

# Williams Experience in Methane Emissions Mitigation



**Producers and Processors  
Technology Transfer Workshop**

**Western Gas Resources and  
EPA's Natural Gas STAR Program  
Rock Springs, WY  
May 11, 2006**



# Reduced Emission Completions (Green Completions)

## Agenda

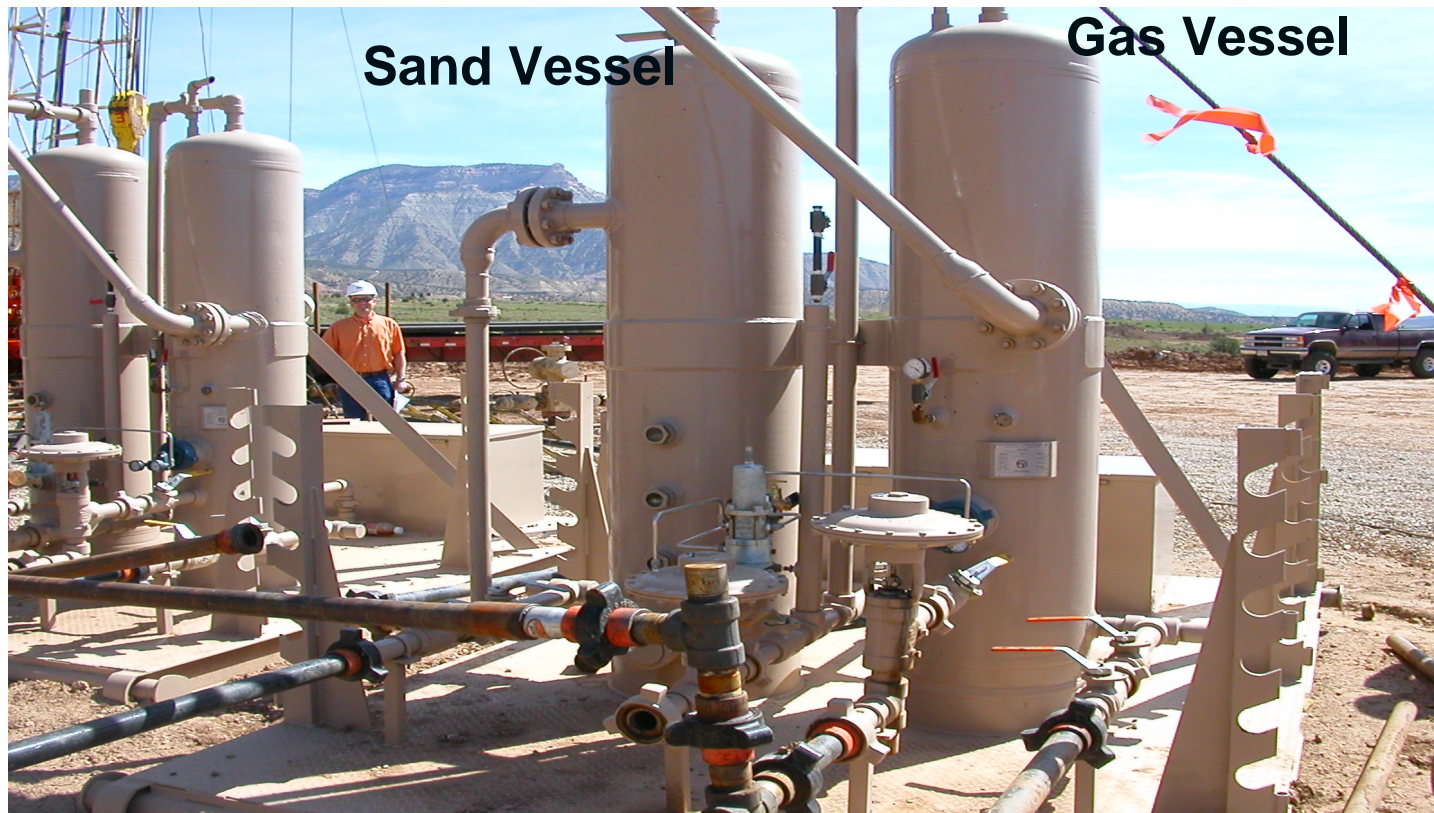
- 🔥 Green Completions
- 🔥 Flowback Skids
- 🔥 Piceance Basin Well Completions
- 🔥 Green Completion Economics
- 🔥 Conclusion



# Green Completions

- 🔥 Technology used to recover gas that is otherwise vented or flared during the completion phase of natural gas well
- 🔥 At Williams, Green Completion technology is a flowback separator skid leased from Breco
- 🔥 Flowback skids used to separate sand, water and gas during initial flowback

# Breco Flowback Skid



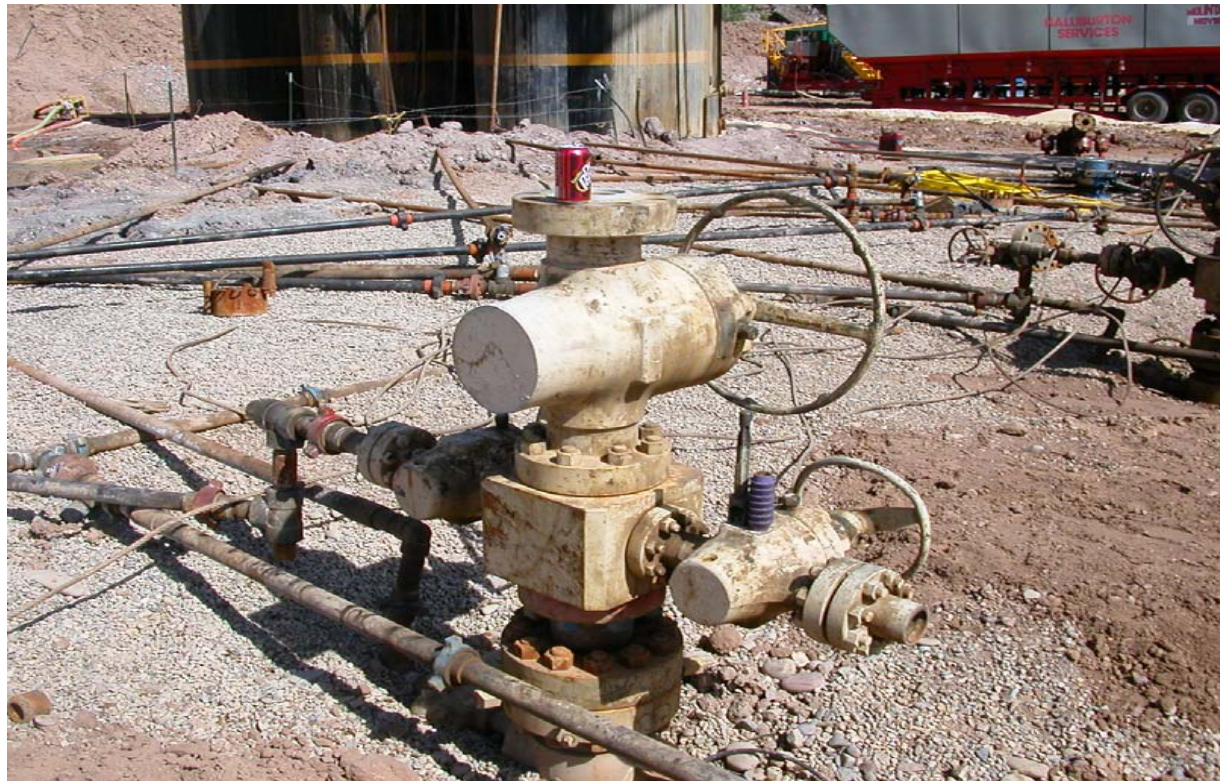
## Flowback Skid – When Is It Used?

- 🔥 Used after each zone is fracture stimulated (frac'd)
- 🔥 Used when all zones are fractured and waiting for workover rig to drill out plugs for final completion (Up to 10 days)
- 🔥 Production well must be located near gathering system
- 🔥 Wildcat and step-out wells are not completed with Green Completion Technology
- 🔥 One Month = time wells at typical 4-well pad are routed to flowback skid

## Flowback Skid - Operation

- 🔥 Sand Vessel separates sand from field gas
- 🔥 Gas Vessel separates gas from water used for hydraulic frac'ing
  - 🔥 Gas routed to sales line
- 🔥 Sand is dumped to reserve pit manually
- 🔥 Water dumps to holding tanks automatically
  - 🔥 Water is filtered and reused for future frac jobs
- 🔥 Flowback skid operates at 20 to 40 psi greater than gas gathering line pressure which is about 260 to 320 psi in Piceance Basin

# Flowback Skid – Wellhead Equipment



# Flowback Skid – Reserve Pit and Water Holding Tanks





# Piceance Well Completions

- 🔥 Well Completion Type = Mechanical Isolation
- 🔥 Perforate casing prior to Stage 1 – makes fracture stimulation possible
- 🔥 Frac Stage 1
- 🔥 Flow back well, first 12 hours is water, afterwards routed to Breco skid
- 🔥 Set plug to isolate frac stage
- 🔥 REPEAT for each stage (avg. 5 to 6 stages/well)
- 🔥 Plugs drilled out by Workover Rig
- 🔥 Producing to flowback skid after frac'ing and before plugs drilled out

# Piceance Well Completions

- 🔥 Williams Fork Formation – low permeability, tight, lenticular sandstone (10% porosity, permeability range of 1 to 10 microdarcies).
- 🔥 Wells drilled to depths of 6,500 ft to 9,000 ft
- 🔥 Flow pressures range from 1,500 to 2,500 psi
- 🔥 Fracture stimulation needed to make wells economical
- 🔥 Frac about 5 to 6 stages per well
- 🔥 Breco Flowback Skid resides on typical 4 well pad for 32 days

# Piceance Well Completions

## Risks Associated with Green Completions

### 1 – Wellbore/Reservoir Risk

- 🔥 Fluids pumped downhole must be recovered as quickly as possible
- 🔥 Flowing fluids to flowback skid results in decreased flowback rates
- 🔥 Wellbore damage by fluids can diminish production

### 2 – Operational Risk

- 🔥 When plugs drilled out well flows to remove produced sand and lift fluids used during frac.
- 🔥 Flowing to Breco skid increases backpressure/decreases flow rates

# Piceance Well Completions

## Risks Associated with Green Completions, con't

### 3 – Safety

- 🔥 Flowing gas, condensate, water, and sand during completion can cause pipe and vessel washouts
- 🔥 Elbows reinforced with high strength metal
- 🔥 Breco person visits each location every 1 to 1.5 hrs to identify leaks before they become washouts

# Flowback Skid – Washout Safety Feature



# Flowback Skid - Safety





# Green Completion Economics

Year	Total Number of Well Spuds	No. of Spuds Not Completed or Completed Without Flowback*	Actual Number of Flowback Completions	Actual Completion Gas Generated (MMscf)	Actual Completion Gas Vented/Flared (MMscf)	Flowback Gas Recovered (MMscf)	Flowback Gas Recovered (%)
2002	75	14	61	599	112	487	81.3
2003	80	9	71	1348	152	1196	88.8
2004	253	34	219	5635	757	4878	86.6
2005	302	0	302	6718	0	6718	100.0
<b>Total</b>	<b>710</b>	<b>58</b>	<b>653</b>	<b>14300</b>	<b>1021</b>	<b>13279</b>	<b>92.9</b>

Flowback Revenue/Cost Analysis							
Year	Total Revenue (MM\$)	Recovery Cost (MM\$)	Net Savings (MM\$)	Actual Methane Generated (MMscf)	Flowback Methane Recovered (MMscf)	Potential Methane Flared (MMscf)	Potential Methane Vented (MMscf)
2002	1.28	.22	1.06	533	434	89	11
2003	6.32	.89	5.43	1200	1065	120	15
2004	27.87	2.85	25.02	5018	4344	600	74
2005	42.68	6.72	35.96	5982	5982	0	0
<b>Total</b>	<b>78.15</b>	<b>10.68</b>	<b>67.48</b>	<b>12733</b>	<b>11824</b>	<b>809</b>	<b>100</b>





# Green Completion Economics continued

AVERAGE PER WELL FLOWBACK STATISTICS	
Average Number of Days of Flowback =	32
Average MMcf Gas Recovered During Flowback =	23
Average MMcf Gas Flowback Recovered/Day =	.71
Average Revenue Per Flowback (\$) =	\$139,941
Average Cost Drill/Complete Well (\$) =	\$1.3 to \$1.5 MM
Average Cost Per Flowback (\$) =	\$11,855
Average Net Saving Per Flowback (\$) =	\$129,510
CH <sub>4</sub> recovered in 2005 = Estimated Mean Methane Concentration Gas: 89.043 vol. %	5982 MMscf or 16 MMscf/day





## Conclusion

- 🔥 Reduces methane emissions, a potent Green House Gas (GHG)
- 🔥 Well completion type determines viability of Green Completion Technologies
- 🔥 Produced water and stimulation fluids from green completions are recycled
- 🔥 Eliminates emissions, noise and citizen complaints associated with flaring
- 🔥 Increases Economic Value Added



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