

HIGH VAPOR PRESSURE OPERATIONS

WESTERN STATES LAND COMMISSIONERS ASSOCIATION
WINTER CONFERENCE
JANUARY 14TH, 2014

DAVE CURTIS
EXECUTIVE VICE PRESIDENT OF STRATEGY AND TECHNOLOGY



Traditional Facilities vs. Tankless Facilities

➤ Traditional facilities stabilize the oil (oil & condensate) on location.

- Gas is separated from the oil, measured, and discharged into the gas pipeline.
- The separated oil is collected into tanks on-site, measured at stock tank conditions, and then discharged into an oil pipeline or hauled off in trucks.

➤ Tankless facilities keep a portion of the light hydrocarbons in the liquid phase and transports them via pipeline to central locations for processing.

- Reported volumes are derived from on-site measurements and compositional analyses.



Benefits of Tankless Gathering

- **Drastically reduces the potential for hydrocarbon emissions by:**
 - Reducing field liquid tank storage.
 - Reducing need for flaring.
 - Reducing need for vapor burning combustors.
 - Eliminating vapor recovery equipment.
 - Providing oil pipeline gathering to each location.
- **Proven, reliable, accurate measurement technology**
 - Using Coriolis measurement equipment.
 - Providing composite oil sampling and analysis.
 - Using advanced diagnostics for near-real time monitoring of the meter and the product.
- **Reduce the size of surface disturbance and impacts by:**
 - Eliminating most liquid tank storage and vapor recovery equipment.
 - Significantly reducing truck traffic due to pipeline product gathering.
- **Reduced noise by:**
 - Removing vapor recovery compressors.
- **Increased reliability by:**
 - Providing automation and remote control capabilities at each site.

HVP Oil

- **Definition: Oil that has not been stabilized and has a high vapor pressure.**
 - This is oil that is produced through tankless facilities.
- **A HVP system requires a constant accounting balance of hydrocarbons (by component) into the system (from custody receipt points) and hydrocarbons out of the system at sales points off of the ROTF's.**
- **This accounting of all hydrocarbons will force the revenue allocation back to the well/lease for NGL's, stabilized condensate, and residue gas contained in the HVP oil.**



Wellhead Separator Level Custody Facility

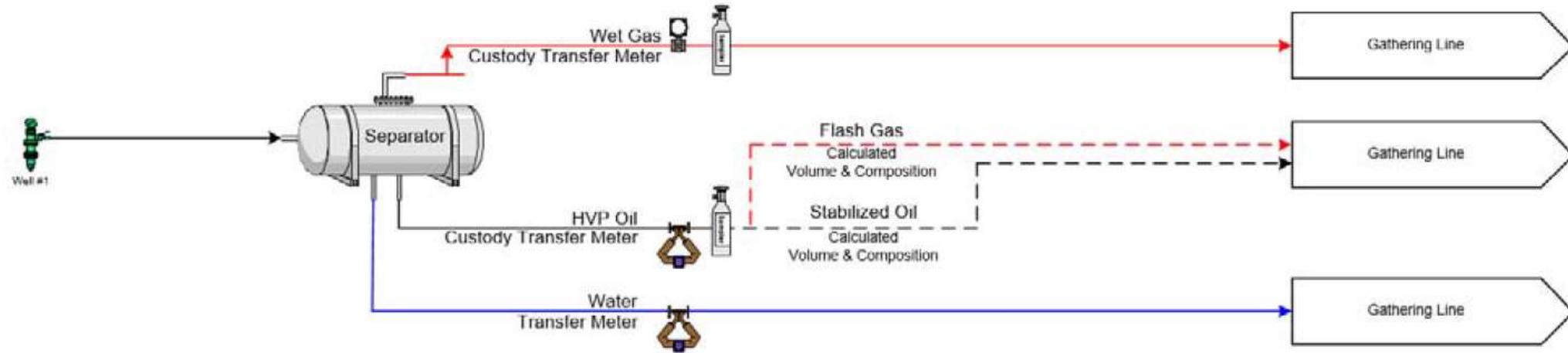


Figure 1: Facilities Diagram - Wellhead Separator Level Custody Measurement

- Each well is equipped with a wellhead separator unit which separates and measures each of the three phases (gas, liquid hydrocarbon, and water).
- At these facilities, the wellhead separator measurement is the custody measurement used for the allocation, accounting, balancing, and reporting of the products produced.

Lease/Unit Level Custody Facility

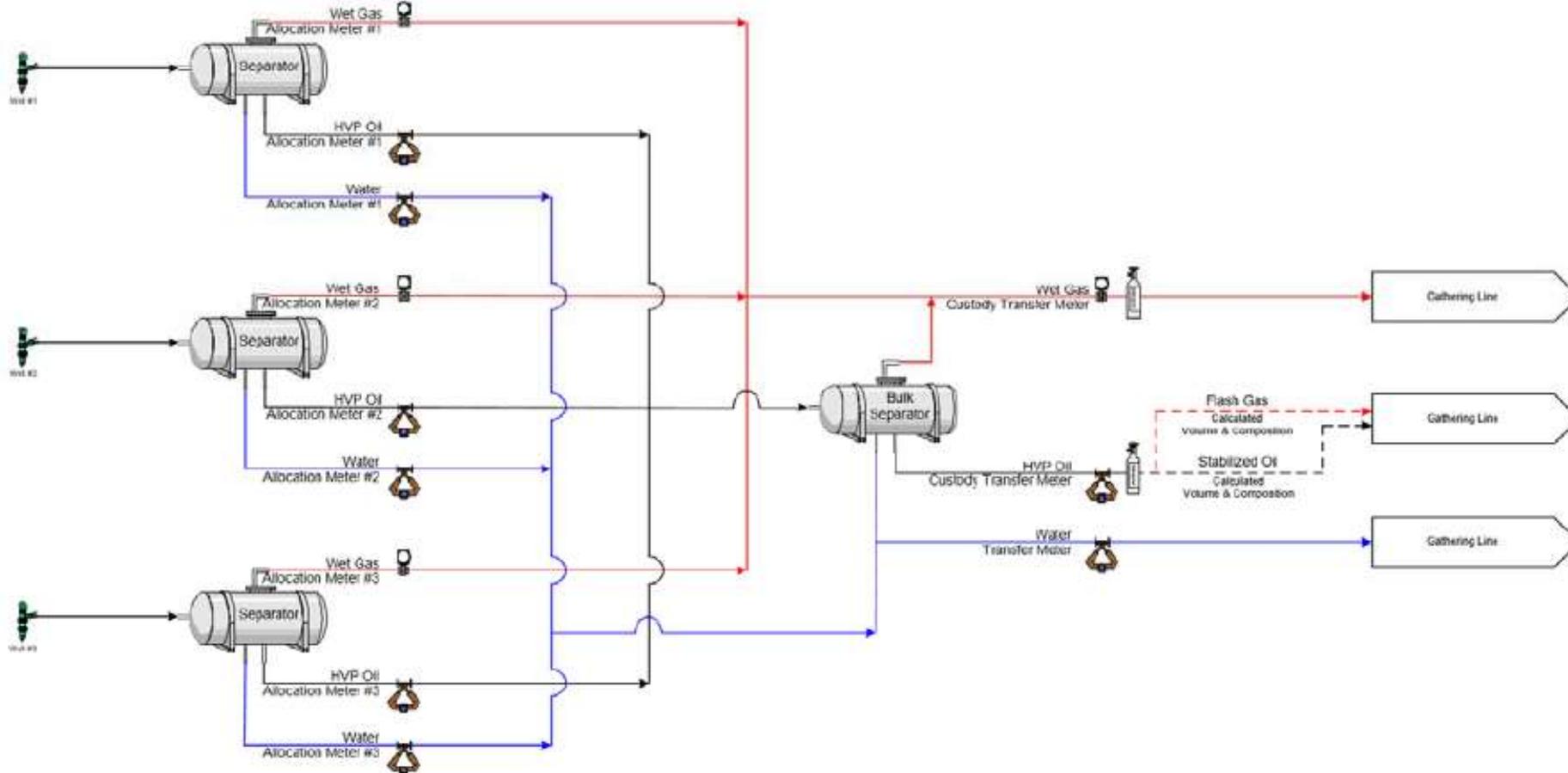


Figure 2: Facilities Diagram – Lease/Unit Level Custody Measurement

Lease/Unit Level Custody Facility

- Each well is equipped with a wellhead separator unit which separates and measures each of the three phases (gas, liquid hydrocarbon, and water).
- At these facilities, the wellhead separator measurement is used for allocation measurement.
- The combined HVP oil products from all of the wells within a given lease/unit are delivered to a bulk separator, which is operated at a pressure slightly lower than the pressures of the wellhead separators behind it.
- The combined HVP oil discharged from the bulk separator is metered through a lease/unit level custody quality meter.
- The combined gaseous products from all of the wells within a given lease/unit, along with any gas evolved from the bulk separator, are metered through a lease/unit level custody quality meter.
- The combined water products from all of the wells within a given lease/unit, along with any water separated within the bulk separator, are metered through a lease/unit level meter.
- The lease/unit level measurement for each of the products is used for allocation, accounting, balancing, and reporting.

State Reporting for Tankless Facilities

➤ **Monthly State reporting uses units of Stock Tank Barrels.**

- Oil is not brought to Standard Conditions on location.
- Without adjustments to facility measurement of oil and gas volumes to Standard Conditions, reported oil volumes would be overstated and gas volumes would be understated .
 - *Facility measurement of oil will be a “swelled” oil volume due to light hydrocarbons remaining within the oil stream.*
 - *Facility measurement of gas does not account for the amount of light hydrocarbons remaining within the oil stream.*

➤ **Facility measurement adjustment methodology was developed to correct tankless oil production to Stock Tank Barrels based on industry standards.**

- Proven, reliable, accurate measurement technology
 - *Using Coriolis measurement equipment.*
 - *Providing oil sampling and analysis.*
 - *Methodology validated and endorsed by third party experts.*

Example Adjustments for 309 psi Separator

➤ Pressurized Separator Metered Volumes (Daily)

- HVP Oil = 17,548 bbls
- Gas = 44,753 mcf



Certificate of Analysis
Number: 1030-17060558-002A

Sid Mullick
Anadarko
1201 Lake Robbins Drive
Woodlands, TX 77380

June 28, 2017

Houston Laboratories
8820 Interchange Drive
Houston, TX 77054
Phone 713-660-0901

Sample ID: 17060018
Station Name: **Tabasco Cat 54-2-6H**
Cylinder No: 1030-09244
Analyzed: 06/15/2017 13:19:57

Sampled By: BB
Sample Of: Liquid Spot
Sample Date: 06/07/2017
Sample Conditions: **309 psig, @ 119 °F**
Method: **GPA 2103M**

Analytical Data					
Components	Mol. %	MW	Wt. %	Sp. Gravity	L.V. %
Nitrogen	0.011	28.013	0.002	0.867	0.002
Methane	3.640	16.043	0.306	0.300	1.018
Carbon Dioxide	0.021	44.010	0.006	0.817	0.008
Ethane	3.253	30.069	0.663	0.356	1.435
Propane	5.307	44.096	1.585	0.507	2.412
Iso-butane	1.454	58.122	0.573	0.563	0.785
n-Butane	5.484	58.122	2.159	0.584	2.852
Iso-pentane	2.650	72.149	1.296	0.625	1.599
n-Pentane	4.057	72.149	1.983	0.631	2.426
Hexanes	6.441	86.175	3.760	0.664	4.369
Heptanes Plus	67.682	191.000	97.577	0.813	83.096
	100.000		100.000		100.000

Calculated Physical Properties		
Specific Gravity at 60°F	Total	C7+
API Gravity at 60°F	0.7716	0.8132
Molecular Weight	51.887	42.504
Pounds per Gallon (in Vacuum)	147.609	101.000
Pounds per Gallon (in Air)	6.433	6.780
Cu. Ft. Vapor per Gallon @ 14.65 psia	6.426	6.772
	16.590	13.512



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Station Name: **Tabasco Cat 54-2-6H**
Cylinder No: 1030-09244
Analyzed: 06/15/2017 13:19:00 by seg

Sampled By: BB
Sample Of: Liquid Spot
Sample Date: 06/07/2017
Sample Conditions: 309 psig, @ 119 °F
Method: EOS Flash

Analytical Data

Analyte	Result	Units	Detection Limit
Shrinkage Factor	0.9518		
Flash Factor	83.8970	Cu.Ft./STBbl	

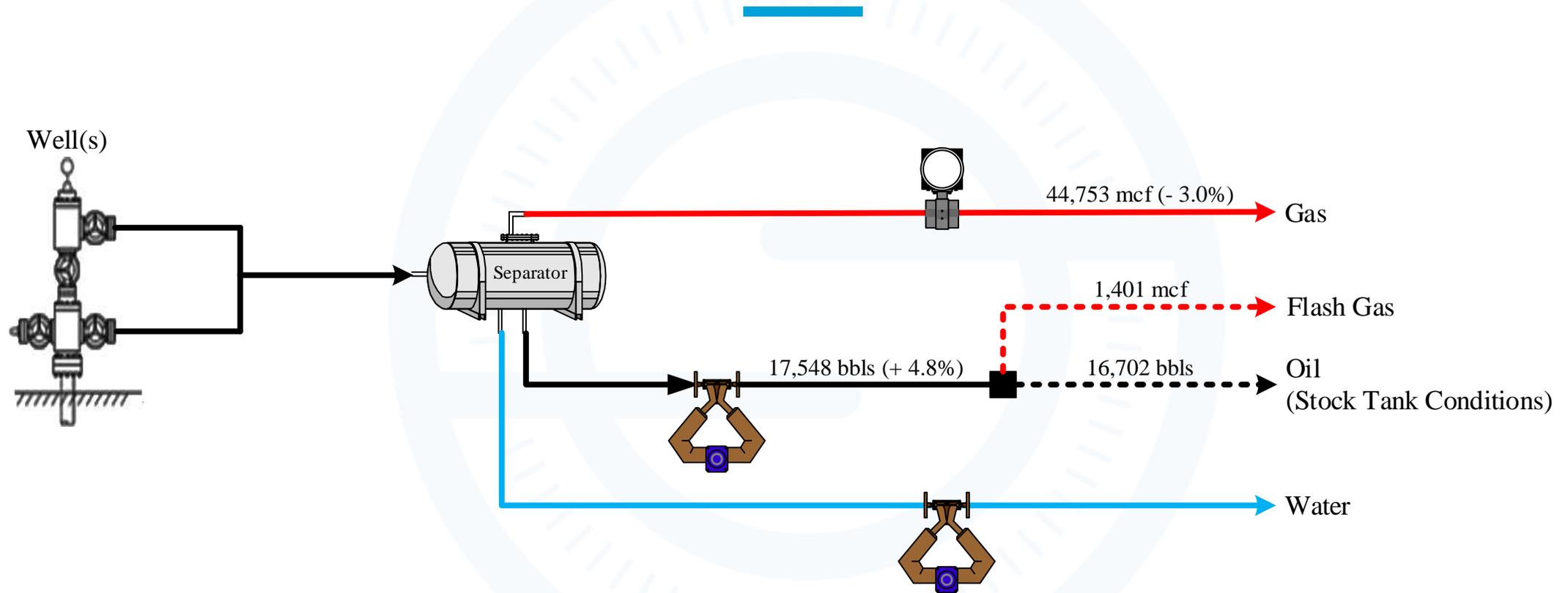
Comments: **Flashed from 323.7 psia @ 119°F to 14.7 psia @ 72°F**

➤ Adjusted Volumes

- Adjusted Oil = 17,548 bbls * 0.9518
= 16,702 Stock Tank bbls
- Flash Gas = 16,702 bbls * 83.8970 ft³/STB
= 1,401 mcf
- Total Gas = 46,154 mcf



Tankless Operations



Example Adjustments (Flash Gas Composition)



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Analyzed: 06/15/2017 13:19:00

Sampled By: BB
Sample Of: Liquid Spot
Sample Date: 06/07/2017
Sample Conditions: 309 psig, @ 119 °F
Method: EOS Flash

Analytical Data

Components	Mol. %	Wt. %	GPM at 14.65 psia		
Nitrogen	0.095	0.074		GPM TOTAL C2+	20.349
Carbon Dioxide	0.164	0.199		GPM TOTAL IC5+	2.467
Methane	30.702	13.548			
Ethane	23.009	19.030	6.224		
Propane	24.569	29.800	6.846		
Iso-Butane	3.880	6.202	1.284		
n-Butane	11.058	17.678	3.528		
Iso-Pentane	2.368	4.699	0.877		
n-Pentane	2.808	5.573	1.029		
Hexanes	1.343	3.182	0.559		
Heptanes Plus	0.004	0.014	0.002		
	100.000	100.000	20.349		

Calculated Physical Properties

	Total
Real Dry BTU at 14.65 Psia, 60°F	2117.3
Real Wet BTU at 14.65 Psia, 60°F	2080.3
Relative Density Real Gas	1.2730
Compressibility Factor	0.9858

Comments: Flashed from 323.7 psia @ 119°F to 14.7 psia @ 72°F
EOS Flash Gas Composition



Example Adjustments (STB Oil Composition)



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Station Name: **Tabasco Cat 54-2-6H**
Cylinder No: 1030-09244
Analyzed: 06/15/2017 13:19:00

Sampled By: BB
Sample Of: Liquid Spot
Sample Date: 06/07/2017
Sample Conditions: 309 psig, @ 119 °F
Method: EOS Flash

Analytical Data

Components	Mol. %	Wt. %	L.V. %
Nitrogen	0.000	0.000	0.000
Carbon Dioxide	0.003	0.001	0.001
Methane	0.151	0.015	0.039
Ethane	0.706	0.131	0.290
Propane	2.824	0.769	1.194
Iso-Butane	1.141	0.410	0.573
n-Butane	4.765	1.710	2.305
Iso-Pentane	2.686	1.197	1.508
n-Pentane	4.218	1.879	2.346
Hexanes	7.098	3.777	4.479
Heptanes Plus	76.407	90.112	87.265
	100.000	100.000	100.000

Calculated Physical Properties	Total	C7+
Molecular Weight	161.952	191.000
BTU / LB.	15010	97211
BTU / GAL.	98551	97211
Cu. Ft. Vapor per Gallon @ 14.65 psia	15.433	13.513
Pounds per Gallon (in Vacuum)	6.568	6.780
Pounds per Gallon (in Air)	6.558	6.772
Specific Gravity at 60°F	0.7875	0.8132
API Gravity at 60°F	48.2000	42.5000

Comments: Flashed from 323.7 psia @ 119°F to 14.7 psia @ 72°F
EOS Liquid Residue Composition



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Cylinder No: 1030-09244

Sampled By: BB
Sample Of: Liquid Spot
Sample Date: 06/07/2017
Sample Conditions: 309 psig, @ 119 °F

Analytical Data

Test	Method	Result	Units	Detection Limit	Lab Tech.	Analysis Date
API Gravity @ 60° F	ASTM D-5002	47.48			JSG	06/19/2017
Specific Gravity @ 60/60° F	ASTM D-5002	0.7906			JSG	06/19/2017
Density @ 60° F	ASTM D-5002	0.7888	g/ml		JSG	06/19/2017
Shrinkage Factor	Proprietary	0.9426			MR	06/16/2017
Flash Factor	Proprietary	82.2113	Cu.Ft./STBbl.		MR	06/16/2017
Color Visual	Proprietary	Light Straw			MR	06/16/2017

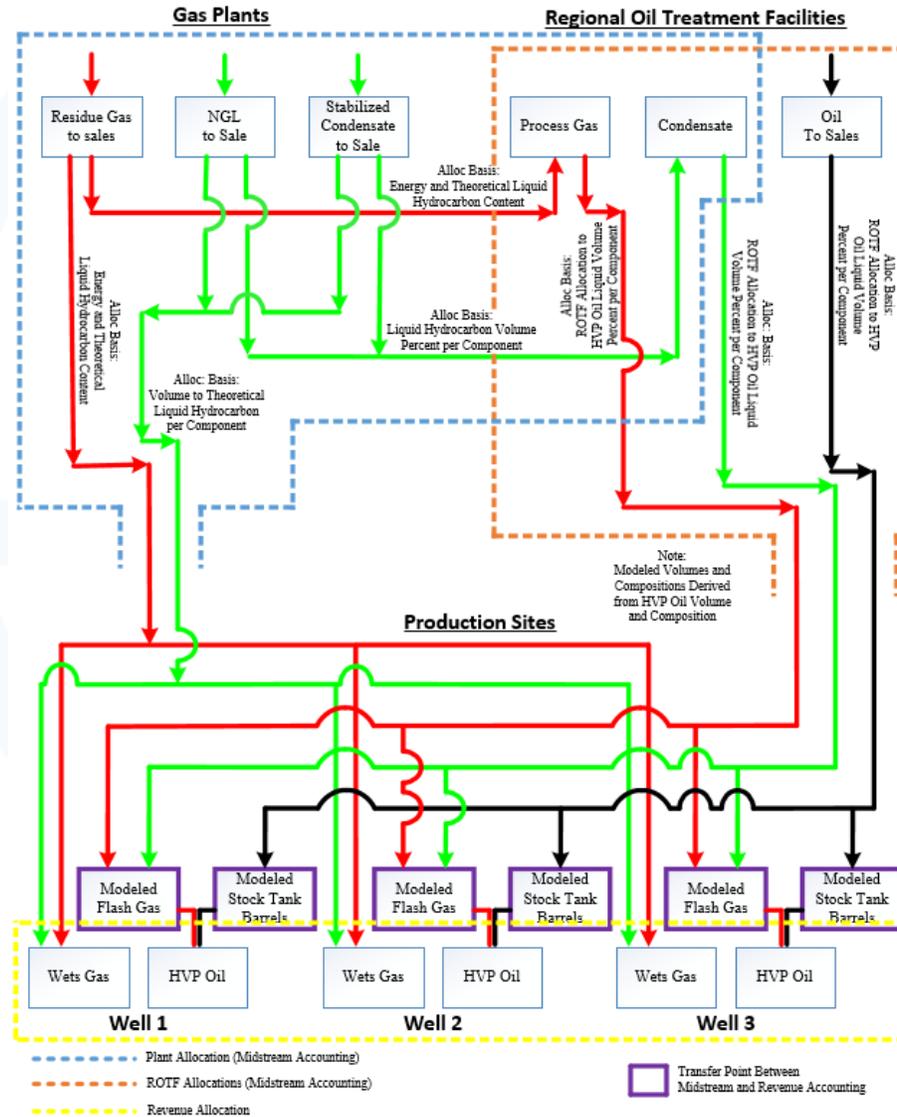
➤ STB Oil (Daily)

- Volume = 16,702 bbls/month
- API Gravity = 47.48
- Water = 0.000%



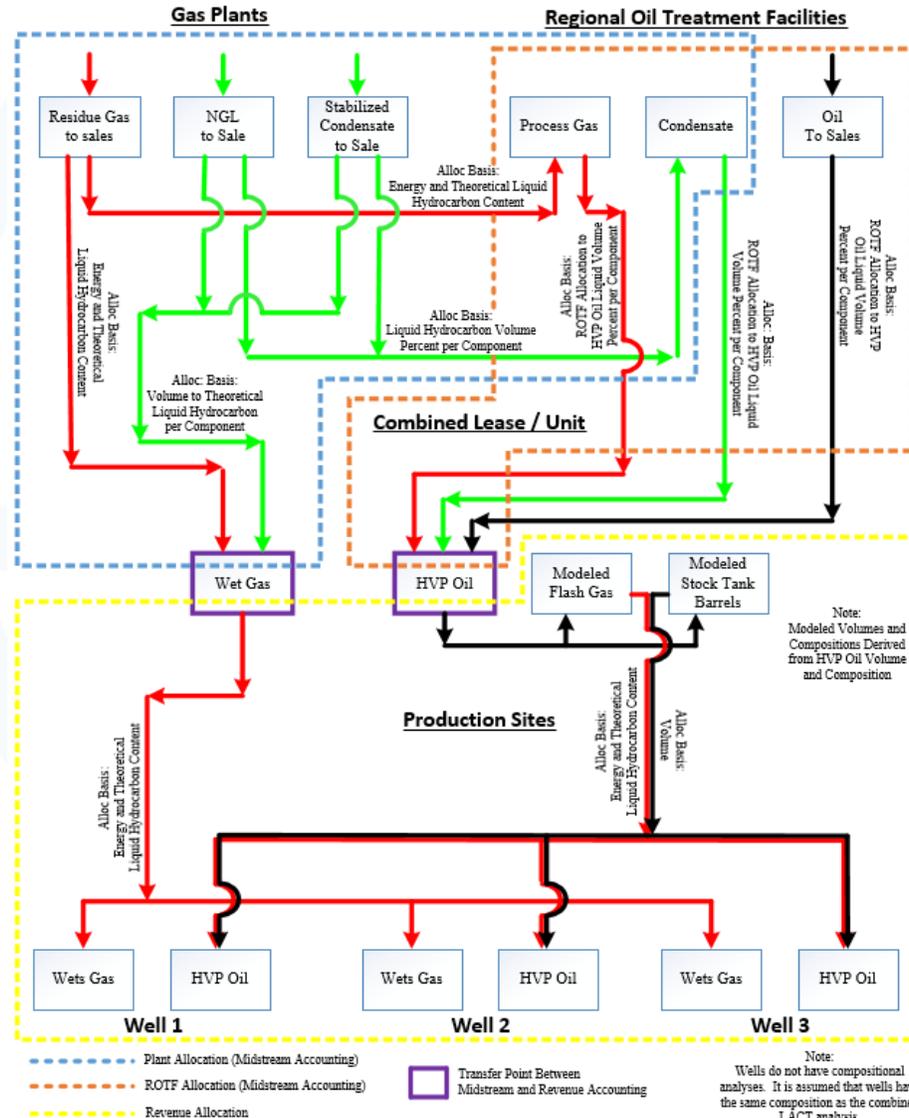
Accounting and Allocation – Wellhead Level Custody

Midstream and Revenue Accounting West Texas HVP Allocation Flow Diagram ROTF's Wellhead Level Custody Transfer Measurement



Accounting and Allocation – Lease/Unit Level Custody

Midstream and Revenue Accounting West Texas HVP Allocation Flow Diagram ROTF's Lease/Unit Level Custody Transfer Measurement



Summary

- Tankless oil gathering provides significant oil and gas conservation and environmental benefits.
- Well/Lease/Unit measurements will be corrected based on on-site sampling and volume measurements using API, AGA, and GPA industry standard methodology.
- Production reporting practice remain unchanged.
- This approach has been approved by the Railroad Commission (RRC), Bureau of Land Management (BLM), the Colorado Oil and Gas Conservation Commission (COGCC), and the National Association of Royalty Owners (NARO).
- Anadarko tankless operations are in full operation in Colorado have begun in West Texas.

Questions, Thoughts, Ideas?