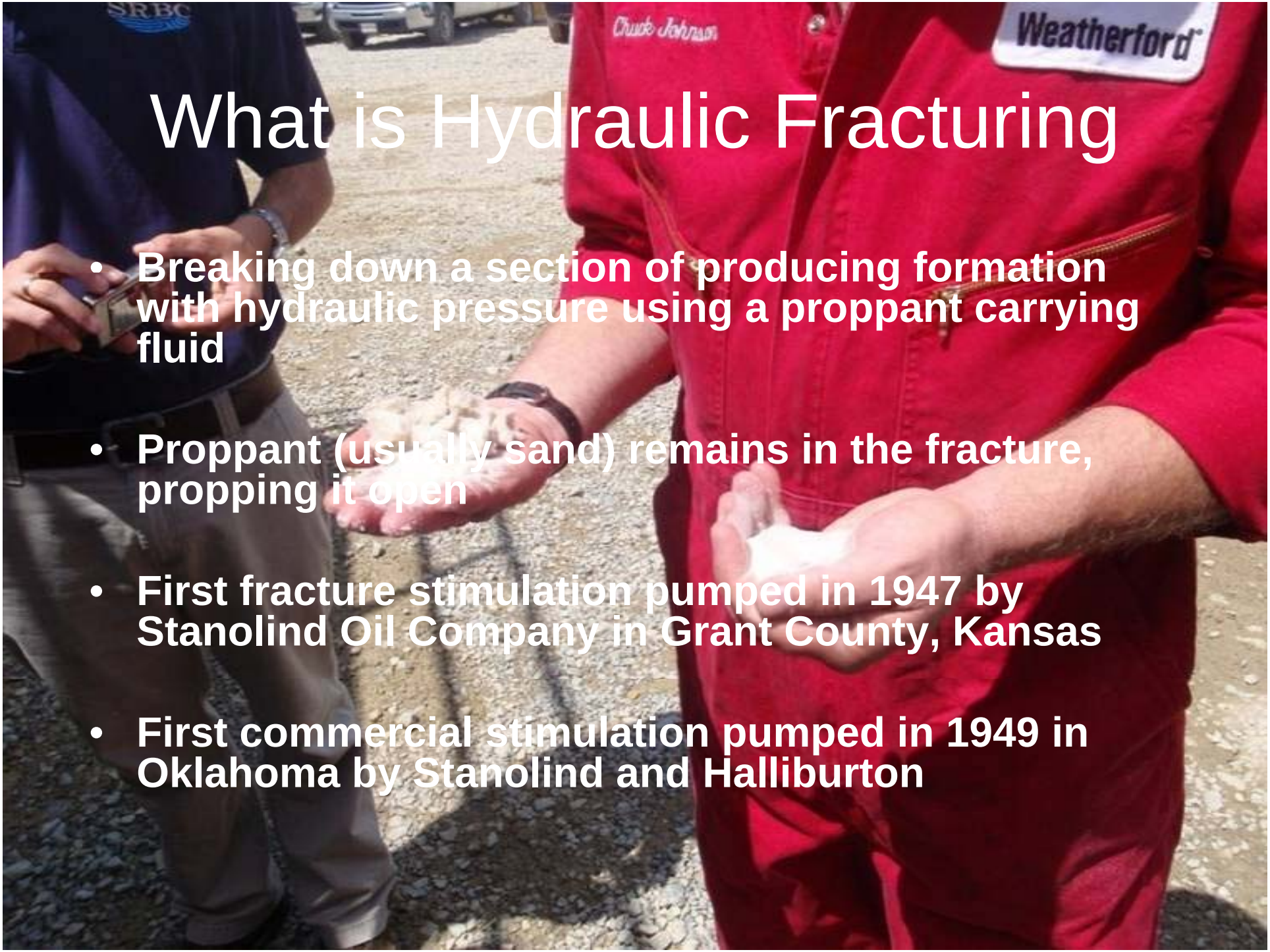
Hydraulic Fracturing Rulemaking

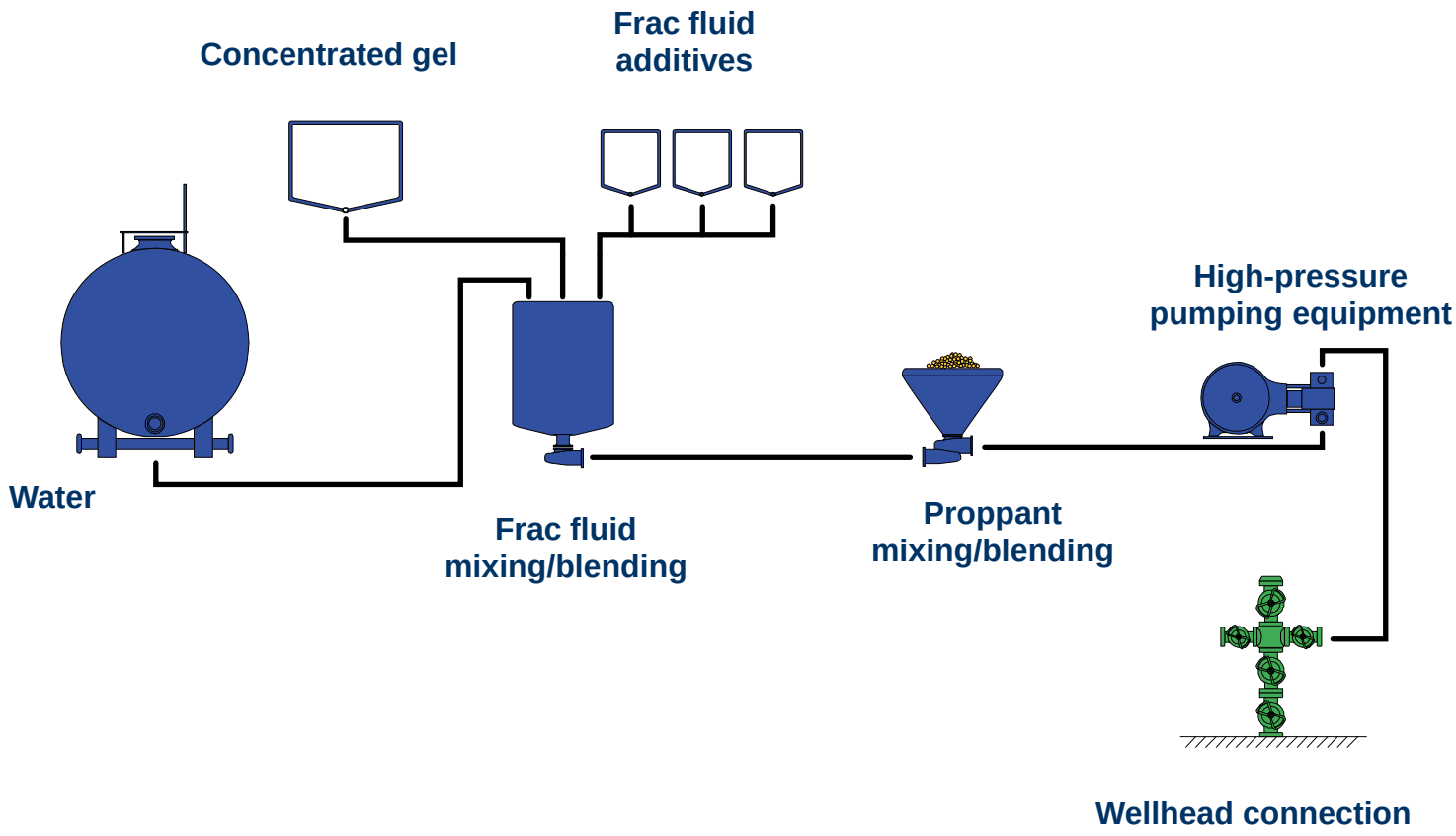
Energy and Telecommunications Interim Committee
Sept 16, 2011



What is Hydraulic Fracturing

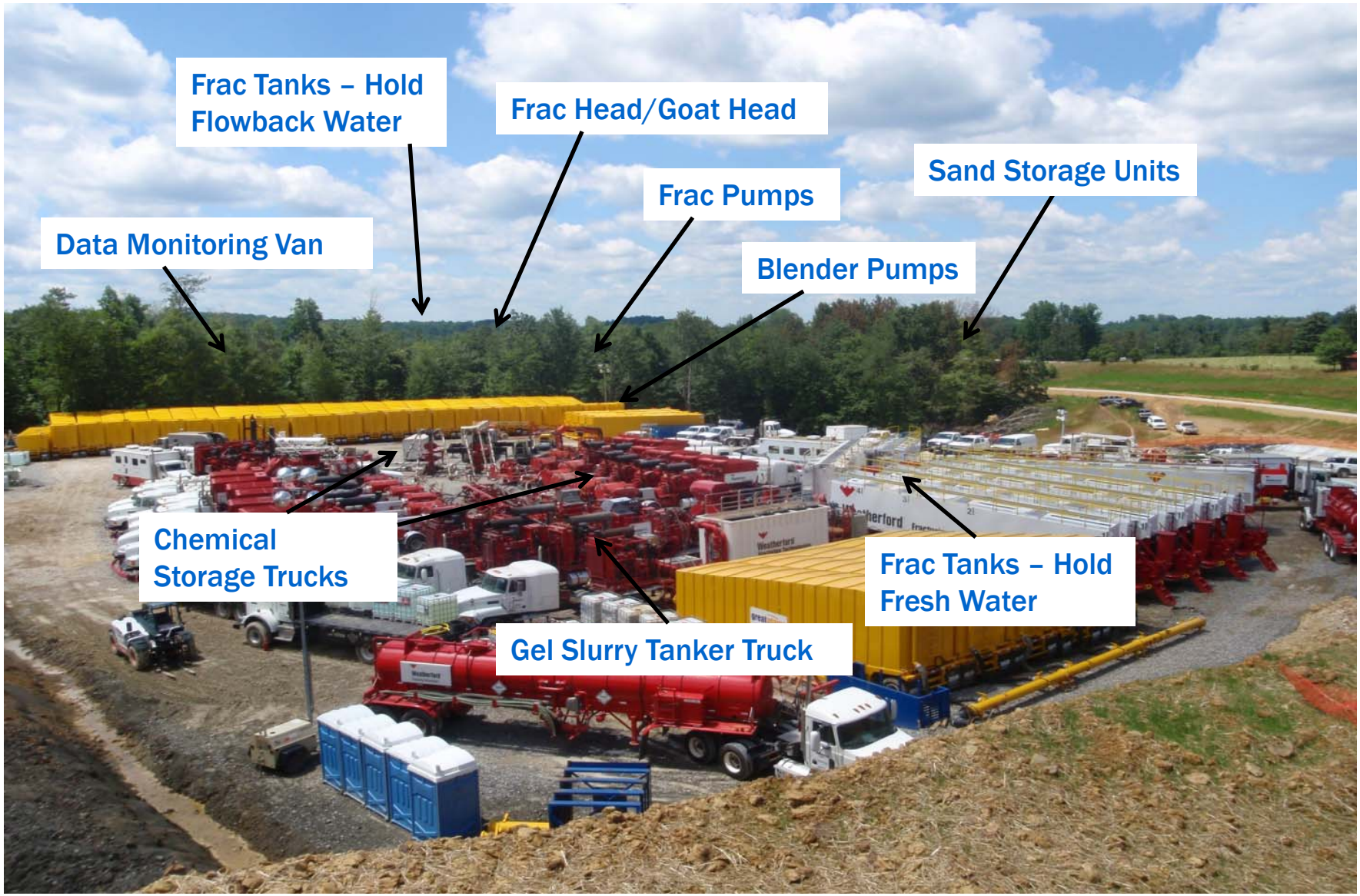
- **Breaking down a section of producing formation with hydraulic pressure using a proppant carrying fluid**
- **Proppant (usually sand) remains in the fracture, propping it open**
- **First fracture stimulation pumped in 1947 by Stanolind Oil Company in Grant County, Kansas**
- **First commercial stimulation pumped in 1949 in Oklahoma by Stanolind and Halliburton**

Fracturing Process



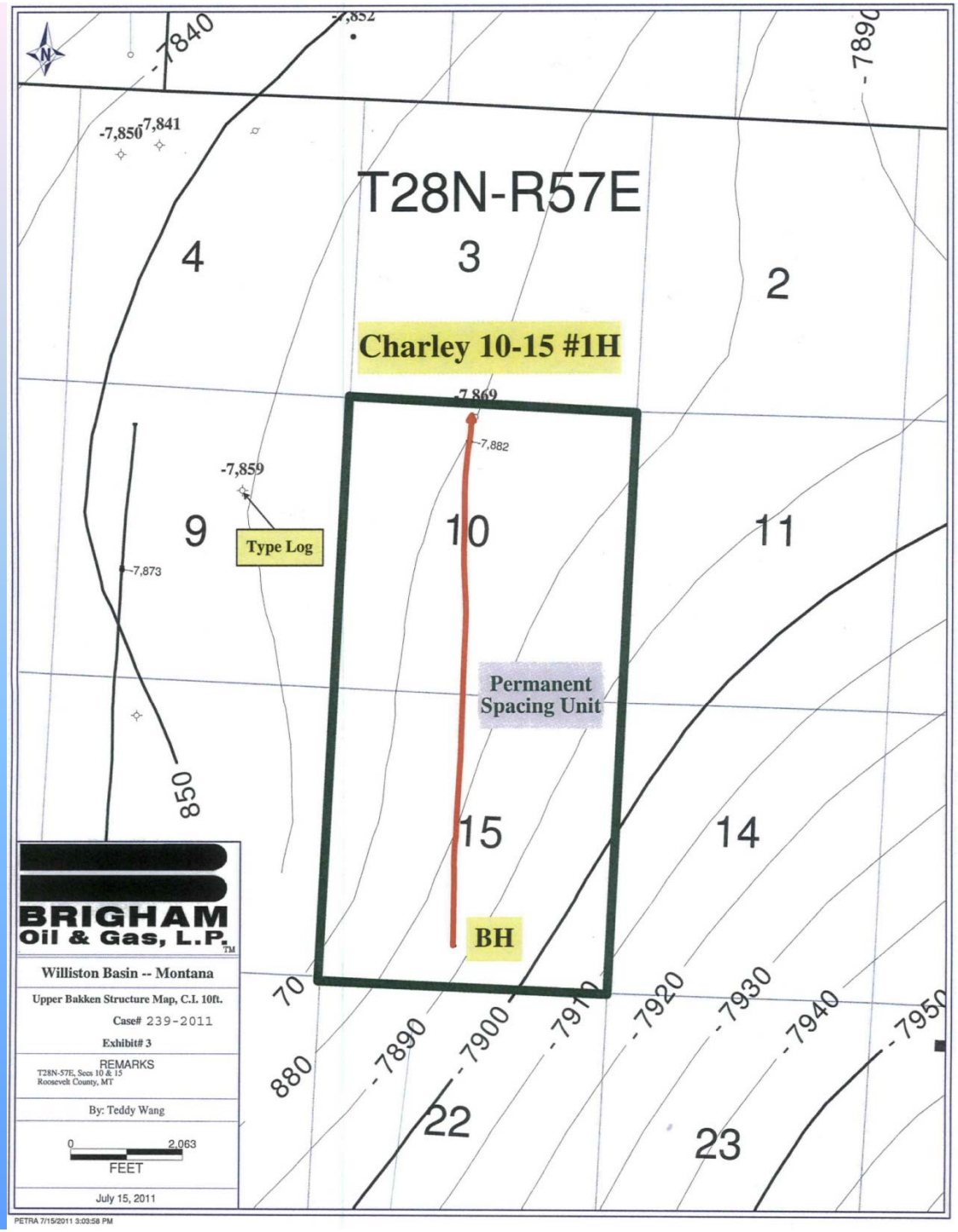
Source: Schlumberger

Fracing requires lots of stuff



100_1312
NO SMOKING
MATCHES OR
OPEN LIGHTS

Schlumberger


T28N-R57E
Charley 10-15 #1H
Type Log
Permanent Spacing Unit
BH
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-7,852
-7,890
-7,850
-7,841
-7,869
-7,882
-7,859
-7,873
850
880
-7890
-7900
-7910
-7920
-7930
-7940
-7950
4
3
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14
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23
BRIGHAM Oil & Gas, L.P.
Williston Basin -- Montana
Upper Bakken Structure Map, C.I. 10ft.
Case# 239-2011
Exhibit# 3
REMARKS
T28N-57E, Secs 10 & 15
Roosevelt County, MT
By: Teddy Wang
0
2,063
FEET
July 15, 2011
PETRA 7/15/2011 3:03:58 PM

WOODS YOUNG 9-1
WILDCAT
TD : 12,508

T28N R57E S9
ROOSEVELT

COMP_DATE : 11/2/1978

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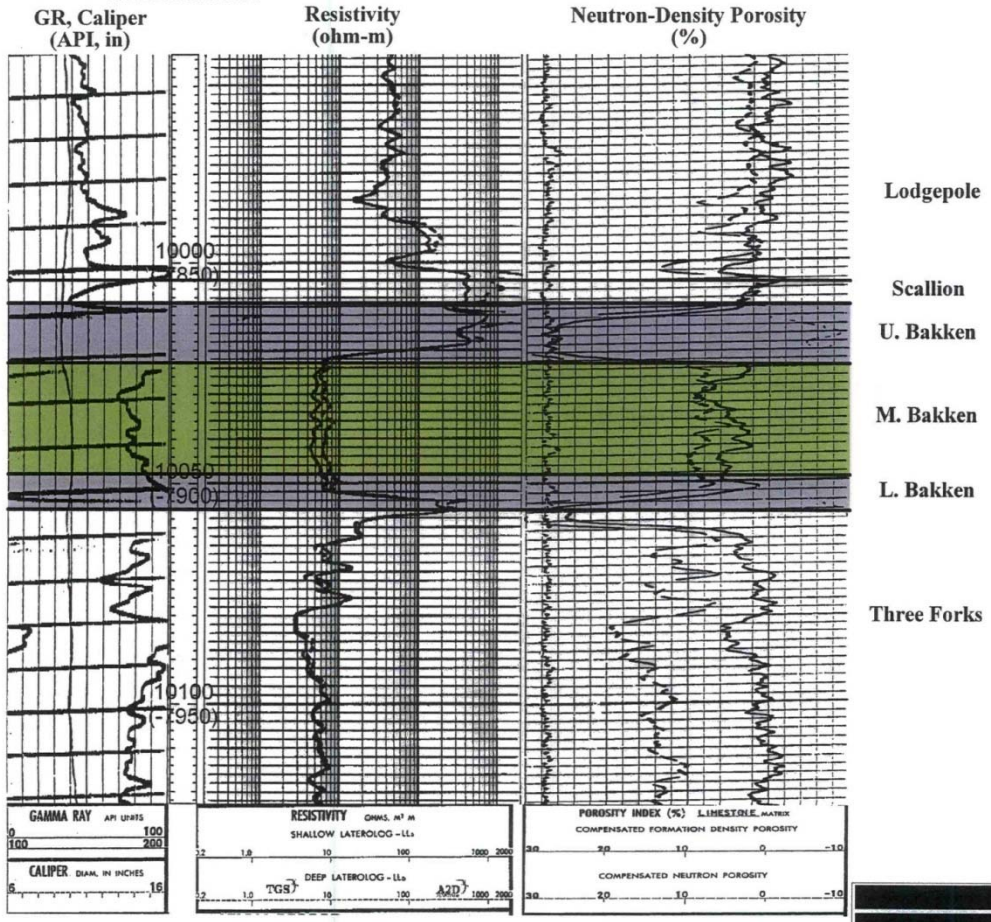


HS=0

BRIGHAM
Oil & Gas, L.P.

Williston Basin - Montana

Bakken Fm Type Section

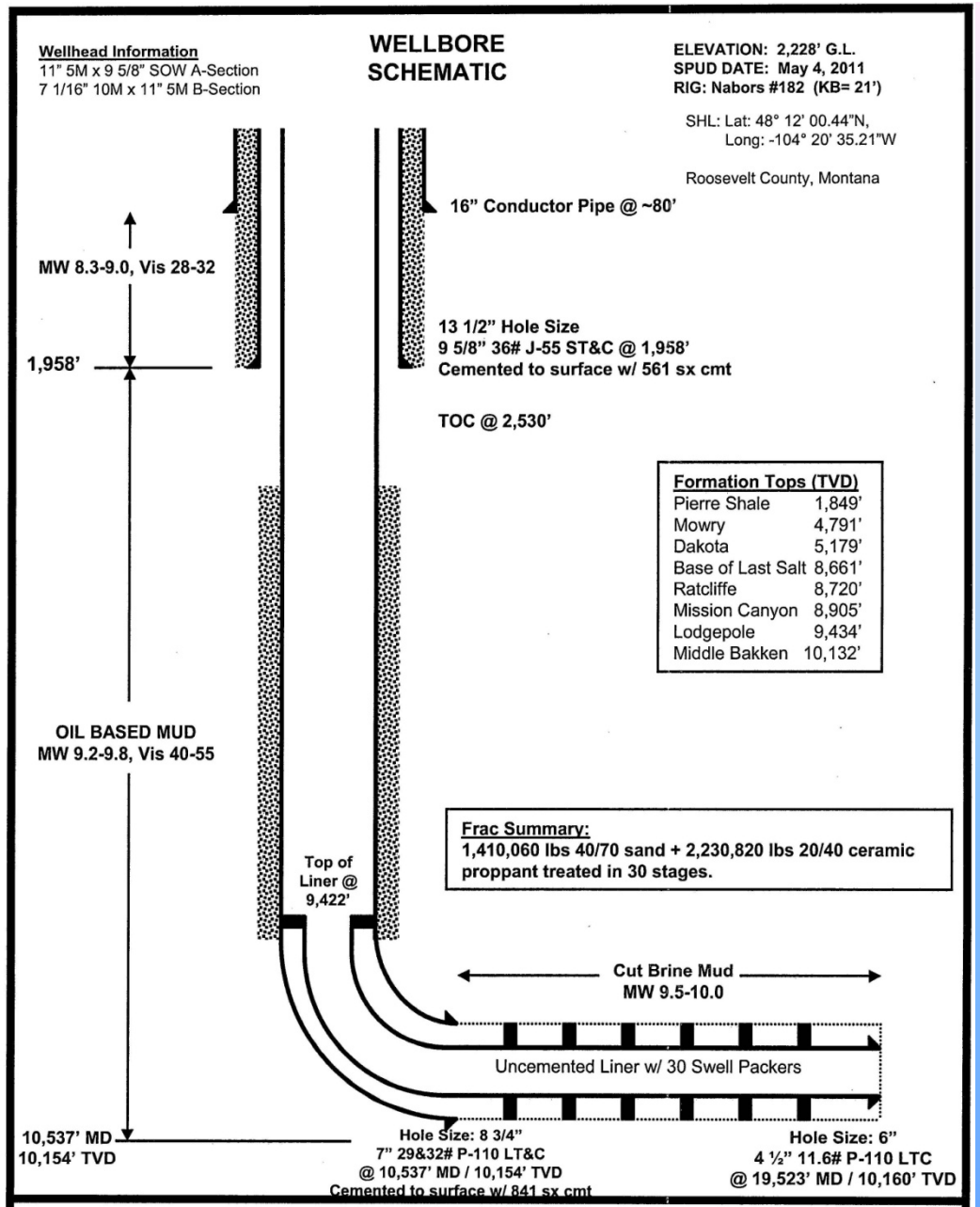
Case # 239-2011

Exhibit # 4

Charley 10-15 #1H Permanent Spacing
T28N-R57E Secs. 10 & 15
Roosevelt County, MT

By: Teddy Wang

July 15,2011 3:05 PM



BRIGHAM OIL & GAS, L.P.

CHARLEY 10-15 #1H SHL: 250' FNL & 2,300' FWL Sec 10-T.28N-R.57E BHL: 712' FSL & 2,398' FWL Sec 15-T.28N-R.57E	**MBOGC Docket No. 239-2011** **Exhibit # 5** **August 11, 2011**

Fracturing is controlled by reservoir and rock parameters

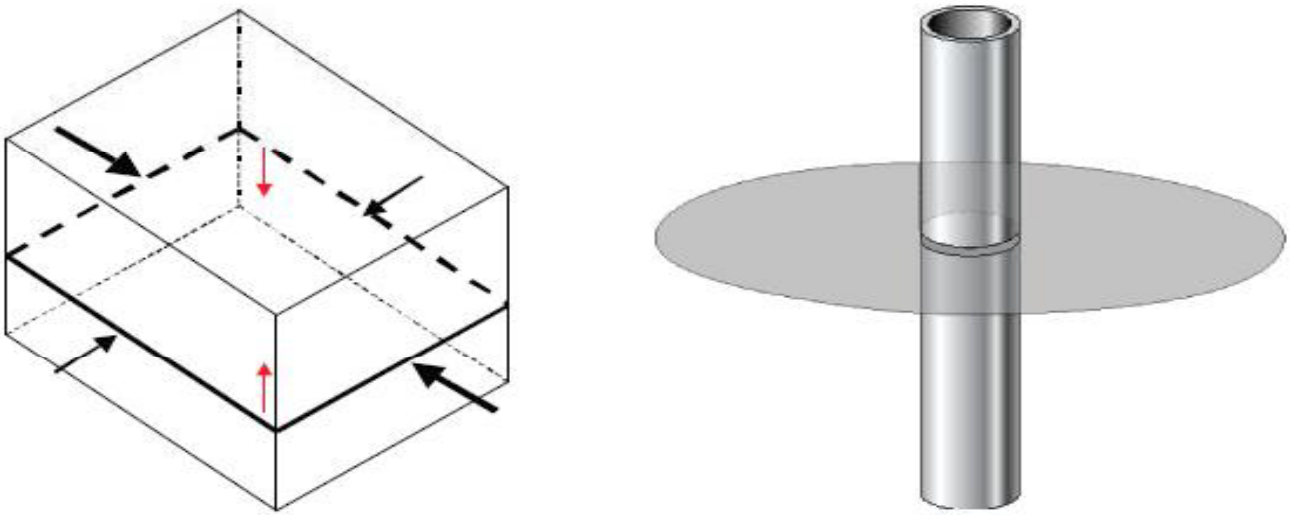


Figure 6—Least Principal Stress is in the Vertical Direction Resulting in a Horizontal Fracture

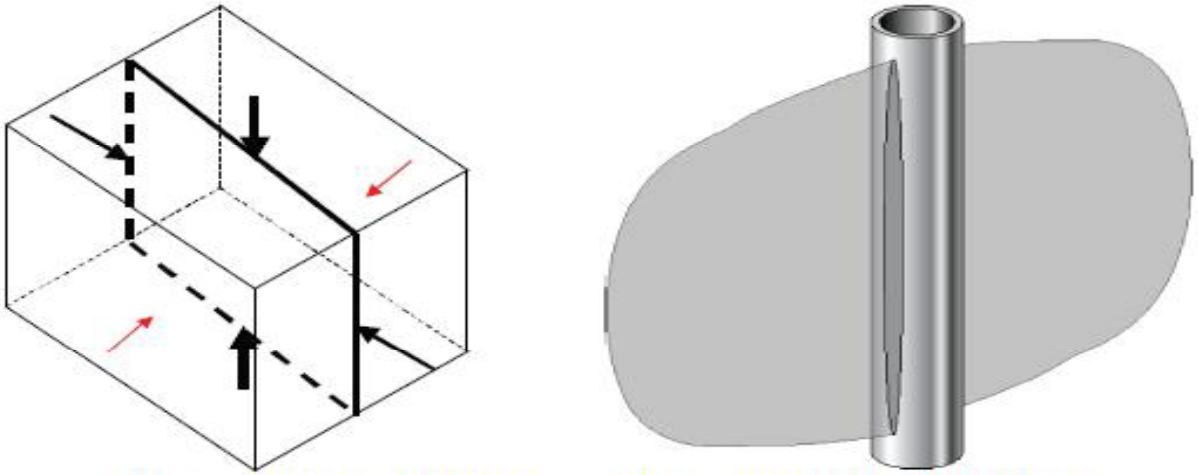
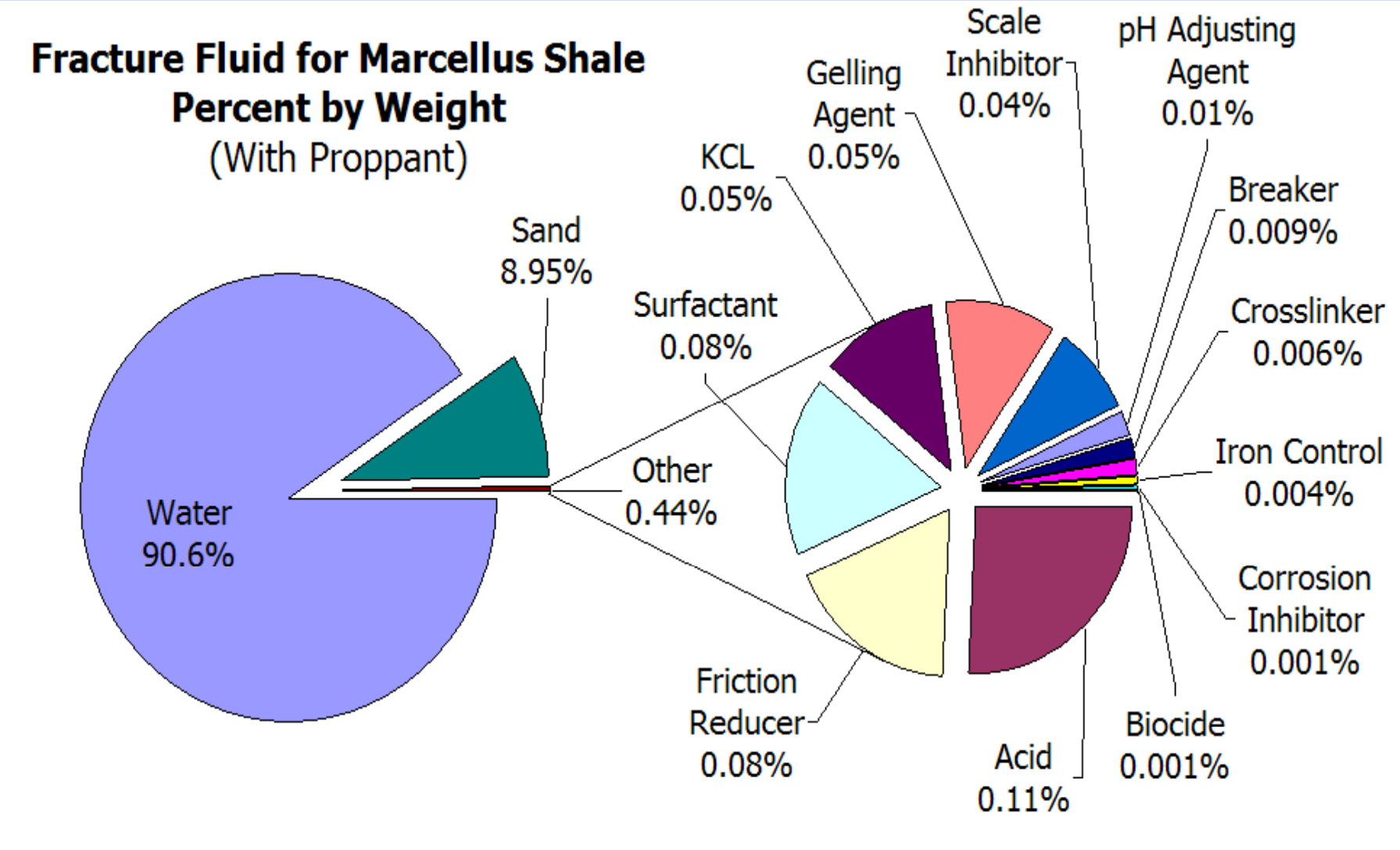
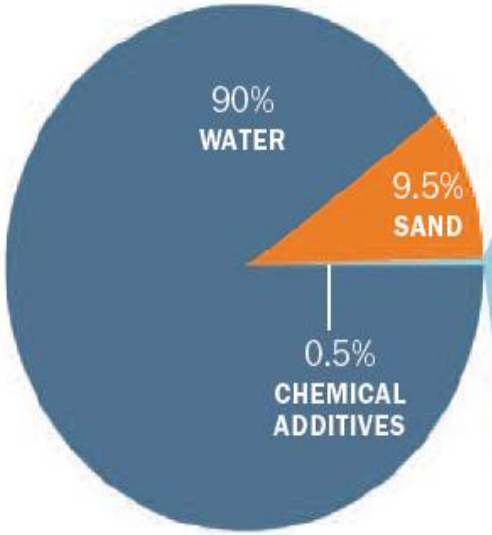


Figure 7—Least Principal Stress in the Horizontal Direction, Vertical Fracture

Fracture Fluid Composition



Typical Shale Fracturing Mixture Makeup

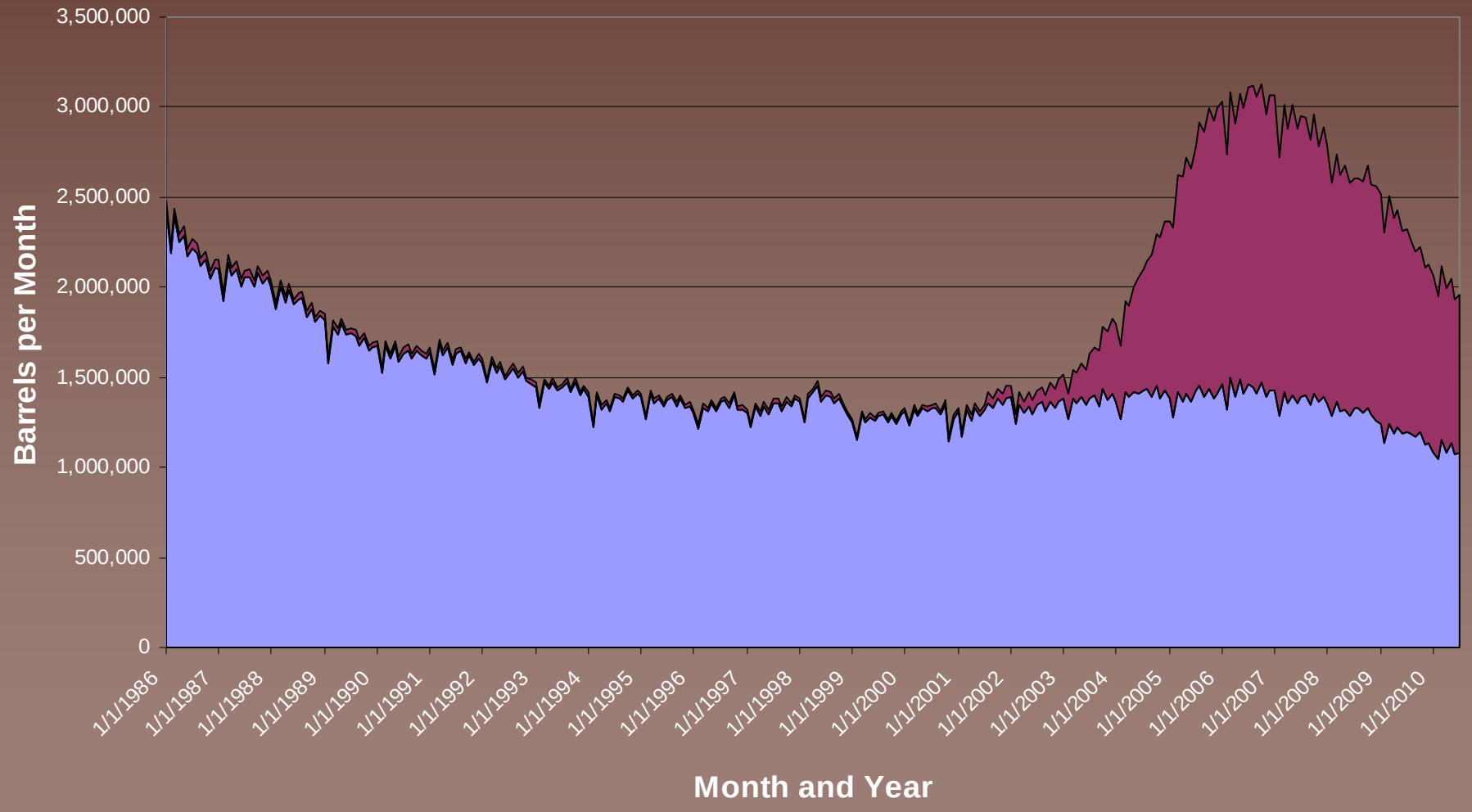


Typical Chemical Additives Used in Frac Water

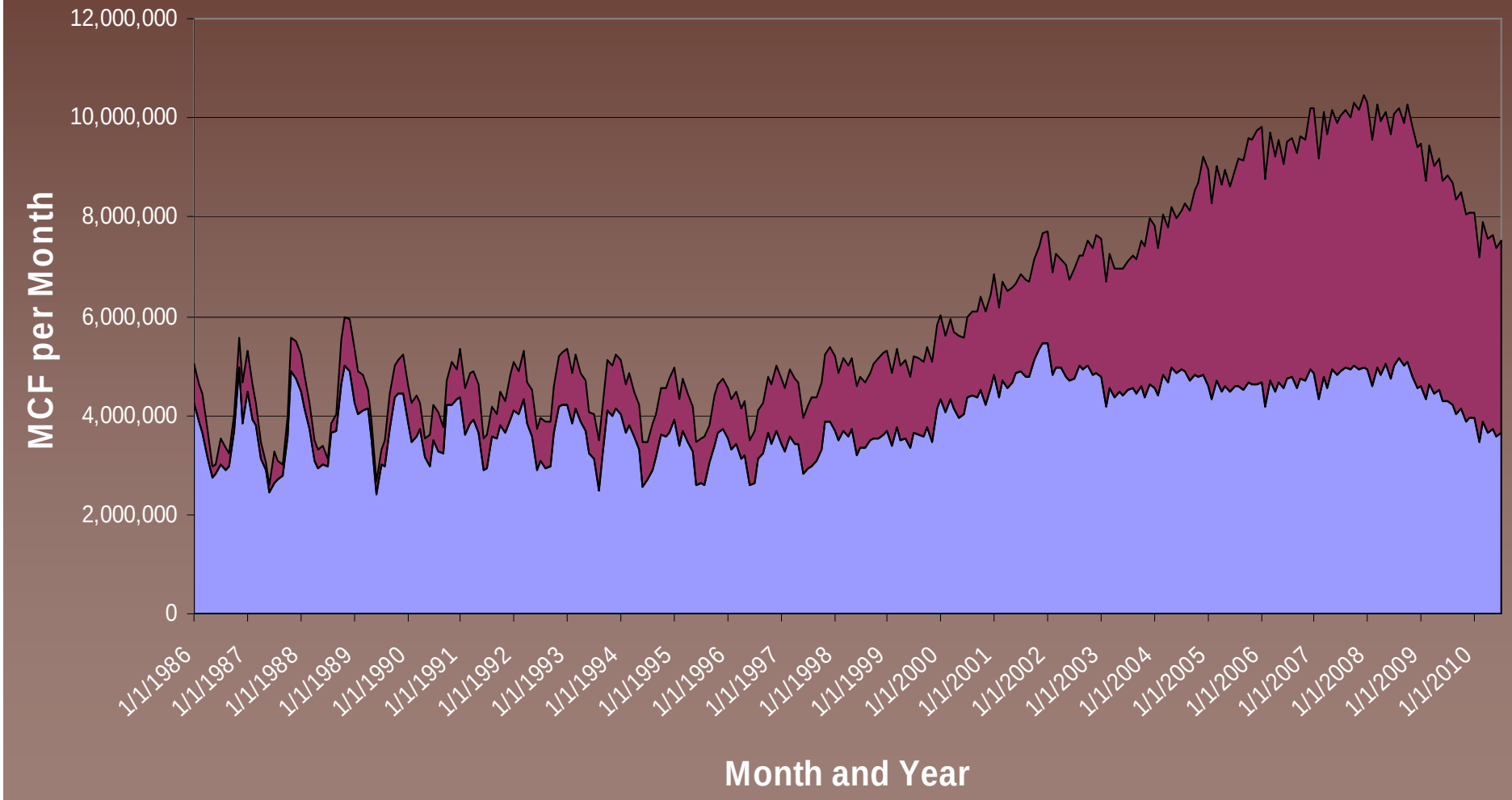
Compound	Purpose	Common application
Acids	Helps dissolve minerals and initiate fissure in rock (pre-fracture)	Swimming pool cleaner
Sodium Chloride	Allows a delayed breakdown of the gel polymer chains	Table salt
Polyacrylamide	Minimizes the friction between fluid and pipe	Water treatment, soil conditioner
Ethylene Glycol	Prevents scale deposits in the pipe	Automotive anti-freeze, deicing agent, household cleaners
Borate Salts	Maintains fluid viscosity as temperature increases	Laundry detergent, hand soap, cosmetics
Sodium/Potassium Carbonate	Maintains effectiveness of other components, such as crosslinkers	Washing soda, detergent, soap, water softener, glass, ceramics
Glutaraldehyde	Eliminates bacteria in the water	Disinfectant, sterilization of medical and dental equipment
Guar Gum	Thickens the water to suspend the sand	Thickener in cosmetics, baked goods, ice cream, toothpaste, sauces
Citric Acid	Prevents precipitation of metal oxides	Food additive; food and beverages; lemon juice
Isopropanol	Used to increase the viscosity of the fracture fluid	Glass cleaner, antiperspirant, hair coloring

Source: DOE, GWPC: Modern Gas Shale Development in the United States: A Primer (2009).

Total Monthly Oil Production With Estimated Contribution from Hydraulic Fracturing



Total Monthly Gas Production With Estimated Contribution from Hydraulic Fracturing



Rulemaking Timeline

- APRIL 28, 2011 BOARD AUTHORIZES DRAFTING OF NEW RULES
- MAY 16, 2011 PROPOSED RULES PUBLISHED IN M.A.R
- JUNE 15, 2011 PUBLIC HEARING AT HELD AT SIDNEY
- JUNE 23, 2011 PUBLIC COMMENT PERIOD ENDS
- AUGUST 10, 2011 BOARD VOTES TO ADOPT AMENDED RULES
- AUGUST 25, 2011 FINAL RULES PUBLISHED
- AUGUST 26, 2011 RULES IN EFFECT

Hydraulic Fracturing Rules

New Rule I

- Clarify Drilling Permit includes well completion activity
- Provides for written modification of the drilling permit with 48 hours notice
- Requires pre-frac disclosure of proposed fluids using estimated quantities and generic or trade names of components
- Allows pre-filing of designs; use of generic designs by geologic province and formation

New Rule II

- Requires disclosure of chemicals, CAS number and rate or concentration of frac fluids actually used
- Requires disclosure of non-hazardous chemicals
- Operator may file job logs, contractors reports, or other reports
- Board may waive direct report if operator submits info to FracFocus.org

Hydraulic Fracturing Rules

New Rule III

- Cites the MT Uniform Trade Secrets Act
- Does not require proprietary information disclosure except:
  - To respond to spills or similar incidents
  - Medical emergency
- Requires non-disclosure agreement for parties receiving confidential info

New Rule IV

- Establishes casing evaluation requirement and pressure testing requirement
- Requires surface safety devices

New Rule V

- Clarifies permit requirements for workover of existing wells
- Exempts mechanical repairs and certain well treatments from permitting
- Requires only a subsequent report for small acid and chemical treatments

FracFocus
Chemical Disclosure Registry

HYDRAULIC FRACTURING HOW IT WORKS | GROUNDWATER PROTECTION | CHEMICAL USE | REGULATIONS BY STATE | FIND A WELL BY STATE | FREQUENT QUESTIONS

WELCOME

Welcome to FracFocus, the hydraulic fracturing chemical registry website. This website is a joint project of the Ground Water Protection Council and the Interstate Oil and Gas Compact Commission.

On this site you can search for information about the chemicals used in the hydraulic fracturing of oil and gas wells. You will also find educational materials designed to help you put this information in perspective.

LEARN MORE >

Welcome | Hydraulic Fracturing | Casing & Cement | State Regulations | Chemical Use

Looking for information about a *well site near you?*

Search for nearby well sites that have been hydraulically fractured to see what chemicals were used in the process.

FAQs

1 / 3

Q. Where does the water used in hydraulic fracturing come from?

A. It comes from many sources including surface water bodies such as ponds, lakes, and streams, municipal authorities, groundwater wells, "produced water" (water that comes to the surface during oil and gas production), and re-cycled water from other hydraulic fracturing jobs. Read more...

All FAQs »

Groundwater Protection: Priority Number One

Oil and natural gas producers have stringent requirements for how wells must be completed. The genesis of these requirements is water safety.

Casing is the first line of defense used to protect freshwater aquifers.

More About Groundwater Protection »

GIS Coming to FracFocus

Within the next few weeks, FracFocus will begin using a new Google maps like interface that will allow you to search for hydraulic fracturing records by pointing at their locations on a map and zooming in for closer inspection. This added feature should make the search function more intuitive and easier to use. The GIS function should be added sometime in September. Look for it!

Read more

GROUNDWATER | Oil & Gas

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Schlumberger

Client:	EXAMPLE CLIENT
Well:	EXAMPLE WELL
Basin:	EXAMPLE BASIN
Field:	EXAMPLE FIELD
Country:	EXAMPLE COUNTRY
Case:	EXAMPLE-CASE
Date Prepared:	1/31/2011

Fluid Name & Volume			Additive	Additive Description	Concentration	Volume
Slickwater	271,124	Gal	M298L	Biocide	0.01 Gal / 1000 Gal	2.7 Gal
			B145	Friction Reducer	0.8 Gal / 1000 Gal	216.9 Gal
			W054	Non-Emulsifier	1.0 Gal / 1000 Gal	271.1 Gal
			L064	Clay Stabilizer	2.0 Gal / 1000 Gal	542.2 Gal

Fluid Name & Volume			Additive	Additive Description	Concentration	Volume
YF122ST+	179,075	Gal	M298L	Biocide	0.01 Gal / 1000 Gal	1.8 Gal
			B306	Gelling Agent	5.5 Gal / 1000 Gal	984.9 Gal
			W054	Non-Emulsifier	1.0 Gal / 1000 Gal	179.1 Gal
			L064	Clay Stabilizer	2.0 Gal / 1000 Gal	358.2 Gal
			J532	Crosslinker	3.0 Gal / 1000 Gal	537.2 Gal
			U028	Delaying Agent	0.5 Gal / 1000 Gal	89.5 Gal
			B360	Diverter	22.0 Lb / 1000 Gal	3939.7 Lb
			J475	Breaker	3.0 Lb / 1000 Gal	537.2 Lb
			J218	Breaker	1.0 Lb / 1000 Gal	179.1 Lb
			9020	20/40 Sand	1.0-5.0 PPA	378,554 Lb

Fluid Name & Volume			Additive	Additive Description	Concentration	Volume
YF120ST+	378,973	Gal	M298L	Biocide	0.01 Gal / 1000 Gal	3.8 Gal
			B306	Gelling Agent	5.0 Gal / 1000 Gal	1,894.9 Gal
			W054	Non-Emulsifier	1.0 Gal / 1000 Gal	379.0 Gal
			L064	Clay Stabilizer	2.0 Gal / 1000 Gal	757.9 Gal
			J532	Crosslinker	3.0 Gal / 1000 Gal	1,136.9 Gal
			U028	Delaying Agent	0.5 Gal / 1000 Gal	189.5 Gal
			B360	Diverter	22.0 Lb / 1000 Gal	8,337.4 Lb
			J475	Breaker	3.0 Lb / 1000 Gal	1,136.9 Lb
			J218	Breaker	1.0 Lb / 1000 Gal	379.0 Lb
			J318	Breaker Aid	0.1 Lb / 1000 Gal	18.9 Lb
			9020	20/40 Sand	1.0-5.0 PPA	817,870 Lb

Fluid Name & Volume			Additive	Additive Description	Concentration	Volume
WF122	29,933	Gal	M298L	Biocide	0.01 Gal / 1000 Gal	0.3 Gal
			B306	Gelling Agent	5.5 Gal / 1000 Gal	164.6 Gal
			W054	Non-Emulsifier	1.0 Gal / 1000 Gal	29.9 Gal
			L064	Clay Stabilizer	2.0 Gal / 1000 Gal	59.9 Gal

Fluid Name & Volume			Additive	Additive Description	Concentration	Volume
WF120	44,899	Gal	M298L	Biocide	0.01 Gal / 1000 Gal	0.4 Gal
			B306	Gelling Agent	5.0 Gal / 1000 Gal	224.5 Gal
			W054	Non-Emulsifier	1.0 Gal / 1000 Gal	44.9 Gal
			L064	Clay Stabilizer	2.0 Gal / 1000 Gal	89.8 Gal

The total volume listed in the tables above represents the gallonage of water and additives. Water is supplied by client.

CAS Number	Chemical Name	Mass Fraction
-	Water (Including Mix Water Supplied by Client)*	84.64903%
14808-60-7	Crystalline silica	14.53179%
64742-47-8	Distillates (petroleum), hydrotreated light	0.19319%
9000-30-0	Guar gum	0.17459%
9051-89-[illegible]	Polylactide resin	0.14763%
75-5[illegible]	Tetramethylammonium chloride	0.09164%
56-81-[illegible]	1, 2, 3 - Propanetriol	0.04667%
67-56-1	Methanol	0.04594%
1303-96-4	Sodium tetraborate decahydrate	0.02800%
7727-54-0	Diammonium peroxidisulphate	0.02304%
1310-73-2	Sodium hydroxide	0.01103%
78330-19-5	Oxyalkylated alcohol (2)	0.00825%
78330-20-8	Oxyalkylated alkyl alcohol (1)	0.00825%
68953-58-2	Organophilic clays	0.00729%
38193-60-1	Vinyl copolymer	0.00665%
30846-35-6	Ethoxylated propoxylated 4-nonylphenol-formaldehyde resin	0.00610%
64742-94-5	Heavy aromatic naphtha	0.00412%
78330-21-9	Oxyalkylated alcohol (1)	0.00412%
68989-00-4	Quaternary ammonium compound	0.00412%
25038-72-6	Vinylidene chloride/methylacrylate copolymer	0.00386%
66455-14-9	Surfactant	0.00182%
25322-68-3	Poly(oxy-1,2-ethanediyl)	0.00181%
68002-97-1	Alcohol ethoxylate C-10/16 with 6.5 EO	0.00119%
7647-14-5	Sodium chloride	0.00095%
55566-30-8	Tetrakis(hydroxymethyl)phosphonium sulfate	0.00094%
14807-96-6	Magnesium silicate hydrate (talc)	0.00020%
102-71-6	2,2',2"-nitrilotriethanol	0.00020%
	Total	**100%**

** Mix water is supplied by the client. Schlumberger has performed no analysis of the water and cannot provide a breakdown of components that may have been added to the water by third parties.*

EXAMPLE - FOR INDICATIVE PURPOSES ONLY

Hydraulic Fracturing Fluid Product Component Information Disclosure

Fracture Date	2011-06-06
State:	Texas
County:	Starr
API Number:	4242734642
Operator Name:	OXY USA Inc - Ebus
Well Name and Number:	TB Slick #230
Longitude:	0
Latitude:	0
Long/Lat Projection:	
Production Type:	
True Vertical Depth (TVD):	0
Total Water Volume (gal)*:	611,678

Hydraulic Fracturing Fluid Composition:

Trade Name	Supplier	Purpose	Ingredients	Chemical Abstract Service Number (CAS #)	Maximum Ingredient Concentration in Additive (% by mass)**	Maximum Ingredient Concentration in HF Fluid (% by mass)**	Comments
Brine Water	Operator				100.00%	83.18946%	Density = 8.340
CERAMIC PROP	Halliburton	Proppant	Crystalline silica, cristobalite	14464-46-1	30.00%	1.81861%	
			Mullite	1302-93-8	100.00%	6.06203%	
			Silica, amorphous - fumed	7631-86-9	30.00%	1.81861%	
CRC SAND	Halliburton	Proppant	Crystalline silica, quartz	14808-60-7	100.00%	7.28831%	
			Hexamethylenetetramine	100-97-0	2.00%	0.14577%	
			Phenol / formaldehyde resin	900303-35-4	5.00%	0.36442%	
PREMIUM PROP P	Halliburton	Proppant	Aluminum oxide	1344-28-1	100.00%	2.33485%	
			Crystalline silica, cristobalite	14464-46-1	5.00%	0.11674%	
CL-23 CROSSLINKI	Halliburton	Crosslinker	Ammonium chloride	12125-02-9	37.00%	0.01776%	
			Zirconium, acetate lactate calc ammoi	68909-34-2	60.00%	0.03946%	
BA-40L BUFFERIN	Halliburton	Buffer	Potassium carbonate	584-08-7	60.00%	0.00898%	
VICON NF BREAKE	Halliburton	Breaker	Chlorous acid, sodium salt	7758-19-2	10.00%	0.01233%	
			Sodium chloride	7647-14-5	30.00%	0.03698%	
BA-20 BUFFERING	Halliburton	Buffer	Acetic acid	64-19-7	30.00%	0.00628%	
			Ammonium acetate	631-61-8	100.00%	0.02093%	
GasPerm 1100	Halliburton	Non-Ionic Surfactant	Ethanol	64-17-5	60.00%	0.05188%	
			Terpenes and Terpenoids, sweet oran	68647-72-3	5.00%	0.00766%	
Clayfix 3	Halliburton	Misc Additive	Sodium chloride	7647-14-5	30.00%	0.07291%	
SP BREAKER	Halliburton	Breaker	Sodium persulfate	7775-27-1	100.00%	0.00199%	
BE-6 MICROBIOCID	Halliburton	Biocide	2-Bromo-2-nitro-1,3-propanediol	52-51-7	100.00%	0.00500%	
BE-9	Halliburton	Biocide	Tributyl tetradecyl phosphonium chlor	81741-28-8	10.00%	0.00078%	
FDP-S704-03	Halliburton	Non-Ionic Surfactant	Amine	Confidential Business Inform	100.00%	0.04321%	
3rd Party Surfactant	Operator	*3rd Party Additive	*Supplied by Operator		100.00%	0.04389%	Density = 9.000
WG-18 GELLING A	Halliburton	Gelling Agent	Guar gum derivative	Confidential Business Inform	100.00%	0.36849%	
WLC-4 WATER SL	Halliburton	Fluid Loss Additive (par	Complex carbohydrate	Confidential Business Inform	60.00%	0.02573%	
GBW-30 BREAKER	Halliburton	Breaker	Hemicellulase enzyme	9012-54-8	15.00%	0.00008%	
			Carbohydrates	Confidential Business Inform	95.00%	0.00050%	
SP BREAKER	Halliburton	Breaker	Sodium persulfate	7775-27-1	100.00%	0.00184%	
3rd Party Clay Cont	Operator	*3rd Party Additive	*Supplied by Operator		100.00%	0.00097%	
Ingredients Listed Below This Line Are Part of the Fluid Composition Provided by Halliburton Which Do Not Appear On the Material Safety Data Sheets (MSDS)							
			Aluminum Silicate	1302-76-7	100.00%	6.06203%	
			Ammonium acetate	631-61-8	5.00%	0.00329%	
			Calcium chloride	10043-52-4	1.00%	0.00246%	
			Ethoxylated Fatty Acid	Confidential Business Inform	10.00%	0.11485%	
			Magnesium chloride hexahydrate	7791-18-6	5.00%	0.01232%	
			Silica, amorphous - fumed	7631-86-9	1.00%	0.00368%	
			Sodium bicarbonate	144-55-8	5.00%	0.01842%	
			Sodium chloride	7647-14-5	0.10%	0.00059%	
			Sodium formate	141-53-7	5.00%	0.01232%	
			Sodium sulfate	7757-82-6	0.10%	0.00000%	
			Terpenes, Orange Oil Blend	Confidential Business Inform	5.00%	0.00766%	
			Water	7732-18-5	100.00%	0.06577%	

* Total Water Volume sources may include fresh water, produced water, and/or recycled water

** Information is based on the maximum potential for concentration and thus the total may be over 100%

Note: For Field Development Products (products that begin with FDP), MSDS level only information has been provided.

All component information listed was obtained from the supplier's Material Safety Data Sheets (MSDS). As such, the Operator is not responsible for inaccurate and/or incomplete information. Any questions regarding the content of the MSDS should be directed to the supplier who provided it. The Occupational Safety and Health Administration's (OSHA) regulations govern the criteria for the disclosure of this information. Please note that Federal Law protects "proprietary", "trade secret", and "confidential business information" and the criteria for how this information is reported on an MSDS is subject to 29 CFR 1910.1200(i) and Appendix D.

Questions?

www.bogc.dnrc.mt.gov