Texas E&P Overview

- +1.25 wells drilled since 1866
- Depths of 100 to +30,000 feet
- 238/254 counties
- #1 US Producer:
  - 1/3rd total domestic oil
  - 1/3rd total domestic gas
- $115 billion to TX economy
Texas E&P Overview

• +1.25 wells drilled since 1866
• Depths of 100 to +30,000 feet
• 238/254 counties
• 7,500 active operators

- Total active producing wells:
  - 152,000 Oil wells
  - 104,000 Gas wells

#1 US Producer:
- 343 million barrels oil
- 7.6 Tcf natural gas

$114.43 billion to TX economy
RRC JURISDICTION

- Well spacing, density, drilling, completion (including HF), production, and plugging
- Pipelines
- Safety
- Waste management:
  - Storage
  - Transport
  - Disposal
  - NORM disposal
NOT RRC JURISDICTION

- Traffic
- Noise
- Scenic impact
- Property values
- Zoning
SOME RRC JURISDICTION

• Water Use
  – RRC: Encourage and regulate recycling
  – TCEQ: Temporary surface water rights
  – TCEQ/TWDB/GCDs: Groundwater withdrawal

• Air
  – RRC: Flaring/venting/H2S (safety)
  – TCEQ/EPA: Pollutant emissions
Hydraulic Fracturing

Practiced since early 1950s

First large scale Barnett Shale hydraulic fracturing stimulation: 1986

Approximately 85% of all wells fracture stimulated
HYDRAULIC FRACTURING

- Deep Formations — Deeper than 1 mile
- Shallow groundwater — less than 1000 feet
- Operator incentives to carefully design fracture program
  - Cost of wells
  - Minimization of wastewater
  - Maximization of production
  - Protection of well and formation
RRC RULEMAKING

• SWR 29: HF chemical disclosure
• SWR 13: Well completion
• SWR 8/Chapter 4, Subchapter B: Recycling
• SWR 9/46: Disposal/Injection Wells
HB 3328 – CHEMICAL DISCLOSURE

RRC Rules:
• Use of FracFocus
• Service companies to supply information
• Allow Trade Secrets
• Limited challenges to Trade Secret
• Provide information to emergency responders and health professionals
SWR 29 – CHEMICAL DISCLOSURE

• Definitions
• Applicability
• Required disclosures
• Disclosures not required
• Trade Secret protection
• Trade Secret challenge
• Trade Secret confidentiality
• Penalties
Applicability

HF Treatment performed on a well for which RRC has issued initial drilling permit on or after February 1, 2012
SWR 29 – CHEMICAL DISCLOSURE

• MSDS Chemicals
  • Provide all information requested by FracFocus

• Non-MSDS Chemicals
  • Provide chemical names and CAS#
<table>
<thead>
<tr>
<th>Trade Name</th>
<th>Supplier</th>
<th>Purpose</th>
<th>Ingredients</th>
<th>Chemical Abstract Service Number (CAS #)</th>
<th>Maximum Ingredient Concentration in Additive (%)**</th>
<th>Maximum Ingredient Concentration in HF Fluid (%) by mass**</th>
<th>Comments</th>
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<tbody>
<tr>
<td>Frac-Side 1000</td>
<td>Baker Hughes</td>
<td>Biocide</td>
<td>2,2-Dibromo-3-Nitropropaneamide, Water</td>
<td>10223-01-2, 7730-18-5</td>
<td>100.00%</td>
<td>83.89991%</td>
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<tr>
<td>Alpha 452</td>
<td>Baker Hughes</td>
<td>Biocide</td>
<td>Tetrakis(hydroxymethyl) Phosphonium Sulfate, Water</td>
<td>55966-30-8, 7730-18-5</td>
<td>40.00%</td>
<td>0.00077%</td>
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<tr>
<td>Enzyme G-1</td>
<td>Baker Hughes</td>
<td>Breaker</td>
<td>Hemicellulose Enzyme Concentrate, Water</td>
<td>9025-55-3, 7730-18-5</td>
<td>3.00%</td>
<td>0.000108%</td>
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<tr>
<td>GRW-23L</td>
<td>Baker Hughes</td>
<td>Breaker</td>
<td>Magnesium Hydroxide, Magnesium Oxide, Magnesium Peroxide</td>
<td>1306-42-8, 1304-44-4, 1488-07-4</td>
<td>5.00%</td>
<td>0.00025%</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>White Mineral Oil, Polysiloxane</td>
<td>8042-47-5</td>
<td>91.00%</td>
<td>0.00113%</td>
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<tr>
<td>EF-3L, 55 gal drum</td>
<td>Baker Hughes</td>
<td>Buffer</td>
<td>Potassium Carbonate, Polysiloxane</td>
<td>184-08-7, 1305-03-3</td>
<td>60.00%</td>
<td>0.00086%</td>
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<tr>
<td>KLW-30AG, tote</td>
<td>Baker Hughes</td>
<td>Crosslinker</td>
<td>Hydrolyzed Light Distillate</td>
<td>64742-47-8</td>
<td>30.00%</td>
<td>0.00120%</td>
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<tr>
<td>GW-3LDF</td>
<td>Baker Hughes</td>
<td>Gelling Agent</td>
<td>Guar Gum, Polysiloxane Distillate Blend</td>
<td>9000-30-0, 1305-03-3</td>
<td>40.00%</td>
<td>0.00167%</td>
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<tr>
<td>NE-900, tote</td>
<td>Baker Hughes</td>
<td>Non-emulsifier</td>
<td>Methanol, Nonyl Phenyl Polyethylene Glycol Ether</td>
<td>67-66-1, 8016-45-9</td>
<td>30.00%</td>
<td>0.00120%</td>
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<tr>
<td>Sand, White, 40/70</td>
<td>Baker Hughes</td>
<td>Proppant</td>
<td>Crystalline Silica (Quartz)</td>
<td>14808-60-7</td>
<td>100.00%</td>
<td>4.70688%</td>
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<tr>
<td>Mg Light, 20/40</td>
<td>Baker Hughes</td>
<td>Proppant</td>
<td>Magnesium Iron Silicate, Magnesium Silicate</td>
<td>1317-7-1, 1343-83-0</td>
<td>10.00%</td>
<td>0.00078%</td>
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<tr>
<td>ScaleSorb 3, (25# gal)</td>
<td>Baker Hughes</td>
<td>Scale Inhibitor</td>
<td>Alumina Yt (Methylene Phosphonic Acid)</td>
<td>6419-19-8</td>
<td>30.00%</td>
<td>0.000583%</td>
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<td></td>
<td>Calcined Diatomaceous Earth</td>
<td>91083-33-3</td>
<td>100.00%</td>
<td>0.00343%</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Crystalline Silica Quartz</td>
<td>14808-60-7</td>
<td>1.00%</td>
<td>0.00019%</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Phosphonic Acid</td>
<td>13598-46-2</td>
<td>1.00%</td>
<td>0.00019%</td>
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<tr>
<td>ISFz 250W</td>
<td>Baker Hughes</td>
<td>Surfactant</td>
<td>Methanol</td>
<td>1511-76-2, 67-66-1</td>
<td>20.00%</td>
<td>0.00380%</td>
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<td></td>
<td>Surfactants</td>
<td>67-66-1</td>
<td>30.00%</td>
<td>0.001335%</td>
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<td>Alkyl Benzenesulfonic Acid, Fatty Acid Amide</td>
<td>65364-22-5, 1303-85-2</td>
<td>80.00%</td>
<td>0.003560%</td>
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<td>Copolymer</td>
<td>1303-85-2</td>
<td>80.00%</td>
<td>0.003560%</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Crystalline Silica</td>
<td>14808-60-7</td>
<td>100.00%</td>
<td>0.00343%</td>
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<tr>
<td></td>
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<td></td>
<td>Ethylene Glycol Monobutyl Ether</td>
<td>111-76-2, 67-66-1</td>
<td>20.00%</td>
<td>0.00380%</td>
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<td></td>
<td></td>
<td></td>
<td>Hydrolyzed Light Distillate</td>
<td>64742-47-8</td>
<td>100.00%</td>
<td>0.00343%</td>
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<td></td>
<td>Modified Amide</td>
<td>68442-77-3</td>
<td>20.00%</td>
<td>0.00380%</td>
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<td>Poly (oxy-1,2-ethanediyl)</td>
<td>24838-91-8</td>
<td>20.00%</td>
<td>0.00380%</td>
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<td></td>
<td>Propylene Carbonate</td>
<td>106-32-7</td>
<td>80.00%</td>
<td>0.003560%</td>
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<td>Quaternary Ammonium Compounds</td>
<td>68953-68-2</td>
<td>80.00%</td>
<td>0.003560%</td>
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<td>Sodium Sulfate</td>
<td>7751-82-6</td>
<td>80.00%</td>
<td>0.003560%</td>
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<td></td>
<td>Sodium monodi(c dodecyl) Disulfonate Oxide</td>
<td>113945-04-9</td>
<td>80.00%</td>
<td>0.003560%</td>
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<td></td>
<td>Sodium Tetradecyl Sulfate</td>
<td>1330-43-4</td>
<td>80.00%</td>
<td>0.003560%</td>
<td></td>
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</tbody>
</table>
WELL COMPLETION

• Surface casing and cement
• Production casing and cement
• Tubing and packer
• Casing pressure testing
• Well control at all times
• Quality cement; testing
• Centralizers
Protected Ground Water

- Surface casing set and cemented thru deepest useable water quality aquifer

- Depth of protected ground water defined by RRC GAU on a well by well basis
SWR 13 – Casing, Cementing, Completion Requirements

• Amendments:
  • Transfer of TCEQ Surface Casing Section to RRC Groundwater Advisory Unit
  • Update references to standards
  • Update requirements for drilling, casing, cementing, well control, and fracture stimulation
SWR 13 – Casing, Cementing, Completion Requirements

- Define “usable quality water”
- Require isolation of “potential flow zones” and “zones with corrosive formation fluids”
- Require integrity testing of surface casing after drillout after reaching total depth or the depth of the next casing string if rotating hours greater than 360 hrs
SWR 13 – Casing, Cementing, Completion Requirements

• Requirements for well on which hydraulic fracturing treatment(s) (HFT) will be performed:
  • Standards for internal yield pressure rating of casing
  • Pressure test casing
  • Monitor all annuli during HFT
  • Notify RRC if pressures deviate
SWR 13 – Casing, Cementing, Completion Requirements

• Requirements for “minimum separation wells” - distance between protection depth and top of FM to be fractured < 1000 feet or inadequate separation, or structurally complex geologic setting;

• All requirements for HFT wells

• Cement evaluation

• Notify RRC is results indicate insufficient isolation
Recycling Regulations

- Amendments adopted March 26, 2013:
  - Authorize certain on-lease, non-commercial recycling of hydraulic fracturing flowback fluid, with conditions
  - Clarify permitting requirements for commercial or centralized recycling of hydraulic fracturing flowback fluid
Recycling Regulations

• Authorized Reuse:
  • Reuse as makeup water or other use in the wellbore of an oil, gas or geothermal well
  • Reuse in any other manner pursuant to a permit issued by another state or federal agency
  • Any reuse if water distilled
  • No discharge to waters of the state without permit
RECYCLING???
SWR 9/46 – Disposal/Injection Wells

- Proposed amendments:
  - Clarification of existing requirements
    - Notice
    - Amendment of existing permits
    - Special conditions for certain areas
  - All wells w/in AoR have adequate and properly placed cement to ensure confinement of injected fluids within permitted interval
  - No automatic transfer of commercial disposal well permits
SWR 9/46 – Disposal/Injection Wells

- CLEARLY STATES INTENT:
  - Confine injected fluids to permitted interval;
  - Isolate UQW to prevent contamination and harm from migration of injected fluids or displaced formation fluids;
  - Isolate potential productive and flow zones to prevent vertical migration of fluids behind the casing; and
  - Ensure injection of fluids will not endanger USDWs or human health and safety.
SWR 9/46 – Disposal/Injection Wells

• New definitions:
  – Groundwater Advisory Unit
  – Orphaned well
  – Protection depth
  – Potential flow zone
  – Usable quality water (UQW)
  – Underground source of drinking water (USDW)
SWR 9/46 – Disposal/Injection Wells

• PERMIT EXPIRATION
  – A disposal well permit with a stated term expires on the last day of that term.
  – Permits w/o stated term expire 2-3 years after permit issuance if operator has not spudded the well, or, in the case of the conversion of an existing well, the operator has not commenced operations on the well specific to the conversion of the well to injection.
SWR 9/46 – Disposal/Injection Wells

• GEOLOGICAL REQUIREMENTS
  – Impervious strata adequate to protecting UQW and USDWs
    • Minimum of 250 feet of impermeable strata between the base of UQW and the top of the injection interval, of which at least one zone has a continuous thickness of at least 100 feet
    • Minimum of 100 feet of continuous impermeable strata between the base of the deepest USDW and the top of the injection interval.
GEOLOGICAL REQUIREMENTS

Groundwater Protection Determination:

- Injection into formation will not endanger UQW in the area
- Formations to be used for disposal are not USD\text{Ws}
SWR 9/46 – Disposal/Injection Wells

• NOTICE:
  – On or not more than 30 days before applicant files
  – Additional entities to be notified:
    • Operator of any well with an unexpired drilling permit located w/in ½-mile of proposed disposal well
    • For all tracts w/in ½-mile of the proposed well, lessees of record for tracts that have no designated operator and all owners of record of unleased mineral interests
    • Groundwater Conservation District
SWR 9/46 – Disposal/Injection Wells

• SUBSEQUENT COMMISSION ACTION
  – Clarifies RRC can modify, suspend or terminate permit if:
    • Continued operation of the well likely to endanger USDWs or human health or safety
    • Applicant provided incorrect information
    • Applicant failed to provide the required notice
  – Transfer of commercial disposal well would require written approval by director after an inspection and a review that confirms compliance with a permit and Commission rules
SWR 9/46 – Disposal/Injection Wells

• AREA OF REVIEW (AoR)
  – Review of ALL wells that penetrate the top of the proposed disposal interval within 1/4 mile to determine if wells are completed to prevent the movement of fluids from the disposal interval into UQW.
  – Wells that penetrate the proposed disposal interval within a 1/4 mile radius must be cemented across the injection interval to prevent movement of fluids from the disposal interval into UQW.
  – Director cannot approve a permit application for a disposal well for which the AoR includes any orphaned wells that penetrate the top of the proposed injection interval.
SWR 9/46 – Disposal/Injection Wells

• CASING AND CEMENT
  – Compliance with SWR13 and such that injected fluids will not endanger oil, gas, geothermal resources or USDWs
  – Director cannot approve permit application for:
    • any well in which the surface casing is not set and cemented from the ground surface to the BUQW
    • any well in which the casing is not cemented across and extending above the base of the deepest USDW
SWR 9/46 – Disposal/Injection Wells

• Clearly states if well fails integrity testing:
  – Shut in
  – Remediate
  – Re-test
  – Get RRC approval before recommencing injection
SWR 9/46 – Disposal/Injection Wells

- INCORPORATES PERMIT CONDITIONS AND ADDS:
  - Additional logging requirements
  - Additional commercial well requirements:
    - Lined secondary containment for tanks at commercial disposal wells
    - On-site sewage system
Leslie Savage, P.G.
Chief Geologist
Oil & Gas Division
Railroad Commission of Texas
Leslie.savage@rrc.state.tx.us

However beautiful the strategy,
you should occasionally look at the results.

Winston Churchill