MarkWest Liberty Gas Gathering Company, L.L.C.
1515 Arapahoe Street
Tower 1, Suite 1600
Denver, CO 80202-2137
(800) 730-8388
(303) 290-8700
(303) 825-0902 Fax

June 29, 2012

Mr. Mark Wayner, PE
Regional Air Quality Manager
PA DEP SW Regional Office
Pittsburgh, PA 15222

Re: MarkWest Liberty Midstream and Resources L.L.C.
Smith Compressor Station Plan Approval Application (PA-63-00968)

Dear Mr. Wayner:

Please find attached the original and two copies of a request for Plan Approval authorization to expand the Smith Compressor Station, which is currently permitted under GP5-63-00968. The modification will include the addition of up to nine (9) Waukesha P9390GSI engines, with an expansion of the flow through the dehydrator to 130 mmscf/d, with a corresponding increase in flow through the storage tanks. With these modifications the equipment and emissions will be identical to the Three Brothers Compressor Station (PA-63-00969). The remaining air emissions units will remain the same. This facility is located in the Smith Township in Washington County, Pennsylvania. The following is included with this submittal:

- Introduction
- Municipal Notifications
- General Information Form
- Compliance Review Form
- Plan Approval Application Form
- Emission Estimates
- Equipment Specifications
- Copy of Existing GP-5 Permit
- $1700 to cover this Plan Approval Application, included in a previous check for $3400 for both this and a future application.

Thank you. Should you have any questions about this air application, please call me at (303) 542-0686 or e-mail at nwheldon@markwest.com.

Sincerely,

Nathan M. Wheldon, PE
Sr. Environmental Engineer

Table of Contents

Section 1

Introduction

Introduction
MarkWest Liberty Midstream & Resource, LLC
Smith Compressor Station

On March 20, 2012 Markwest Liberty Midstream & Resources, LLC received a GP-5 Permit (GP5-63-00968) and is currently constructing the Smith Compressor Station located in Smith Township, Washington County, PA. This General Permit authorized the construction, installation and operation of the following emission sources:

- Two (2) Waukesha L7042G 1480hp rich burn engines with 3-way catalysts
- Two (2) John Deere 197 hp diesel engines
- One (1) 40MM scfd dehydration unit with a 2.0MM Btu/hr. re-boiler
- One (1) 550bbl gun-barrel separation tank
- Four (4) 400bbl condensate and/or produced water tanks
    - Note: The storage tanks are controlled with a Vapor Recovery Unit (VRU) designed to control 100% of the flashing, breathing and evaporative losses. 98% control is being claimed to account for minor outages, etc...

Recently producers have stated that they will be drilling more in this area thus requiring more compression and dehydration than previously anticipated. After a further review of the projections for this station MarkWest has determined that the following additional changes and additional engines are needed:

- Nine (9) additional Waukesha P9390GSI 1980hp rich burn engines with 3-way catalysts
- An Increase in Dehydration capacity to 130MM scfd

With these changes the Smith station will have identical equipment and emission rates as the Three Brothers Compressor Station. The new Waukesha engines are subject to 40 CFR Part 60 Subpart JJJJ – Standards of Performance for Stationary Spark Ignition Combustion Engines and 40 CFR 63 Subpart ZZZZ for Spark Ignition and Compression Reciprocating Internal Combustion Engines. The diesel engines are subject to 40 CFR 60 Subpart IIII and meets the Tier III standards. The dehydrator is subject to 40 CFR Part 63 Subpart HH, National Emission Standards for hazardous Air Pollutants from Oil and Gas Production Facilities.

With these proposed changes in place the facility will remain a minor source of Air Pollutants. Additionally total GHG $CO_2(e)$ is less than 100,000 metric tons per year and the GHG Tailoring Rule does not apply to this facility.

The following is included with this application:

- Introduction
- General Information Form
- Municipal Notifications
- Compliance History Form
- Plan Approval Application Form
- Emission Estimates
- Manufacturers Specifications
- Payment of $1700 to cover the application fee.

REGULATORY DISCUSSION

MarkWest Liberty Midstream & Resources L.L.C. has reviewed the regulatory provisions and offers the following discussion regarding applicability to the proposed construction.

FEDERAL

40 CFR PART 60 SUBPART KKK - STANDARDS OF PERFORMANCE FOR STATIONARY FOR EQUIPMENT LEAKS OF VOC FROM ONSHORE NATURAL GAS PROCESSING PLANTS:
This site does not involve processing and therefore will be exempt from this regulation.

40 CFR PART 60 SUBPART IIII - STANDARDS OF PERFORMANCE FOR COMPRESSION IGNITION INTERNAL COMBUSTION ENGINES:
The proposed diesel-fired generator engine meets the Tier 3 requirements for diesel engines as shown in the manufacturers data. No further testing or documentation is required.

40 CFR PART 60 SUBPART JJJJ - STANDARDS OF PERFORMANCE FOR STATIONARY SPARK IGNITION INTERNAL COMBUSTION ENGINES:
The proposed natural gas-fired compressor engines are stationary spark ignition internal combustion engines manufactured after July 1, 2007 and will therefore be subject to this subpart. As such MarkWest is required to make notifications of construction and startup of the engines and follow procedures to perform stack emission test in accordance with the subpart.

40 CFR Part 63 SUBPART HH – NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS FROM OIL AND NATURAL GAS PRODUCTION FACILITIES.
The dehydration unit at the facility is potentially subject to Subpart HH. However, potential benzene emissions from the unit are less than 0.90 megagram per year. As such, the only applicable requirement is to keep records showing that the unit continues to comply with the exemption criterion.

40 CFR PART 63 SUBPART ZZZZ - NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS FOR SOURCE CATEGORIES FROM STATIONARY RECIPROCATING INTERNAL COMBUSTION ENGINES:
The facility will be a minor (area) source of hazardous air pollutants (HAP). The proposed natural gas-fired engines are stationary reciprocating internal combustion engines (RICE) and will commence construction after the June 12, 2006 effective date for new stationary RICE at area sources and are therefore subject to this subpart. The engines will meet requirements by compliance with Subpart JJJJ. No further requirements apply for these engines under this subpart.

Section 2

General Information Form

8000-PM-IT0001 Rev. 10/2009
Form

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

GENERAL INFORMATION FORM – AUTHORIZATION APPLICATION

Before completing this General Information Form (GIF), read the step-by-step instructions provided in this application package. This version of the General Information Form (GIF) must be completed and returned with any program-specific application being submitted to the Department.

Related ID#s (If Known)		DEP USE ONLY
Client ID# 271958	APS ID#	Date Received & General Notes
Site ID#	Auth ID#	
Facility ID#		

CLIENT INFORMATION

DEP Client ID#	Client Type / Code
271958	OWOP

Organization Name or Registered Fictitious Name	Employer ID# (EIN)	Dun & Bradstreet ID#
MarkWest Liberty Midstream & Resources, L.L.C.	30-0528059	

Individual Last Name	First Name	MI	Suffix	SSN

Additional Individual Last Name	First Name	MI	Suffix	SSN

Mailing Address Line 1	Mailing Address Line 2
1515 Arapahoe Street Tower 1, Suite 1600	

Address Last Line – City	State	ZIP+4	Country
Denver	CO	80202-2137	USA

Client Contact Last Name	First Name	MI	Suffix
Wheldon	Nathan		

Client Contact Title	Phone	Ext
Sr. Environmental Engineer	(303) 542-0686	486

Email Address	FAX
nwheldon@markwest.com	(303) 825-0920

SITE INFORMATION

DEP Site ID#	Site Name
	Smith Compressor Station

EPA ID# **Estimated Number of Employees to be Present at Site**

Description of Site
Natural Gas Processing

County Name	Municipality	City	Boro	Twp	State
Washington	Smith	☐	☐	☒	
County Name	**Municipality**	**City**	**Boro**	**Twp**	**State**
		☐	☐	☐	

Site Location Line 1	Site Location Line 2
South of Hwy 22, West of Point Pleasant Road	

Site Location Last Line – City	State	ZIP+4
Smith Township	PA	15379

Detailed Written Directions to Site
From Pittsburgh head west on Hwy 22 to Exit 60A, stay left o n Steubenville Pike (0.9 mi.), take left onto Creek Rd (0.5 mi.), keep left on Point Pleasant Rd. (0.4 mi.), turn left onto lease road to Smith CS.

Site Contact Last Name	First Name	MI	Suffix
Sullivan	Greg		

Site Contact Title	Site Contact Firm
Operations Manager	

Mailing Address Line 1	Mailing Address Line 2
800 Western Ave	

Mailing Address Last Line – City	State	ZIP+4
Washington	PA	15317

Phone	Ext	FAX	Email Address
(740) 314-9571			gsullivan@markwest.com

NAICS Codes (Two- & Three-Digit Codes – List All That Apply) **6-Digit Code** (Optional)
211111

Client to Site Relationship
OWNOP

FACILITY INFORMATION

Modification of Existing Facility

		Yes	No
1.	**Will this project modify an existing facility, system, or activity?**	☐	☒
2.	**Will this project involve an addition to an existing facility, system, or activity?**	☐	☒

If "Yes", check all relevant facility types and provide DEP facility identification numbers below.

	Facility Type	DEP Fac ID#		Facility Type	DEP Fac ID#
☒	Air Emission Plant		☐	Industrial Minerals Mining Operation	
☐	Beneficial Use (water)		☐	Laboratory Location	
☐	Blasting Operation		☐	Land Recycling Cleanup Location	
☐	Captive Hazardous Waste Operation		☐	MineDrainageTrmt/LandRecyProjLocation	
☐	Coal Ash Beneficial Use Operation		☐	Municipal Waste Operation	
☐	Coal Mining Operation		☐	Oil & Gas Encroachment Location	
☐	Coal Pillar Location		☐	Oil & Gas Location	
☐	Commercial Hazardous Waste Operation		☐	Oil & Gas Water Poll Control Facility	
☐	Dam Location		☐	Public Water Supply System	
☐	Deep Mine Safety Operation -Anthracite		☐	Radiation Facility	
☐	Deep Mine Safety Operation -Bituminous		☐	Residual Waste Operation	
☐	Deep Mine Safety Operation -Ind Minerals		☐	Storage Tank Location	
☐	Encroachment Location (water, wetland)		☐	Water Pollution Control Facility	
☐	Erosion & Sediment Control Facility		☐	Water Resource	
☐	Explosive Storage Location		☐	Other:	

Latitude/Longitude Point of Origin	Latitude			Longitude		
	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
	40	25	04	80	21	24

Horizontal Accuracy Measure Feet --or-- Meters

Horizontal Reference Datum Code
☐ North American Datum of 1927
☐ North American Datum of 1983
☐ World Geodetic System of 1984

Horizontal Collection Method Code

Reference Point Code

Altitude Feet 1155 --or-- Meters

Altitude Datum Name
☐ The National Geodetic Vertical Datum of 1929
☐ The North American Vertical Datum of 1988 (NAVD88)

Altitude (Vertical) Location Datum Collection Method Code

Geometric Type Code

Data Collection Date

Source Map Scale Number Inch(es) = Feet
--or-- Centimeter(s) = Meters

PROJECT INFORMATION

Project Name
Smith Compressor Station

Project Description
Construct and operate additional nine Waukesha P9390GSI engines and increase dehydrator flow to 130 mmscfd.

Project Consultant Last Name **First Name** **MI** **Suffix**

Project Consultant Title **Consulting Firm**

Mailing Address Line 1 **Mailing Address Line 2**

Address Last Line – City **State** **ZIP+4**

Phone	Ext	FAX	Email Address

Time Schedules	Project Milestone (Optional)
March 2012	Begin to operate additional engines

1. **Have you informed the surrounding community and addressed any concerns prior to submitting the application to the Department?** ☐ Yes ☒ No

2. **Is your project funded by state or federal grants?** ☐ Yes ☒ No
   Note: If "Yes", specify what aspect of the project is related to the grant and provide the grant source, contact person and grant expiration date.
   Aspect of Project Related to Grant
   Grant Source: _____
   Grant Contact Person: _____
   Grant Expiration Date: _____

3. **Is this application for an authorization on Appendix A of the Land Use Policy? (For referenced list, see Appendix A of the Land Use Policy attached to GIF instructions)** ☐ Yes ☒ No
   Note: If "No" to Question 3, the application is not subject to the Land Use Policy.
   If "Yes" to Question 3, the application is subject to this policy and the Applicant should answer the additional questions in the **Land Use Information** section.

LAND USE INFORMATION

Note: Applicants are encouraged to submit copies of local land use approvals or other evidence of compliance with local comprehensive plans and zoning ordinances.

1. **Is there an adopted county or multi-county comprehensive plan?** ☒ Yes ☐ No
2. **Is there an adopted municipal or multi-municipal comprehensive plan?** ☒ Yes ☐ No
3. **Is there an adopted county-wide zoning ordinance, municipal zoning ordinance or joint municipal zoning ordinance?** ☒ Yes ☐ No
   Note: If the Applicant answers "No" to either Questions 1, 2 or 3, the provisions of the PA MPC are not applicable and the Applicant does not need to respond to questions 4 and 5 below.
   If the Applicant answers "Yes" to questions 1, 2 and 3, the Applicant should respond to questions 4 and 5 below.
4. **Does the proposed project meet the provisions of the zoning ordinance or does the proposed project have zoning approval?** If zoning approval has been received, attach documentation. ☒ Yes ☐ No
5. **Have you attached Municipal and County Land Use Letters for the project?** ☐ Yes ☒ No
   Will provide information upon request.

COORDINATION INFORMATION

Note: The PA Historical and Museum Commission must be notified of proposed projects in accordance with DEP Technical Guidance Document 012-0700-001 and the accompanying Cultural Resource Notice Form.

If the activity will be a mining project (i.e., mining of coal or industrial minerals, coal refuse disposal and/or the operation of a coal or industrial minerals preparation/processing facility), respond to questions 1.0 through 2.5 below.

If the activity will not be a mining project, skip questions 1.0 through 2.5 and begin with question 3.0.

1.0	**Is this a coal mining project?** If "Yes", respond to 1.1-1.6. If "No", skip to Question 2.0. (DEP Use/48y1)	☐	Yes	☒	No
1.1	**Will this coal mining project involve coal preparation/ processing activities in which the total amount of coal prepared/processed will be equal to or greater than 200 tons/day?** (DEP Use/4x70)	☐	Yes	☐	No
1.2	**Will this coal mining project involve coal preparation/ processing activities in which the total amount of coal prepared/processed will be greater than 50,000 tons/year?** (DEP Use/4x70)	☐	Yes	☐	No
1.3	**Will this coal mining project involve coal preparation/ processing activities in which thermal coal dryers or pneumatic coal cleaners will be used?** (DEP Use/4x70)	☐	Yes	☐	No
1.4	**For this coal mining project, will sewage treatment facilities be constructed and treated waste water discharged to surface waters?** (DEP Use/4x62)	☐	Yes	☐	No
1.5	**Will this coal mining project involve the construction of a permanent impoundment meeting one or more of the following criteria: (1) a contributory drainage area exceeding 100 acres; (2) a depth of water measured by the upstream toe of the dam at maximum storage elevation exceeding 15 feet; (3) an impounding capacity at maximum storage elevation exceeding 50 acre-feet?** (DEP Use/3140)	☐	Yes	☐	No
1.6	**Will this coal mining project involve underground coal mining to be conducted within 500 feet of an oil or gas well?** (DEP Use/4z41)	☐	Yes	☐	No
2.0	**Is this a non-coal (industrial minerals) mining project?** If "Yes", respond to 2.1-2.6. If "No", skip to Question 3.0. (DEP Use/48y1)	☐	Yes	☒	No
2.1	**Will this non-coal (industrial minerals) mining project involve the crushing and screening of non-coal minerals other than sand and gravel?** (DEP Use/4x70)	☐	Yes	☐	No
2.2	**Will this non-coal (industrial minerals) mining project involve the crushing and/or screening of sand and gravel with the exception of wet sand and gravel operations (screening only) and dry sand and gravel operations with a capacity of less than 150 tons/hour of unconsolidated materials?** (DEP Use/4x70)	☐	Yes	☐	No
2.3	**Will this non-coal (industrial minerals) mining project involve the construction, operation and/or modification of a portable non-metallic (i.e., non-coal) minerals processing plant under the authority of the General Permit for Portable Non-metallic Mineral Processing Plants (i.e., BAQ-PGPA/GP-3)?** (DEP Use/4x70)	☐	Yes	☐	No
2.4	**For this non-coal (industrial minerals) mining project, will sewage treatment facilities be constructed and treated waste water discharged to surface waters?** (DEP Use/4x62)	☐	Yes	☐	No
2.5	**Will this non-coal (industrial minerals) mining project involve the construction of a permanent impoundment meeting one or more of the following criteria: (1) a contributory drainage area exceeding 100 acres; (2) a depth of water measured by the upstream toe of the dam at maximum storage elevation exceeding 15 feet; (3) an impounding capacity at maximum storage elevation exceeding 50 acre-feet?** (DEP Use/3140)	☐	Yes	☐	No

3.0	**Will your project, activity, or authorization have anything to do with a well related to oil or gas production, have construction within 200 feet of, affect an oil or gas well, involve the waste from such a well, or string power lines above an oil or gas well?** If "Yes", respond to 3.1-3.3. If "No", skip to Question 4.0. (DEP Use/4z41)	☒	Yes	☐	No
3.1	**Does the oil- or gas-related project involve any of the following: placement of fill, excavation within or placement of a structure, located in, along, across or projecting into a watercourse, floodway or body of water (including wetlands)?** (DEP Use/4z41)	☐	Yes	☒	No
3.2	**Will the oil- or gas-related project involve discharge of industrial wastewater or stormwater to a dry swale, surface water, ground water or an existing sanitary sewer system or storm water system?** If "Yes", discuss in *Project Description*. (DEP Use/4z41)	☐	Yes	☒	No
3.3	**Will the oil- or gas-related project involve the construction and operation of industrial waste treatment facilities?** (DEP Use/4z41)	☐	Yes	☒	No
4.0	**Will the project involve a construction activity that results in earth disturbance?** If "Yes", specify the total disturbed acreage. (DEP Use/4x66) **4.0.1 Total Disturbed Acreage**	☐	Yes	☒	No
5.0	**Does the project involve any of the following?** If "Yes", respond to 5.1-5.3. If "No", skip to Question 6.0. (DEP Use/4x10)	☐	Yes	☒	No
5.1	**Water Obstruction and Encroachment Projects – Does the project involve any of the following: placement of fill, excavation within or placement of a structure, located in, along, across or projecting into a watercourse, floodway or body of water?** (DEP Use /4x10).	☐	Yes	☒	No
5.2	**Wetland Impacts – Does the project involve any of the following: placement of fill, excavation within or placement of a structure, located in, along, across or projecting into a wetland?** (DEP Use/4x10).	☐	Yes	☒	No
5.3	**Floodplain Projects by the commonwealth, a Political Subdivision of the commonwealth or a Public Utility – Does the project involve any of the following: placement of fill, excavation within or placement of a structure, located in, along, across or projecting into a floodplain?** (DEP Use /4x10).	☐	Yes	☒	No
6.0	**Will the project involve discharge of stormwater or wastewater from an industrial activity to a dry swale, surface water, ground water or an existing sanitary sewer system or separate storm water system?** (DEP Use/4x62)	☐	Yes	☒	No
7.0	**Will the project involve the construction and operation of industrial waste treatment facilities?** (DEP Use/4x62)	☐	Yes	☒	No
8.0	**Will the project involve construction of sewage treatment facilities, sanitary sewers, or sewage pumping stations?** If "Yes", indicate estimated proposed flow (gal/day). Also, discuss the sanitary sewer pipe sizes and the number of pumping stations/treatment facilities/name of downstream sewage facilities in the *Project Description*, where applicable. (DEP Use/4x62) **8.0.1 Estimated Proposed Flow (gal/day)**	☐	Yes	☒	No
9.0	**Will the project involve the subdivision of land, or the generation of 800 gpd or more of sewage on an existing parcel of land or the generation of an additional 400 gpd of sewage on an already-developed parcel, or the generation of 800 gpd or more of industrial wastewater that would be discharged to an existing sanitary sewer system?** (DEP Use/4x61). **9.0.1 Was Act 537 sewage facilities planning submitted and approved by DEP?** If "Yes" attach the approval letter. Approval required prior to 105/NPDES approval.	☐ ☐	Yes Yes	☒ ☐	No No
10.0	**Is this project for the beneficial use of biosolids for land application within Pennsylvania?** If "Yes" indicate how much (i.e. gallons or dry tons per year). (DEP Use/4X62) **10.0.1 Gallons Per Year (residential septage)** _____ **10.0.2 Dry Tons Per Year (biosolids)**	☐	Yes	☒	No

11.0	**Does the project involve construction, modification or removal of a dam?** If "Yes", identify the dam. (DEP Use/3140)	☐	Yes	☒	No
	11.0.1 Dam Name				
12.0	**Will the project interfere with the flow from, or otherwise impact, a dam?** If "Yes", identify the dam. (DEP Use/3140)	☐	Yes	☒	No
	12.0.1 Dam Name				
13.0	**Will the project involve operations (excluding during the construction period) that produce air emissions (i.e., NOX, VOC, etc.)?** If "Yes", identify each type of emission followed by the amount of that emission. (DEP Use/4x70)	☒	Yes	☐	No
	13.0.1 Enter all types & amounts of emissions; separate each set with semicolons. See Application				
14.0	**Does the project include the construction or modification of a drinking water supply to serve 15 or more connections or 25 or more people, at least 60 days out of the year?** If "Yes", check all proposed sub-facilities. (DEP Use/4x81)	☐	Yes	☒	No
	14.0.1 Number of Persons Served _____				
	14.0.2 Number of Employee/Guests _____				
	14.0.3 Number of Connections _____				
	14.0.4 Sub-Fac: Distribution System	☐	Yes	☐	No
	14.0.5 Sub-Fac: Water Treatment Plant	☐	Yes	☐	No
	14.0.6 Sub-Fac: Source	☐	Yes	☐	No
	14.0.7 Sub-Fac: Pump Station	☐	Yes	☐	No
	14.0.8 Sub Fac: Transmission Main	☐	Yes	☐	No
	14.0.9 Sub-Fac: Storage Facility	☐	Yes	☐	No
15.0	**Will your project include infiltration of storm water or waste water to ground water within one-half mile of a public water supply well, spring or infiltration gallery?** (DEP Use/4x81) and 4x52).	☐	Yes	☒	No
16.0	**Is your project to be served by an existing public water supply?** If "Yes", indicate name of supplier and attach letter from supplier stating that it will serve the project. (DEP Use/4x81)	☐	Yes	☒	No
	16.0.1 Supplier's Name _____				
	16.0.2 Letter of Approval from Supplier is Attached	☐	Yes	☐	No
17.0	**Will this project involve a new or increased drinking water withdrawal from a stream or other water body?** If "Yes", should reference both Water Supply and Watershed Management. (DEP Use/4x81 and 4x10)	☐	Yes	☒	No
	17.0.1 Stream Name				
18.0	**Will the construction or operation of this project involve treatment, storage, reuse, or disposal of waste?** If "Yes", indicate what type (i.e., hazardous, municipal (including infectious & chemotherapeutic), residual) and the amount to be treated, stored, re-used or disposed. (DEP/Use4x32)	☐	Yes	☒	No
	18.0.1 Type & Amount				
19.0	**Will your project involve the removal of coal, minerals, etc. as part of any earth disturbance activities?** (DEP Use/48y1)	☐	Yes	☒	No
20.0	**Does your project involve installation of a field constructed underground storage tank?** If "Yes", list each Substance & its Capacity. **Note:** Applicant may need a Storage Tank Site Specific Installation Permit. (DEP Use/2570)	☐	Yes	☒	No
	20.0.1 Enter all substances & capacity of each; separate each set with semicolons.				
21.0	**Does your project involve installation of an aboveground storage tank greater than 21,000 gallons capacity at an existing facility?** If "Yes", list each Substance & its Capacity. **Note:** Applicant may need a Storage Tank Site Specific Installation Permit. (DEP Use/2570)	☐	Yes	☒	No
	21.0.1 Enter all substances & capacity of each; separate each set with semicolons.				

22.0	**Does your project involve installation of a tank greater than 1,100 gallons which will contain a highly hazardous substance as defined in DEP's Regulated Substances List, 2570-BK-DEP2724?** If "Yes", list each Substance & its Capacity. **Note:** Applicant may need a Storage Tank Site Specific Installation Permit. (DEP Use/2570) **22.0.1 Enter all substances & capacity of each; separate each set with semicolons.**	☐	Yes	☒	No
23.0	**Does your project involve installation of a storage tank at a new facility with a total AST capacity greater than 21,000 gallons?** If "Yes", list each Substance & its Capacity. **Note:** Applicant may need a Storage Tank Site Specific Installation Permit. (DEP Use/2570) **23.0.1 Enter all substances & capacity of each; separate each set with semicolons.**	☐	Yes	☒	No
24.0	**Will the intended activity involve the use of a radiation source?** (DEP Use/4x90).	☐	Yes	☒	No

CERTIFICATION

I certify that I have the authority to submit this application on behalf of the applicant named herein and that the information provided in this application is true and correct to the best of my knowledge and information.

Type or Print Name Leanne Meyer

Signature	Title	Date
Leanne Meyer	VP EH&S	6·28·12

Section 3

Municipal Notifications

MarkWest Liberty Midstream and Resources, L.L.C.
1515 Arapahoe Street
Tower 1, Suite 1600
Denver, CO 80202-2137
(800) 730-8388
(303) 290-8700
(303) 825-0902 Fax

May 21, 2012

Certified Mail #: 7010 3090 0002 9932 4566

Smith Township Supervisors
P.O. Box 94
Slovan, PA. 15078

Re: MarkWest Liberty Midstream and Resources L.L.C.
Air Quality Plan Approval Application
Smith Compressor Station

Dear Commissioners:

This letter is being sent to notify County Officials that MarkWest Liberty Midstream and Resources, L.L.C. will be applying to PADEP for an Air Quality Plan Approval to install up to nine (9) 1,980 hp Waukesha P9390GSI rich burn engines with Non-Selective Catalytic Control to reduce NOx, CO, VOC, and Formaldehyde emissions. These engines will be in addition to two (2) 1,480 hp Waukesha L7042 engines that are already permitted for. Additional equipment at the site will include a dehydration unit capable of 130 mmscf/d, a 2.0 mmbtu/hr reboiler, two 197-hp diesel engine for power, and storage tanks consisting of a 500-bbl bullet separation tanks and (4) 400-bbl tanks for storing condensate/produced water all controlled with a vapor recovery unit (VRU). The site will be located south of Highway 22 and west of Point Pleasant Road in Smith Township. The source will remain a minor source of air pollutants as defined by the Clean Air Act. This notice is being provided in accordance with the Municipal Notification requirements in 25 PA Code Section 127.43a and by Section 1905-A of the Administrative Code as amended by Act 14 in 1984. This activity is allowed in the area and thus there are no land use issues under Acts 67 and 68.

Anyone wishing to view this application may do so by making arrangements with:

PA Department of Environmental Protection
Southwest Regional Office
400 Waterfront Drive
Pittsburgh, PA. 15222
(412) 442-4000

Those wishing to make comments to the PADEP on this proposal must do so within 30 days of receipt of this notice.

Thank you. Should you have any questions, please call me at (303) 542-0686 or e-mail at nwheldon@markwest.com.

Sincerely,

Nathan M. Wheldon, PE
Sr. Environmental Engineer

MarkWest Liberty Midstream and Resources, L.L.C.
1515 Arapahoe Street
Tower 1, Suite 1600
Denver, CO 80202-2137
(800) 730-8388
(303) 290-8700
(303) 825-0902 Fax

May 21, 2012

Certified Mail #: 7010 3090 0002 9932 4559

Office of the Commissioners
Washington County
Courthouse Square, Suite 702
Washington, PA 15301

Re: MarkWest Liberty Midstream and Resources L.L.C.
Air Quality Plan Approval Application
Smith Compressor Station

Dear Commissioners:

This letter is being sent to notify County Officials that MarkWest Liberty Midstream and Resources, L.L.C. will be applying to PADEP for an Air Quality Plan Approval to install up to nine (9) 1,980 hp Waukesha P9390GSI rich burn engines with Non-Selective Catalytic Control to reduce NOx, CO, VOC, and Formaldehyde emissions. These engines will be in addition to two (2) 1,480 hp Waukesha L7042 engines that are already permitted for. Additional equipment at the site will include a dehydration unit capable of 130 mmscf/d, a 2.0 mmbtu/hr reboiler, two 197-hp diesel engine for power, and storage tanks consisting of a 500-bbl bullet separation tanks and (4) 400-bbl tanks for storing condensate/produced water all controlled with a vapor recovery unit (VRU). The site will be located south of Highway 22 and west of Point Pleasant Road in Smith Township. The source will remain a minor source of air pollutants as defined by the Clean Air Act. This notice is being provided in accordance with the Municipal Notification requirements in 25 PA Code Section 127.43a and by Section 1905-A of the Administrative Code as amended by Act 14 in 1984. This activity is allowed in the area and thus there are no land use issues under Acts 67 and 68.

Anyone wishing to view this application may do so by making arrangements with:

PA Department of Environmental Protection
Southwest Regional Office
400 Waterfront Drive
Pittsburgh, PA. 15222
(412) 442-4000

Those wishing to make comments to the PADEP on this proposal must do so within 30 days of receipt of this notice.

Thank you. Should you have any questions, please call me at (303) 542-0686 or e-mail at nwheldon@markwest.com.

Sincerely,

Nathan M. Wheldon, PE
Sr. Environmental Engineer

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Slovan, PA 15078
PS Form 3800, August 2006
See Reverse for Instructions
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MAY 22 2012
Sent To
Street, Apt. No.; or PO Box No.
City, State, ZIP+4
Office of the Commissioners
Washington County
Courthouse Square, Suite 702
Washington, PA 15301
PS Form 3800,
7010 3090 0002 9932 4559

SENDER: *COMPLETE THIS SECTION*

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Office of the Commissioners
Washington County
Courthouse Square, Suite 702
Washington, PA 15301

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X Kathryn Wolf ☐ Agent ☐ Addressee

B. Received by *(Printed Name)*

C. Date of Delivery 5-25

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☑ Certified Mail ☐ Express Mail
☐ Registered ☑ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? *(Extra Fee)* ☐ Yes

2. Article Number
(Transfer from service label) 7010 3090 0002 9932 4559

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

Section 4

Compliance Review Form

2700-PM-AQ0004 Rev. 6/2006

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

AIR POLLUTION CONTROL ACT COMPLIANCE REVIEW FORM

Fully and accurately provide the following information, as specified. Attach additional sheets as necessary.

Type of Compliance Review Form Submittal (check all that apply)

☐ Original Filing — Date of Last Compliance Review Form Filing:
☒ Amended Filing — May 1, 2012

Type of Submittal

☒ New Plan Approval ☐ New Operating Permit ☐ Renewal of Operating Permit
☐ Extension of Plan Approval ☐ Change of Ownership ☐ Periodic Submission (@ 6 mos)
☐ Other: _____

SECTION A. GENERAL APPLICATION INFORMATION

Name of Applicant/Permittee/("applicant")
(non-corporations-attach documentation of legal name)
MarkWest Liberty Midstream and Resources, L.L.C.

Address 1515 Arapahoe Street, Tower 1, Suite 1600
Denver, CO. 80202-2137

Telephone (303) 825-9200 **Taxpayer ID#** 30-0528059

Permit, Plan Approval or Application ID#

Identify the form of management under which the applicant conducts its business (check appropriate box)

☐ Individual ☐ Syndicate ☐ Government Agency
☐ Municipality ☐ Municipal Authority ☐ Joint Venture
☐ Proprietorship ☐ Fictitious Name ☐ Association
☒ Public Corporation ☐ Partnership ☐ Other Type of Business, specify below:
☐ Private Corporation ☐ Limited Partnership

Describe below the type(s) of business activities performed.
MarkWest Liberty Midstream and Resources, L.L.C. is a natural gas gathering and processing company.

SECTION B. GENERAL INFORMATION REGARDING "APPLICANT"

If applicant is a corporation or a division or other unit of a corporation, provide the names, principal places of business, state of incorporation, and taxpayer ID numbers of all domestic and foreign parent corporations (including the ultimate parent corporation), and all domestic and foreign subsidiary corporations of the ultimate parent corporation with operations in Pennsylvania. Please include all corporate divisions or units, (whether incorporated or unincorporated) and privately held corporations. (A diagram of corporate relationships may be provided to illustrate corporate relationships.) Attach additional sheets as necessary.

Unit Name	Principal Places of Business	State of Incorporation	Taxpayer ID	Relationship to Applicant

SECTION C. SPECIFIC INFORMATION REGARDING APPLICANT AND ITS "RELATED PARTIES"

Pennsylvania Facilities. List the name and location (mailing address, municipality, county), telephone number, and relationship to applicant (parent, subsidiary or general partner) of applicant and all Related Parties' places of business, and facilities in Pennsylvania. Attach additional sheets as necessary.

Unit Name	Street Address	County and Municipality	Telephone No.	Relationship to Applicant

Provide the names and business addresses of all general partners of the applicant and parent and subsidiary corporations, if any.

Name	Business Address
MarkWest Liberty Gas Gathering, L.L.C.	601 Technology Dr., Suite 130, Canonsburg, PA. 15317
NGP Midstream and Resources, L.P.	1401 McKinney St., Suite 1025, Houston, TX. 77010
MarkWest Energy Operating Company, L.L.C	1515 Arapahoe St., Tower 1, Suite 1600, Denver, CO. 80202-2137
MarkWest Energy Partners, L.P.	1515 Arapahoe St., Tower 1, Suite 1600, Denver, CO. 80202-2137

List the names and business address of persons with overall management responsibility for the process being permitted (i.e. plant manager).

Name	Business Address
Greg Sullivan, Operations Manager	800 Western Ave., Washington, PA. 15301
Brian Rayburn, Area Manager	601 Technology Dr., Suite 130, Canonsburg, PA. 15317
Leanne Meyer, VP of EH&S	1515 Arapahoe St., Tower 1, Suite 1600, Denver, CO 80202-2137

Plan Approvals or Operating Permits. List all plan approvals or operating permits issued by the Department or an approved local air pollution control agency under the APCA to the applicant or related parties that are currently in effect or have been in effect at any time 5 years prior to the date on which this form is notarized. This list shall include the plan approval and operating permit numbers, locations, issuance and expiration dates. Attach additional sheets as necessary.

Air Contamination Source	Plan Approval/ Operating Permit#	Location	Issuance Date	Expiration Date
Houston Gas Plant	GP and PA 63-00936	Chartiers Twp.,Wash. Co.	12/2011	
Lowry Station	SOOP & GP5 63-00947	Hopewell Twp.,Wash. Co.	12/2011	
Hoskins Station	GP5 63-00938	Blaine Twp., Wash. Co.	05/2011	
Dryer Station	GP5 63-00942	Ind. Twp., Wash. Co.	09/2011	
Stewart Station	GP5 63-00939	Mt. Pleasant Twp., Wash. Co.	12/2010	
Shaw Station	GP5 63-00940	Chartiers Twp.,Wash. Co.	08/2011	
Godwin Station	GP5 63-00934	Canton Twp., Wash. Co.	08/2011	
Fulton Station	GP5 63-00937	Mt. Pleasant Twp., Wash. Co.	05/2010	
Johnston Station	GP5 63-00933	Chartiers Twp.,Wash. Co.	07/2011	
Tupta Day Station (Bedillion Day)	GP5 63-00948	Amwell Twp., Wash. Co.	01/2012	
Brigich Station	GP5 63-00954	Chartiers Twp, Wash. Co.	09/2010	
Welling Station	GP5 63-00958	Buffalo Twp, Wash. Co.	09/2010	
Baker Station	GP5 63-00960	Amwell Twp., Wash Co.	04/2011	
Redd Station	GP5 63-00962	Amwell Twp., Wash Co.	05/2011	
Three Brothers	GP5 63-00969	Smith Twp., Wash Co.	12/2011	

Compliance Background. (Note: Copies of specific documents, if applicable, must be made available to the Department upon its request.) List all documented conduct of violations or enforcement actions identified by the Department pursuant to the APCA, regulations, terms and conditions of an operating permit or plan approval or order by applicant or any related party, using the following format grouped by source and location in reverse chronological order. Attach additional sheets as necessary. See the definition of "documented conduct" for further clarification. Unless specifically directed by the Department, deviations which have been previously reported to the Department in writing, relating to monitoring and reporting, need not be reported.

Date	Location	Plan Approval/ Operating Permit#	Nature of Documented Conduct	Type of Department Action	Status: Litigation Existing/Continuing or Corrected/Date	Dollar Amount Penalty
						$
						$
						$
						$
						$

List all incidents of deviations of the APCA, regulations, terms and conditions of an operating permit or plan approval or order by applicant or any related party, using the following format grouped by source and location in reverse chronological order. This list must include items both currently known and unknown to the Department. Attach additional sheets as necessary. See the definition of "deviations" for further clarification.

Date	Location	Plan Approval/ Operating Permit#	Nature of Deviation	Incident Status: Litigation Existing/Continuing Or Corrected/Date

<u>CONTINUING OBLIGATION</u>. Applicant is under a continuing obligation to update this form using the Compliance Review Supplemental Form if any additional deviations occur between the date of submission and Department action on the application.

VERIFICATION STATEMENT
Subject to the penalties of Title 18 Pa.C.S. Section 4904 and 35 P.S. Section 4009(b)(2), I verify under penalty of law that I am authorized to make this verification on behalf of the Applicant/Permittee. I further verify that the information contained in this Compliance Review Form is true and complete to the best of my belief formed after reasonable inquiry. I further verify that reasonable procedures are in place to ensure that "documented conduct" and "deviations" as defined in 25 Pa Code Section 121.1 are identified and included in the information set forth in this Compliance Review Form.
Leanne M Meyer — Signature; 6.28.12 — Date
Leanne Meyer — Name (Print or Type)
VP of EH&S — Title

Section 5

Plan Approval Application Form

2700-PM-AQ0007 Rev. 7/2004

Submit in Triplicate

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

PROCESSES

Application for Plan Approval to Construct, Modify or Reactivate an Air Contamination Source and/or Install an Air Cleaning Device

This application must be submitted with the General Information Form (GIF).

Before completing this form, read the instructions provided for the form.

Section A - Facility Name, Checklist And Certification

Organization Name or Registered Fictitious Name/Facility Name: MarkWest Liberty Midstream & Resources LLC

DEP Client ID# (if known): 271958

Type of Review required and Fees:

- ☐ Source which is not subject to NSPS, NESHAPs, MACT, NSR and PSD: ..... $ _____
- ☒ Source requiring approval under NSPS or NESHAPS or both: $1,700.00
- ☐ Source requiring approval under NSR regulations: ..... $ _____
- ☐ Source requiring the establishment of a MACT limitation: ..... $ _____
- ☐ Source requiring approval under PSD: ..... $ _____

Applicant's Checklist

Check the following list to make sure that all the required documents are included.

- ☒ **General Information Form (GIF)**
- ☒ **Processes Plan Approval Application**
- ☒ **Compliance Review Form** or provide reference of most recently submitted compliance review form for facilities submitting on a periodic basis: _____
- ☒ **Copy and Proof of County and Municipal Notifications**
- ☒ **Permit Fees**
- ☐ **Addendum A:** Source Applicable Requirements (only applicable to existing Title V facility)

Certification of Truth, Accuracy and Completeness by a Responsible Official

I, **Leanne Meyer**, certify under penalty of law in 18 Pa. C. S. A. §4904, and 35 P.S. §4009(b) (2) that based on information and belief formed after reasonable inquiry, the statements and information in this application are true, accurate and complete.

(Signature): Leanne M Meyer Date: 6·28·12

Name (Print): Leanne Meyer Title: VP of EH&S

OFFICIAL USE ONLY

Application No. _____ Unit ID _____ Site ID _____

DEP Client ID #: _____ APS. ID _____ AUTH. ID _____

Date Received _____ Date Assigned _____ Reviewed By _____

Date of 1st Technical Deficiency _____ Date of 2nd Technical Deficiency _____

Comments: _____

Section B - Processes Information

1. Source Information

Source Description (give type, use, raw materials, product, etc). Attach additional sheets as necessary.
Modification to existing GP5- 63-00968 to add the following equipment:
1. Addition of up to 9 Waukesha P9390GSI engines with 3-way catalysts
2. Increase of dehydration capacity to 130MM cfd

Manufacturer	Model No.	Number of Sources
1. Waukesha 2. NATCO	P9390GSI	5 (new) 1 (existing capacity increase)

Source Designation	Maximum Capacity	Rated Capacity
Smith Compressor Station	130MM cfd	130MM cfd

Type of Material Processed
Natural Gas (dehydrated and compressed at site)

Maximum Operating Schedule

Hours/Day	Days/Week	Days/Year	Hours/Year
24	7	365	8760

Operational restrictions existing or requested, if any (e.g., bottlenecks or voluntary restrictions to limit PTE)

Capacity (specify units)

Per Hour	Per Day	Per Week	Per Year
5.42MM cf	130MM cf	910MM cf	47,320MM cf

Operating Schedule

Hours/Day	Days/Week	Days/Year	Hours/Year
24	7	365	8760

Seasonal variations (Months) From to

If variations exist, describe them
no seasonal variations

2. Fuel

Type	Quantity Hourly	Annually	Sulfur	% Ash (Weight)	BTU Content
Oil Number Diesel additional	8.6 GPH @ 60°F	75.34 X 10^3 Gal	LSD% by wt		137,380 Btu/Gal. & Lbs./Gal. @ 60 °F
Oil Number _____	GPH @ 60°F	X 10^3 Gal	% by wt		Btu/Gal. & Lbs./Gal. @ 60 °F
Natural Gas	~150,000 SCFH	1314 X 10^6 SCF	0 grain/100 SCF		~1100 Btu/SCF
Gas (other) _____	SCFH	X 10^6 SCF	grain/100 SCF		Btu/SCF
Coal _____	TPH	Tons	% by wt		Btu/lb
Other * _____					

*Note: Describe and furnish information separately for other fuels in Addendum B.

Section B - Processes Information (Continued)

3. Burner

Manufacturer	Type and Model No.	Number of Burners
Superior Fabrication		1

Description:
Burner for Re-boiler

Rated Capacity	Maximum Capacity
2.0MM Btu/hr.	2.0MM Btu/hr.

4. Process Storage Vessels

A. For Liquids:

Name of material stored
all existing see previous application

Tank I.D. No.	Manufacturer	Date Installed

Maximum Pressure	Capacity (gallons/Meter^3)
atmospheric	16,800

Type of relief device (pressure set vent/conservation vent/emergency vent/open vent)

Relief valve/vent set pressure (psig)	Vapor press. of liquid at storage temp. (psia/kPa)

Type of Roof: Describe:

Total Throughput Per Year	Number of fills per day (fill/day): 0.15 Filling Rate (gal./min.): 1.76 Duration of fill hr./fill): 6.63
21985 bbls =923,379 gallons	

B. For Solids

Type: ☐ Silo ☐ Storage Bin ☐Other, Describe	Name of Material Stored

Silo/Storage Bin I.D. No.	Manufacturer	Date Installed

State whether the material will be stored in loose or bags in silos	Capacity (Tons)

Turn over per year in tons	Turn over per day in tons

Describe fugitive dust control system for loading and handling operations

Describe material handling system

5. Request for Confidentiality

Do you request any information on this application to be treated as "Confidential"? ☐ Yes ☒ No
If yes, include justification for confidentiality. Place such information on separate pages marked **"confidential"**.

Section B - Processes Information (Continued)

6. Miscellaneous Information

Attach flow diagram of process giving all (gaseous, liquid and solid) flow rates. Also, list all raw materials charged to process equipment, and the amounts charged (tons/hour, etc.) at rated capacity (give maximum, minimum and average charges describing fully expected variations in production rates). Indicate (on diagram) all points where contaminants are controlled (location of water sprays, collection hoods, or other pickup points, etc.). Describe collection hoods location, design, airflow and capture efficiency. Describe any restriction requested and how it will be monitored.

Describe fully the facilities provided to monitor and to record process operating conditions, which may affect the emission of air contaminants. Show that they are reasonable and adequate.
All sources will be monitored in conjunction with the entire plant operation. Records of gas processed will be kept electronically.

Describe each proposed modification to an existing source.
This application will add to GP5 63-00968 by adding up to 9 additional Waukesha engines, and flow through the dehydrator to a capacity of130MM cfd.

Identify and describe all fugitive emission points, all relief and emergency valves and any by-pass stacks.
Fugitive leaks and tank emissions are estimated and included in Section 6 (EmissionEstimates)

Describe how emissions will be minimized especially during start up, shut down, process upsets and/or disruptions.
Facility plans on operating 8760 hrs/yr.

Anticipated Milestones:

i. Expected commencement date of construction/reconstruction/installation: December 2012
ii. Expected completion date of construction/reconstruction/installation: March 2012
iii. Anticipated date of start-up: March 2012

Section C - Air Cleaning Device

1. Precontrol Emissions*

Pollutant	Maximum Emission Rate				Calculation/ Estimation Method
	Specify Units	Pounds/Hour	Hours/Year	Tons/Year	
PM					
PM_{10}		1.28	8760	5.5	mfg/AP-42
SO_x		neg.	8760	neg.	gas content
CO		13.04	8760	56.9	mfg.
NO_x		11.42	8760	50.1	mfg.
VOC		10.03	8760	43.8	GRI/HYSYS/mfg.
Others: (e.g., HAPs)	-----	-----	-----	-----	-----
HCOH		0.43	8760	1.90	mfg.
Other HAPs				2.83	GRI etc.

* These emissions must be calculated based on the requested operating schedule and/or process rate, e.g., operating schedule for maximum limits or restricted hours of operation and/or restricted throughput. Describe how the emission values were determined. Attach calculations.

2. Gas Cooling

Water quenching ☐ Yes ☐ No Water injection rate _____ GPM

Radiation and convection cooling ☐ Yes ☐ No

Air dilution ☐ Yes ☐ No
If yes, _____CFM

Forced Draft ☐ Yes ☐ No

Water cooled duct work ☐ Yes ☐ No

Other

Inlet Volume _____ACFM
@ _____°F _____% Moisture

Outlet Volume _____ACFM
@ _____°F _____% Moisture

Describe the system in detail.

Section C - Air Cleaning Device (Continued)

3. Settling Chambers

Manufacturer not applicable	Volume of gas handled _____ACFM @ _____°F	Gas velocity (ft/sec.)

Length of chamber (ft.)	Width of chamber (ft.)	Height of chamber (ft.)	Number of trays

Water injection ☐ Yes ☐ No	Water injection rate (GPM)

Emissions Data

Inlet	Outlet	Removal Efficiency (%)

4. Inertial and Cyclone Collectors

Manufacturer	Type	Model No.
Pressure drop (in. of water)	Inlet volume _____ACFM @ _____°F	Outlet volume _____ACFM @ _____°F

Number of individual cyclone(s)	Outlet straightening vanes used? ☐ Yes ☐ No

Length of Cyclone(s) Cylinder (ft.)	Diameter of Cyclone(s) Cylinder (ft.)	Length of Cyclone(s) cone (ft.)

Inlet Diameter (ft.) or duct area ($ft.^2$) of cyclone(s)	Outlet Diameter (ft.) or duct area ($ft.^2$) of cyclone(s)

If a multi-clone or multi-tube unit is installed, will any of the individual cyclones or cyclone tubes be blanked or blocked off?

Describe any exhaust gas recirculation loop to be employed.

Attach particle size efficiency curve

Emissions Data

Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

5. Fabric Collector

Equipment Specifications

Manufacturer not applicable	Model No.	☐ Pressurized Design ☐ Suction Design
Number of Compartments	Number of Filters Per Compartment	Is Baghouse Insulated? ☐ Yes ☐ No

Can each compartment be isolated for repairs and/or filter replacement? ☐ Yes ☐ No

Are temperature controls provided? (Describe in detail) ☐ Yes ☐ No

Dew point at maximum moisture _____ °F | Design inlet volume _____ SCFM

Type of Fabric

Material _____ ☐ Felted ☐ Membrane

Weight _____ oz/sq.yd ☐ Woven ☐ Others: List: _____

Thickness _____ in ☐ Felted-Woven

Fabric permeability (clean) @ ½" water-Δ P _____ CFM/sq.ft.

Filter dimensions Length _____ Diameter/Width _____

Effective area per filter _____ | Maximum operating temperature (°F) _____

Effective air to cloth ratio Minimum _____ Maximum _____

Drawing of Fabric Filter

A sketch of the fabric filter showing all access doors, catwalks, ladders and exhaust ductwork, location of each pressure and temperature indicator should be attached.

Operation and Cleaning

Volume of gases handled

_____ ACFM @ _____ °F

Pressure drop across collector (in. of water).
Describe the equipment to be used to monitor the pressure drop.

Type of filter cleaning

☐ Manual Cleaning ☐ Bag Collapse ☐ Reverse Air Jets

☐ Mechanical Shakers ☐ Sonic Cleaning ☐ Other: _____

☐ Pneumatic Shakers ☐ Reverse Air Flow

Describe the equipment provided if dry oil free air is required for collector operation

Cleaning Initiated By

☐ Timer Frequency if timer actuated _____

☐ Expected pressure drop range _____ in. of water ☐ Other Specify _____

Does air cleaning device employ hopper heaters, hopper vibrators or hopper level detectors? If yes, describe.

Describe the warning/alarm system that protects against operation when the unit is not meeting design requirements.

Emissions Data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

6. Wet Collection Equipment

Equipment Specifications

Manufacturer	Type	Model No.
not applicable		

Design Inlet Volume (SCFM)	Relative Particulate/Gas Velocity (ejector scrubbers only)

Describe the internal features (e.g., variable throat, gas/liquid diffusion plates, spray nozzles, liquid redistributors, bed limiters, etc.).

Describe pH monitoring and pH adjustment systems, if applicable.

Describe mist eliminator or separator (type, configuration, backflush capability, frequency).

Attach particulate size efficiency curve.

Operating Parameters

Inlet volume of gases handled _____ (ACFM) @ _____ °F	Outlet volume of gases handled _____ (ACFM) @ _____ °F _____% Moisture

Liquid flow rates. Describe equipment provided to measure liquid flow rates to scrubber (e.g., quenching section, recirculating solution, makeup water, bleed flow, etc.)

Describe scrubber liquid supply system (amount of make-up and recirculating liquid, capacity of recirculating liquid system, etc.)

State pressure drop range (in water) across scrubber (e.g., venturi throat, packed bed, etc.) only. Describe the equipment provide to measure the pressure drop. Do not include duct or de-mister losses.

Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.

Emissions Data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

7. Electrostatic Precipitator

Equipment Specifications

Manufacturer not applicable	Model No.	☐ Wet ☐ Dry ☐ Single-Stage ☐ Two-Stage

Gas distribution grids ☐ Yes ☐ No

Design Inlet Volume (SCFM) _____

Maximum operating temperature (°F) _____

Total collecting surface area _____ sq. ft. Collector plates size length _____ ft. x width _____ ft.

Number of fields _____ Number of collector plates/field _____

Spacing between collector plates _____ inches.

Maximum gas velocity _____ ft./sec. Minimum gas treatment time: _____ sec.

Total discharge electrode length _____ ft.

Number of discharge electrodes _____ Number of collecting electrode rappers _____

Rapper control ☐ Magnetic ☐ Pneumatic ☐ Other _____ Describe in detail

Operating Parameters

Inlet gas temperature (°F) _____

Outlet gas temperature (°F) _____

State pressure drop range (inches water gauge) across collector only _____

Describe the equipment

Volume of gas handled (ACFM) _____

Dust resistivity (ohm-cm). Will resistivity vary?

Power requirements

Number and size of Transformer Rectifier sets by electrical field

Field No.	No. of Sets	Each Transformer KVA	Each Rectifier KV Ave./Peak	Ma DC

Current Density _____ Micro amperes/ft^2.

Corona Power _____ Watts/1000 ACFM

Corona Power Density _____ Watts/ft^2.

Will a flue gas conditioning system be employed? If yes, describe it.

Does air cleaning device employ hopper heaters, hopper vibrators or hopper level detectors? If yes, describe.

Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.

Emissions Data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

8. Adsorption Equipment

Equipment Specifications

Manufacturer	Type	Model No.
not applicable		

Design Inlet Volume (SCFM)	Adsorbent charge per adsorber vessel and number of adsorber vessels

Length of Mass Transfer Zone (MTZ), supplied by the manufacturer based upon laboratory data.

Adsorber diameter (ft.) and area ft^2.)	Adsorption bed depth (ft.)

Adsorbent Information

Adsorbent type and physical properties.

Working capacity of adsorbent (%)	Heel percent or unrecoverable solvent weight % in the adsorbent after regeneration.

Operating Parameters

Inlet volume of gases handled _____ (ACFM) @ _____ °F

Adsorption time per adsorption bed	Breakthrough capacity: Lbs. of solvent / 100 lbs. of adsorbent = _____
Vapor pressure of solvents at the inlet temperature	Available steam in pounds to regenerate carbon adsorber (if applicable)

Percent relative saturation of each solvent at the inlet temperature

Attach any additional data including auxiliary equipment and operation details to thoroughly evaluate the control equipment.

Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.

Emissions Data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

9. Absorption Equipment

Equipment Specifications

Manufacturer	Type	Model No.
not applicable		

Design Inlet Volume (SCFM)	Tower height (ft.) and inside diameter (ft.)
Packing type and size (if applicable)	Height of packing (ft.) (if applicable)
Number of trays (if applicable)	Number of bubble caps (if applicable)

Configuration

☐ Counter-current ☐ Cross flow ☐ Cocurrent flow

Describe pH and/or other monitoring and controls.

Absorbent Information

Absorbent type and concentration.	Retention time (sec.)

Attach equilibrium data for absorption (if applicable)

Attach any additional information regarding auxiliary equipment, absorption solution supply system (once through or recirculating, system capacity, etc.) to thoroughly evaluate the control equipment. Indicate the flow rates for makeup, bleed and recirculation.

Operating Parameters

Volume of gas handled (ACFM)	Inlet temperature (°F)	Pressure drop (in. of water) and liquid flow rate. Describe the monitoring equipment.

State operating range for pH and/or absorbent concentration in scrubber liquid.

Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.

Emissions Data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

10. ☐ **Selective Catalytic Reduction (SCR)**
☐ **Selective Non-Catalytic Reduction (SNCR)**
☒ **Non-Selective Catalytic Reduction (NSCR)**

Equipment Specifications

Manufacturer	Type	Model No.
Johnson Matthey	Custom	Custom

Design Inlet Volume (SCFM)	Design operating temperature (°F)
13,713 lbs/hr.	1177

Is the system equipped with process controls for proper mixing/control of the reducing agent in gas stream? If yes, give details.
Yes, Altronic EPC-100 or equivalent

Attach efficiency and other pertinent information (e.g., ammonia slip)

Operating Parameters

Volume of gases handled _____ (ACFM) @ _____ °F

Operating temperature range for the SCR/SNCR/NSCR system (°F) From _____ °F To _____ °F

Reducing agent used, if any	Oxidation catalyst used, if any
	3-way NSCR catalyst for Waukesha rich burn engine

State expected range of usage rate and concentration.

Service life of catalyst	Ammonia slip (ppm)
3 - 5 yrs.	

Describe fully with a sketch giving locations of equipment, controls systems, important parameters and method of operation.
See attachment in Section 7

Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.
See Altronic EPC-100 AFRC Installation Drawings in Section 7

Emissions Data

Pollutant	Inlet	Outlet	Removal Efficiency (%)
NOx	13.0g/hp-hr	0.2g/hp-hr	> 98
CO	9.0g/hp-hr.	0.26g/hp-hr.	
VOC	0.3g/hp-hr.	0.12g/hp-hr.	

Section C - Air Cleaning Device (Continued)

11. Oxidizer/Afterburners

Equipment Specifications

Manufacturer not applicable	Type ☐ Thermal ☐ Catalytic	Model No.
Design Inlet Volume (SCFM)	Combustion chamber dimensions (length, cross-sectional area, effective chamber volume, etc.)	

Describe design features, which will ensure mixing in combustion chamber.

Describe method of preheating incoming gases (if applicable).	Describe heat exchanger system used for heat recovery (if applicable).

Catalyst used	Life of catalyst	Expected temperature rise across catalyst (°F)	Dimensions of bed (in inches). Height: _____ Diameter or Width: _____ Depth: _____

Are temperature sensing devices being provided to measure the temperature rise across the catalyst? ☐ Yes ☐ No
If yes, describe.

Describe any temperature sensing and/or recording devices (including specific location of temperature probe in a drawing or sketch.

Burner Information

Burner Manufacturer	Model No.	Fuel Used
Number and capacity of burners	Rated capacity (each)	Maximum capacity (each)

Describe the operation of the burner	Attach dimensioned diagram of afterburner

Operating Parameters

Inlet flow rate (ACFM) _____ @ _____°F	Outlet flow rate (ACFM) _____ @ _____°F
State pressure drop range across catalytic bed (in. of water).	Describe the method adopted for regeneration or disposal of the used catalyst.

Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.

Emissions Data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

12. Flares

Equipment Specifications

Manufacturer	Type	Model No.
Superior Fabrication Inc. (SFI)	☐ Elevated flare ☒ Ground flare ☐ Other _____ Describe	48"

Design Volume (SCFM)	Dimensions of stack (ft.)
1500	Diameter 48" Height _____

Residence time (sec.) and outlet temperature (°F)	Turn down ratio	Burner details
		2.1MM btu/hr.

Describe the flare design (air/steam-assisted or nonassisted), essential auxiliaries including pilot flame monitor of proposed flare with a sketch. non-assisted natural draft type

Describe the operation of the flare's ignition system.
constant pilot

Describe the provisions to introduce auxiliary fuel to the flare.

Operation Parameters

Detailed composition of the waste gas	Heat content	Exit velocity
	approx. 1700Btu/cf	10ft/sec.

Maximum and average gas flow burned (ACFM)	Operating temperature (°F)
approx. 1000	

Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.

Emissions Data

Pollutant	Inlet	Outlet	Removal Efficiency (%)
VOC	76.2	1.52 lbs/hr.	approx. 98 +
THC	210.7	4.21 lb/hr	approx. 98 +

Section C - Air Cleaning Device (Continued)

13. Other Control Equipment

Equipment Specifications

Manufacturer	Type	Model No.

Design Volume (SCFM)	Capacity

Describe pH monitoring and pH adjustment, if any.

Indicate the liquid flow rate and describe equipment provided to measure pressure drop and flow rate, if any.

Attach efficiency curve and/or other efficiency information.

Attach any additional date including auxiliary equipment and operation details to thoroughly evaluate the control equipment.

Operation Parameters

Volume of gas handled

_____ ACFM @ _____ °F _____ % Moisture

Describe fully giving important parameters and method of operation.

Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.

Emissions Data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

14. Costs

Indicate cost associated with air cleaning device and its operating cost (attach documentation if necessary)

Device	Direct Cost	Indirect Cost	Total Cost	Annual Operating Cost
Waukesha	included in design package			

15. Miscellaneous

Describe in detail the removal, handling and disposal of dust, effluent, etc. from the air cleaning device including proposed methods of controlling fugitive emissions.

not applicable

Attach manufacturer's performance guarantees and/or warranties for each of the major components of the control system (or complete system).

See Section 7 for guarantees on Waukesha engines

Attach the maintenance schedule for the control equipment and any part of the process equipment that if in disrepair would increase air contaminant emissions.

routine maintenance will be conducted as per plant specifications and mfg. specifications

Section D - Additional Information

Will the construction, modification, etc. of the sources covered by this application increase emissions from other sources at the facility? If so, describe and quantify.

Modification will increase plant capacity from 40MM cfd to 130MM cfd

If this project is subject to any one of the following, attach a demonstration to show compliance with applicable standards.

a. Prevention of Significant Deterioration permit (PSD), 40 CFR 52?	☐ YES	☒ NO
b. New Source Review (NSR), 25 Pa. Code Chapter 127, Subchapter E?	☐ YES	☒ NO
c. New Source Performance Standards (NSPS), 40 CFR Part 60? (If Yes, which subpart) JJJJ and IIII	☒ YES	☐ NO
d. National Emissions Standards for Hazardous Air Pollutants (NESHAP), 40 CFR Part 61? (If Yes, which subpart) _____	☐ YES	☒ NO
e. Maximum Achievable Control Technology (MACT) 40 CFR Part 63? (If Yes, which part) ZZZZ and HH	☒ YES	☐ NO

Attach a demonstration showing that the emissions from any new sources will be the minimum attainable through the use of best available technology (BAT).

1. New Waukesha Engines - Rich Burn Engines will be equipped with John Matthey 3-way catalyst for control of NOx, CO, VOC and HCOH

Provide emission increases and decreases in allowable (or potential) and actual emissions within the last five (5) years for applicable PSD pollutant(s) if the facility is an existing major facility (PSD purposes).

Facility is currently constructing under GP5-63-00969. This PA will modifiy existing source. Total plant emissions are shown in Section 6.

Section D - Additional Information (Continued)

Indicate emission increases and decreases in tons per year (tpy), for volatile organic compounds (VOCs) and nitrogen oxides (NOx) for NSR applicability since January 1, 1991 or other applicable dates (see other applicable dates in instructions). The emissions increases include all emissions including stack, fugitive, material transfer, other emission generating activities, quantifiable emissions from exempted source(s), etc.

Permit number (if applicable)	Date issued	Indicate *Yes* or *No* if emission increases and decreases were used previously for netting	Source I. D. or Name	VOCs		NOx	
				Emission increases in potential to emit (tpy)	Creditable emission decreases in actual emissions (tpy)	Emission increases in potential to emit (tpy)	Creditable emission decreases in actual emissions (tpy)
			not applicable				
			facility remains a natural minor source				

If the source is subject to 25 Pa. Code Chapter 127, Subchapter E, New Source Review requirements,

a. Identify Emission Reduction Credits (ERCs) for emission offsets or demonstrate ability to obtain suitable ERCs for emission offsets.

b. Provide a demonstration that the lowest achievable emission rate (LAER) control techniques will be employed (if applicable).

c. Provide an analysis of alternate sites, sizes, production processes and environmental control techniques demonstrating that the benefits of the proposed source outweigh the environmental and social costs (if applicable).

Attach calculations and any additional information necessary to thoroughly evaluate compliance with all the applicable requirements of Article III and applicable requirements of the Clean Air Act adopted thereunder The Department may request additional information to evaluate the application such as a standby plan, a plan for air pollution emergencies, air quality modeling, etc.

Section E - Compliance Demonstration

Note: Complete this section if source is not a Title V facility. Title V facilities must complete Addendum A.

Method of Compliance Type: Check all that apply and complete all appropriate sections below

☐ Monitoring ☒ Testing ☒ Reporting

☒ Recordkeeping ☒ Work Practice Standard

Monitoring:

a. Monitoring device type (Parameter, CEM, etc): Source testing of engines, flowmeters and engine interface

b. Monitoring device location: Compressor engine stacks and plant outlet

c. Describe all parameters being monitored along with the frequency and duration of monitoring each parameter:
Stack testing as required by PA DEP and NSPS Subpart JJJJ. Also total gas flow through station will be taken on a daily basis, engine hours will be recorded on a monthly basis and gas analysis will be conducted monthly

Testing:

a. Reference Test Method: Citation 40 CFR part 60 Appendix A for NOx, VOC and CO and other tests as required by PA

b. Reference Test Method: Description As stipulated in 40 CFR Part 60 Appendix A

Recordkeeping:

Describe what parameters will be recorded and the recording frequency:
Gas analysis, plant throughput and engine run times will be kept at the facility and provided to PA DEP as requested.

Reporting:

a. Describe what is to be reported and frequency of reporting:
Reports will be submitted as required by Federal NSPS, Plan Approval and State Only Operating Permit (SOOP)

b. Reporting start date: Annually or as required by PA or SOOP

Work Practice Standard:

Describe each: Routine maintenance will be conducted at this location to ensure proper operation of the facility

Section F - Flue and Air Contaminant Emission

1. Estimated Atmospheric Emissions*

Pollutant	Maximum emission rate			Calculation/ Estimation Method
	specify units	lbs/hr	tons/yr.	
PM				
PM_{10}		1.28	5.5	See Section 6
SO_x		neg.	neg.	See Section 6
CO		13.04	56.9	See Section 6
NO_x		11.42	5.01	See Section 6
VOC		10.03	43.8	See Section 6
Others: (e.g., HAPs)	-----	-----	-----	-----
HCOH		0.43	1.90	See Section 6
Other HAPs			2.83	See Section 6

* These emissions must be calculated based on the requested operating schedule and/or process rate e.g., operating schedule for maximum limits or restricted hours of operation and /or restricted throughput. Describe how the emission values were determined. Attach calculations.

2. Stack and Exhauster

Stack Designation/Number New Engines Sources 103 through 110

List Source(s) or source ID exhausted to this stack:
8 new Waukesha engines

% of flow exhausted to stack: 100

Stack height above grade (ft.) 35
Grade elevation (ft.) 1100

Stack diameter (ft) or Outlet duct area (sq. ft.)
approx. 1'

f. Weather Cap ☒ YES ☐ NO

Distance of discharge to nearest property line (ft.). Locate on topographic map.
located in remote area see attached map following GIF

Does stack height meet Good Engineering Practice (GEP)?
no

If modeling (estimating) of ambient air quality impacts is needed, attach a site plan with buildings and their dimensions and other obstructions.

Location of stack** Latitude/Longitude Point of Origin	Latitude			Longitude		
	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
	40	19	54	80	22	43

Stack exhaust
Volume see spec. sheet ACFM Temperature 1177 °F Moisture _____ %

Indicate on an attached sheet the location of sampling ports with respect to exhaust fan, breeching, etc. Give all necessary dimensions.

Exhauster (attach fan curves) _____ in. of water _____ HP @ _____RPM.

** If the data and collection method codes differ from those provided on the General Information Form-Authorization Application, provide the additional detail required by that form on a separate form.

Section G - Attachments

Number and list all attachments submitted with this application below:

Section 1 - Introduction
Section 2 - GIF
Section 3 - Municipal Notifications
Section 4 - Compliance Review Form
Section 5 - Plan Approval Application
Section 6 - Emission Estimates
Section 7 - Equipment Specifications
Section 8 - Copy of current GP-5

Section 6

Emission Estimates

Emission Estimates
MarkWest Liberty Midstream & Resource, LLC
Smith Compressor Station

On March 20, 2012 Markwest Liberty Midstream & Resources, LLC received a GP-5 Permit (GP5-63-00968) and is currently construction the Smith Compressor Station located Smith Township, Washington County, PA. This General Permit authorized the construction, installation and operation of the following emission sources:

- Two (2) Waukesha L7042G 1480hp rich burn engines with 3-way catalysts
- Two (2) John Deere 197 hp diesel engines
- One (1) 40MM scfd dehydration unit with a 2.0MM Btu/hr. re-boiler
- One (1) 550bbl gun-barrel separation tank
- Four (4) 400bbl condensate and/or produced water tanks
    - Note: The storage tanks are controlled with a Vapor Recovery Unit (VRU) designed to control 100% of the flashing, breathing and evaporative losses. 98% control is being claimed to account for minor outages, etc...

Recently producers have stated that they will be drilling more in this area thus requiring more compression and dehydration than previously anticipated. After a further review of the projections for this station MarkWest has determined that the following additional changes and additional engines are needed:

- Nine (9) additional Waukesha P9390GSI 1980hp rich burn engines with 3-way catalysts
- An Increase in Dehydration capacity to 130MM cfd
- Engine and facility blowdowns accounted for.

Emission projections from the new and modified sources are estimated as follows:

- Waukesha Engine P9390GSI 1980hp rich burn engines with 3-way catalysts
    - NO_x = 0.2g/bhp-hr. x 1980hp = 396g/hr. = 0.87lbs/hr. = 3.82tpy
    - CO = 0.26g/bhp-hr. x 1980hp = 515g/hr. = 1.14lbs/hr. = 4.97tpy
    - VOC = 0.12g/bhp-hr. x 1980hp = 238g/hr. = 0.53lbs/hr. = 2.30tpy
    - HCOH = 0.01 g/hp-hr = 0.044 lbs/hr. = 0.20 tpy
    - PM = 0.027 g/hp-hr = 0.12 lbs/hr = 0.51 tpy
    - CO_2 =15.428Mm Btu/hr. x 53.02kg/MM Btu x 8760hrs/yr. = 7165600kg/yr. = 7,165.6 metric tons/yr. (adding estimated $CO_2(e)$ for CH_4 and N_2O adds approx. 5.68tpy)
    - $CO_2(e)$ = 7,171.3 metric tons per year

- Dehydration Unit upgrade to 130MM cfd
    - VOC emissions = 4.21 lbs/hr. = 6.68 tpy (from GRI-CLYCalc)
    - HAPs = 0.22 lbs/hr. = 0.094 tpy
    - CO_2 (from oxidation of CH_4)
        - 8.36 tpy methane = 177 tpy CO_2e

- Re-boiler (2.0MM Btu/hr.) – approximately 1818 scf/hr
  - NO_x = 1818 cf/hr. x 0.0001lb/cf = 0.182 lbs/hr. = 0.80 tpy
  - CO = 1818 cf/hr x 0.000084lbs/cf = 0.153 lbs/hr. = 0.67 tpy
  - VOCs = 1818 cf/hr x 0.0000055lbs/cf = 0.010 lbs/hr. = 0.044 tpy
  - CO_2 = 1,057 metric tpy
  - Other emissions = negligible

- HYSYS Run (Tanks and VRU)
  - Predicted VOC 0.90 tpy or 0.20 lbs/hr.
  - Predicted HAP 0.02 tpy or <0.01 lbs/hr.

- Diesel Engines. (Emission Rates for NOx and CO based on GP-9 maximum emission limits of 2.98 g/hp-hr NOx, 0.1 g/hp-hr CO [with secondary control], 0.15 g/hp-hr for PM. Actual data from engine manufacturer shows 2.68 g/hp-hr for NOx and 0.13 g/hp-hr for PM).
  - NOx = 2.98 g/hp-hr = 1.29 lb/hr = 5.65 tpy
  - CO = 0.1 g/hp-hr = 0.04 lb/hr = 0.19 tpy
  - VOC = 25% of NOx at 2.68 g/hp-hr = 0.29 lb/hr = 1.27 tpy
  - HCHO = negligible
  - SO_2 = negligible
  - PM_{10} = 0.15 g/bhp-hr = 0.07 lb/hr = 0.31 tpy
  - CO_2 = 624 metric tpy

- Fugitive emissions from leaks, etc.

Fugitive Emissions from Component Leaks							
Equipment Type	Count	Leak Emission Factors Lbs/hr./component	Source of Factor	Stream Type (gas/liquid etc.)	Estimated Emissions (Tons/yr.)		
					VOC	HAPs	Notes
Connectors/Flanges	165	0.00086	EPA	Nat. Gas	0.174	0.0065	
Connectors/Flanges	66	0.000243	EPA	Light Oil	0.0548	0.0044	
Connectors/Flanges	66	0.000006	EPA	Water/Lt. Oil	0.0017	0.0017	
Compressors	11	0.0194	EPA	Nat. Gas	0.2617	0.0098	
Open Ended Lines	11	0.00441	EPA	Nat. Gas	0.0595	0.0022	
Pump Seals	0	0.00529	EPA	Nat. Gas	0.00	0.00	
Pump Seals	11	0.02866	EPA	Light Oil	1.0770	0.0870	
Pump Seals	11	0.000052	EPA	Water/Lt. Oil	0.0025	0.0025	
Valves	165	0.00992	EPA	Nat. Gas	2.0074	0.0753	
Valves	66	0.0055	EPA	Light Oil	1.2402	0.1002	
Valves	66	0.000216	EPA	Water/Lt. Oil	0.0624	0.0624	
Totals					4.9412	0.3520	

The projected emissions from the facility are projected in the following table:

Emission Point	NOx lbs/hr	NOx tpy	CO lbs/hr	CO tpy	VOC lbs/hr	VOC tpy	PM Lbs/hr.	PM tpy	HCOH lbs/hr	HCOH tpy	CO_2 tpy
Waukesha L7042G With NSCR	0.66	2.86	0.82	3.57	0.56	2.46	0.09	0.39	0.033	0.14	6669
Waukesha L7042G With NSCR	0.66	2.86	0.82	3.57	0.56	2.46	0.09	0.39	0.033	0.14	6669
Waukesha P9390GS With 3-way cat.	0.87	3.82	1.14	4.97	0.53	2.30	0.12	0.51	0.044	0.20	9054
Waukesha P9390GSI With 3-way cat.	0.87	3.82	1.14	4.97	0.53	2.30	0.12	0.51	0.044	0.20	9054
Waukesha P9390GSI With 3-way cat.	0.87	3.82	1.14	4.97	0.53	2.30	0.12	0.51	0.044	0.20	9054
Waukesha P9390GSI With 3-way cat.	0.87	3.82	1.14	4.97	0.53	2.30	0.12	0.51	0.044	0.20	9054
Waukesha P9390GSI With 3-way cat.	0.87	3.82	1.14	4.97	0.53	2.30	0.12	0.51	0.044	0.20	9054
Waukesha P9390GSI With 3-way cat.	0.87	3.82	1.14	4.97	0.53	2.30	0.12	0.51	0.044	0.20	9054
Waukesha P9390GSI With 3-way cat.	0.87	3.82	1.14	4.97	0.53	2.30	0.12	0.51	0.044	0.20	9054
Waukesha P9390GSI With 3-way cat.	0.87	3.82	1.14	4.97	0.53	2.30	0.12	0.51	0.044	0.20	9054
John Deere DCA150USJ	1.29	5.65	0.04	0.19	0.29	1.27	0.07	0.31	Neg.	0.01	890
John Deere DCA150USJ	1.29	5.65	0.04	0.19	0.29	1.27	0.07	0.31	Neg.	0.01	890
Dehydration Unit	--	--	--	--	1.52	6.68	--	--	--	--	2553
Re-boiller	0.18	0.82	0.15	0.67	0.01	0.04	--	--	Neg.	Neg.	1139
Flare	0.38	1.65	2.05	8.96	--	--	--	--	--	--	8
Four 400bbl tanks From HYSYS Run	--	--	--	--	0.20	0.90	--	--	0.01	0.02	5
Fugitive Emissions	--	--	--	--	1.13	4.94	--	--	--	--	101
Blowdown Emissions	-	-	-	-	1.23	5.40	-	-	-	-	251
TOTALS	11.42	50.1	13.04	56.9	10.03	43.8	1.28	5.5	0.43	1.90	91607

The projected HAP emissions from the facility are projected in the following table:

Emission Point	HAP lbs/hr	HAP tpy	Benzene lbs/hr	Benzene tpy	Toluene lbs/hr	Toluene tpy	Xylene lbs/hr	Xylene tpy
Fugitive Leaks	0.08	0.35	-	-	-	-	-	-
Waukesha L7042s x2	0.17	0.76	0.04	0.16	0.02	0.056	0.01	0.02
Waukesha P9390s x9	0.75	3.29	0.20	0.85	0.07	0.30	0.03	0.11
Diesel Engines x2	-	0.02	-	0.01	-	-	-	-
2.0 mmbtu/hr reboiler	0.004	0.016	-	-	-	-	-	-
Blowdown Emissions	0.07	0.29	0.001	0.003	0.002	0.007	0.001	0.004
TOTALS	1.09	4.73	0.24	1.02	0.09	0.36	0.04	0.13

Estimation of Potential GHG Emissions

Three Brothers Compressor Station

MarkWest Liberty Midstream and Resources, L.L.C.

Color Key: Site specific Data from EI/Permit

Site specific Data Entry Required

Data Constants (see reference tab)

Calculation Algorithms

Engine CO_2e = Rated Capacity x Emission Factor x Hours of Operation x Conversion Factor

Flare CO_2 = Vol Gas Flared x MoleVol Conversion x MW CO_2 x Mass Conversion x [(Σ Moles C x 98 Moles CO_2/Mole C) + Mole CO_2]

Flare N_2O = Gas Flared x Emission Factor

CH_4 =

Tanks CH_4 = VOC emissions x Mol % CH_4

Loading CH_4 = VOC emissions x Mol % CH_4

Facility-wide Summary

GHG Emission Source	Total GHG Emissions (m.t. CO_2e)	(tons CO_2e)
Natural Gas Combustion	77,570.87	85,507.15
Venting	390.53	430.49
Total Facility Emissions:	**77,961.41**	**85,937.64**

* Facilities with total GHG emissions greater than 100,000 tons CO_2e per year are subject to Title V and are considered to be PSD major sources.

tons CO_2e are used to determine Title V and/or PSD

Combustion Sources

Source ID Number	Description	Maximum Hours of Operation	Rated HP	Rated Capacity (MMBtu/hr)	Factor (ton/m.t.)	Factor (m.t./kg)	Emission Factors CO_2 (kg/MMBtu)	CH_4 (kg/MMBtu)	N_2O (kg/MMBtu)	Emissions CO_2 (m.t.)	CH_4 (m.t.)	N_2O (m.t.)	Global Warming Potential CO_2	CH_4	N_2O	Emissions CO_2 (m.t. CO_2e)	CH_4 (m.t. CO_2e)	N_2O (m.t. CO_2e)	Total Emissions (m.t. CO_2e)	(tons CO_2e)
1	Waukesha L7042 w/NSCR	8,760	1,480	11.390	1.10231	0.001	54.70	0.001	0.0001	5,457.77	0.10	0.01	1	21	310	5,457.77	2.10	3.09	5,462.96	6,021.87
2	Waukesha L7042 w/NSCR	8,760	1,480	11.390	1.10231	0.001	54.70	0.001	0.0001	5,457.77	0.10	0.01	1	21	310	5,457.77	2.10	3.09	5,462.96	6,021.87
3	Waukesha G9390GSI w/NSCR	8,760	1,980	15.428	1.10231	0.001	53.02	0.001	0.0001	7,165.61	0.14	0.01	1	21	310	7,165.61	2.84	4.19	7,172.64	7,906.48
4	Waukesha G9390GSI w/NSCR	8,760	1,980	15.428	1.10231	0.001	53.02	0.001	0.0001	7,165.61	0.14	0.01	1	21	310	7,165.61	2.84	4.19	7,172.64	7,906.48
5	Waukesha G9390GSI w/NSCR	8,760	1,980	15.428	1.10231	0.001	53.02	0.001	0.0001	7,165.61	0.14	0.01	1	21	310	7,165.61	2.84	4.19	7,172.64	7,906.48
6	Waukesha G9390GSI w/NSCR	8,760	1,980	15.428	1.10231	0.001	53.02	0.001	0.0001	7,165.61	0.14	0.01	1	21	310	7,165.61	2.84	4.19	7,172.64	7,906.48
7	Waukesha G9390GSI w/NSCR	8,760	1,980	15.428	1.10231	0.001	53.02	0.001	0.0001	7,165.61	0.14	0.01	1	21	310	7,165.61	2.84	4.19	7,172.64	7,906.48
8	Waukesha G9390GSI w/NSCR	8,760	1,980	15.428	1.10231	0.001	53.02	0.001	0.0001	7,165.61	0.14	0.01	1	21	310	7,165.61	2.84	4.19	7,172.64	7,906.48
9	Waukesha G9390GSI w/NSCR	8,760	1,980	15.428	1.10231	0.001	53.02	0.001	0.0001	7,165.61	0.14	0.01	1	21	310	7,165.61	2.84	4.19	7,172.64	7,906.48
10	Waukesha G9390GSI w/NSCR	8,760	1,980	15.428	1.10231	0.001	53.02	0.001	0.0001	7,165.61	0.14	0.01	1	21	310	7,165.61	2.84	4.19	7,172.64	7,906.48
11	Waukesha G9390GSI w/NSCR	8,760	1,980	15.428	1.10231	0.001	53.02	0.001	0.0001	7,165.61	0.14	0.01	1	21	310	7,165.61	2.84	4.19	7,172.64	7,906.48
Diesel	Deere 6068HF285	8,760	197	1.18	1.10231	0.001	54.70	0.001	0.0001	565.42	0.01	0.00	1	21	310	565.42	0.22	0.32	565.96	623.86
Diesel	Deere 6068HF285	8,760	197	1.18	1.10231	0.001	54.70	0.001	0.0001	565.42	0.01	0.00	1	21	310	565.42	0.22	0.32	565.96	623.86
Reboiler	Reboiler	8,760	–	2	1.10231	0.001	54.70	0.001	0.0001	958.34	0.02	0.002	1	21	310	958.34	0.37	0.54	959.26	1,057.40

Note - Emissions estimated using API Compendium Sections 5.7.3 and 8.1

Vented Sources

Source ID Number	Description	Maximum Days of Operation	Emissions CO_2 (tpy)	CH_4 (tpy)	N_2O (tpy)	Conversion Factor (ton/m.t.)	Emissions CO_2 (m.t.)	CH_4 (m.t.)	N_2O (m.t.)	Global Warming Potential CO_2	CH_4	N_2O	Emissions CO_2 (m.t. CO_2e)	CH_4 (m.t. CO_2e)	N_2O (m.t. CO_2e)	Total Emissions (m.t. CO_2e)	(tons CO_2e)
–	Storage Tanks	365	0.11	0.200	–	1.10231	0.10	0.18	–	1	21	–	0.10	3.81	–	3.91	4.31
–	Blowdown Emissions	365	0.11	11.929	–	1.10231	0.10	10.82	–	1	21	–	0.10	227.26	–	227.36	250.62

Note - Emissions estimated using API Compendium Sections 5.7.3 and 8.1

Flare

Source ID Number	Description	Maximum Hours of Operation	Annual Gas Usage (scf/hr)	Processed (scf/yr)	Factor (ton/m.t.)	Emissions (tons)	CO_2 (mol %)	CH_4 (mol %)	Emission Factor N_2O (m.t./MMscf)	Emissions CO_2 (m.t.)	CH_4 (m.t.)	N_2O (m.t.)	Global Warming Potential CO_2	CH_4	N_2O	Emissions CO_2 (m.t. CO_2e)	CH_4 (m.t. CO_2e)	N_2O (m.t. CO_2e)	Total Emissions (m.t. CO_2e)	(tons CO_2e)
FLARE1	TEG Dehy Flare	8,760	5,800	48,438	1.10231	8.3600	0.000	0.00	7.10E-07	0.00	7.5641	0.00000	1	21	310	0.00	159.27	0.00	159.27	175.56

[1] Annual amount of gas processed at the dehy flare obtained from GRI-GLYCalc report for regenerator overheads stream, and CH_4 emissions obtained from GRI-GLYCalc emissions report for controlled regenerator emissions

Note - CO_2 and N_2O Emissions estimated using API Compendium Section 4.6

AP-42 HAP Estimate
Minus Formaldehyde
Waukesha L7042 Fuel Comsumption = 7696 btu/bhp-hr = 99777 mmbtu/yr

Compound	Emission Factor (lb/MMBtu)	L7042 (MMBtu/yr)	Emission Rate (lb/yr)	Emission Rate (tpy)
1,1,2,2-Tetrachloroethane	2.52E-05	9.98E+04	2.51E+00	1.26E-03
1,1,2-Trichloroethane	1.53E-05	9.98E+04	1.53E+00	7.63E-04
1,3-Butadiene	6.63E-04	9.98E+04	6.62E+01	3.31E-02
1,3-Dichloropropene	1.27E-05	9.98E+04	1.27E+00	6.34E-04
Acetaldehyde	2.79E-03	9.98E+04	2.78E+02	1.39E-01
Acrolein	2.63E-03	9.98E+04	2.62E+02	1.31E-01
Benzene	1.58E-03	9.98E+04	1.58E+02	7.88E-02
Carbon Tetrachloride	1.77E-05	9.98E+04	1.77E+00	8.83E-04
Chlorobenzene	1.29E-05	9.98E+04	1.29E+00	6.44E-04
Chloroform	1.37E-05	9.98E+04	1.37E+00	6.83E-04
Ethylbenzene	2.48E-05	9.98E+04	2.47E+00	1.24E-03
Ethylene Dibromide	2.13E-05	9.98E+04	2.13E+00	1.06E-03
Methanol	3.06E-03	9.98E+04	3.05E+02	1.53E-01
Methylene Chloride	4.12E-05	9.98E+04	4.11E+00	2.06E-03
Naphthalene	9.71E-05	9.98E+04	9.69E+00	4.84E-03
PAH	1.41E-04	9.98E+04	1.41E+01	7.03E-03
Styrene	1.19E-05	9.98E+04	1.19E+00	5.94E-04
Toluene	5.58E-04	9.98E+04	5.57E+01	2.78E-02
Vinyl Chloride	7.18E-06	9.98E+04	7.16E-01	3.58E-04
Xylene	1.95E-04	9.98E+04	1.95E+01	9.73E-03
Uncontrolled Total HAP Emissions:			**1.19E+03**	**5.95E-01**
Controlled HAP Emissions (60% Control), tpy:				**2.38E-01**

AP-42 HAP Estimate
Minus Formaldehyde
Waukesha G9390PSI Fuel Comsumption = 7792 btu/bhp-hr = 135149 mmbtu/yr

Compound	Emission Factor (lb/MMBtu)	G9390PSI (MMBtu/yr)	Emission Rate (lb/yr)	Emission Rate (tpy)
1,1,2,2-Tetrachloroethane	2.52E-05	1.35E+05	3.41E+00	1.70E-03
1,1,2-Trichloroethane	1.53E-05	1.35E+05	2.07E+00	1.03E-03
1,3-Butadiene	6.63E-04	1.35E+05	8.96E+01	4.48E-02
1,3-Dichloropropene	1.27E-05	1.35E+05	1.72E+00	8.58E-04
Acetaldehyde	2.79E-03	1.35E+05	3.77E+02	1.89E-01
Acrolein	2.63E-03	1.35E+05	3.55E+02	1.78E-01
Benzene	1.58E-03	1.35E+05	2.14E+02	1.07E-01
Carbon Tetrachloride	1.77E-05	1.35E+05	2.39E+00	1.20E-03
Chlorobenzene	1.29E-05	1.35E+05	1.74E+00	8.72E-04
Chloroform	1.37E-05	1.35E+05	1.85E+00	9.26E-04
Ethylbenzene	2.48E-05	1.35E+05	3.35E+00	1.68E-03
Ethylene Dibromide	2.13E-05	1.35E+05	2.88E+00	1.44E-03
Methanol	3.06E-03	1.35E+05	4.14E+02	2.07E-01
Methylene Chloride	4.12E-05	1.35E+05	5.57E+00	2.78E-03
Naphthalene	9.71E-05	1.35E+05	1.31E+01	6.56E-03
PAH	1.41E-04	1.35E+05	1.91E+01	9.53E-03
Styrene	1.19E-05	1.35E+05	1.61E+00	8.04E-04
Toluene	5.58E-04	1.35E+05	7.54E+01	3.77E-02
Vinyl Chloride	7.18E-06	1.35E+05	9.70E-01	4.85E-04
Xylene	1.95E-04	1.35E+05	2.64E+01	1.32E-02
Uncontrolled Total HAP Emissions:			**1.61E+03**	**8.05E-01**
Controlled HAP Emissions (60% Control), tpy:				**3.22E-01**

AP-42 HAP Estimate
Minus Formaldehyde
2.0 mmbtu/hr reboiler = 17,520 mmbtu/yr = 16.69

Compound	Emission Factor (lb/MMBtu)*	2.0 mmbtu/hr Reboiler (MMBtu/yr)	Emission Rate (lb/yr)	Emission Rate (tpy)
Acenapththene	1.80E-06	1.67E+01	3.00E-05	1.50E-08
Acenaphthylene	1.80E-06	1.67E+01	3.00E-05	1.50E-08
Anthracene	2.40E-06	1.67E+01	4.01E-05	2.00E-08
Benz(a)anthracene	1.80E-06	1.67E+01	3.00E-05	1.50E-08
Benzene	2.10E-03	1.67E+01	3.50E-02	1.75E-05
Benzo(a)pyrene	1.20E-06	1.67E+01	2.00E-05	1.00E-08
Benzo(b)fluoranthene	1.80E-06	1.67E+01	3.00E-05	1.50E-08
Benzo(g,h,i)perylene	1.20E-06	1.67E+01	2.00E-05	1.00E-08
Benzo(k)fluoranthene	1.80E-06	1.67E+01	3.00E-05	1.50E-08
Chrysene	1.80E-06	1.67E+01	3.00E-05	1.50E-08
7,12-dimethylbenz(a)anthrancene	1.60E-05	1.67E+01	2.67E-04	1.34E-07
Dibenzo(a,h)anthracene	1.20E-06	1.67E+01	2.00E-05	1.00E-08
Flouranthene	3.00E-06	1.67E+01	5.01E-05	2.50E-08
Fluorene	2.80E-06	1.67E+01	4.67E-05	2.34E-08
Formaldehyde	7.50E-02	1.67E+01	1.25E+00	6.26E-04
Hexane	1.80E+00	1.67E+01	3.00E+01	1.50E-02
Indeno(1,2,3-cd)pyrene	1.80E-06	1.67E+01	3.00E-05	1.50E-08
2-methylnaphthalene	2.40E-05	1.67E+01	4.01E-04	2.00E-07
3-methylchloranthrene	1.80E-06	1.67E+01	3.00E-05	1.50E-08
Naphthalene	6.10E-04	1.67E+01	1.02E-02	5.09E-06
Phenanthrene	1.70E-05	1.67E+01	2.84E-04	1.42E-07
Pyrene	5.00E-06	1.67E+01	8.35E-05	4.17E-08
Toluene	3.40E-03	1.67E+01	5.67E-02	2.84E-05
Uncontrolled Total HAP Emissions:			**3.14E+01**	**1.57E-02**

*Table 1.4-3 Emission Factors for Speciated Organic Compounds From Natural Gas Combustion

AP-42 HAP Estimate

Deere 197 HP Diesel Fuel Comsumption = 8.6 gal/hr * 139,200 btu/gal = 10487 mmbtu/yr

Compound	Emission Factor (lb/MMBtu)	Deere (MMBtu/yr)	Emission Rate (lb/yr)	Emission Rate (tpy)
1,3-Butadiene	3.91E-05	1.05E+04	4.10E-01	2.05E-04
Acetaldehyde	7.67E-04	1.05E+04	8.04E+00	4.02E-03
Acrolein	9.25E-05	1.05E+04	9.70E-01	4.85E-04
Benzene	9.33E-04	1.05E+04	9.78E+00	4.89E-03
Formaldehyde	1.18E-03	1.05E+04	1.24E+01	6.19E-03
Naphthalene	8.48E-05	1.05E+04	8.89E-01	4.45E-04
Toluene	4.09E-04	1.05E+04	4.29E+00	2.14E-03
Xylene	2.85E-04	1.05E+04	2.99E+00	1.49E-03
Uncontrolled Total HAP Emissions:			**3.97E+01**	**1.99E-02**
Controlled HAP Emissions (60% Control), tpy:				**7.95E-03**

Blowdown and ESD Emission Estimates
Measured in Total Gas

Station	Total Emissions From Each Engine Type (lbs) and Number of Engines of Each Type G3516B	#	G9390PSI	#	Avg. Flow mmscf/d	Site-Wide ESD Emissions Per Event (lbs)	Total Engine Blowdown Emissions (lbs/yr)	Total Site Blowdown Emissions (lbs/yr)
Smith	38	2	51	9	130	6216	19260	44123

* From historical data assume each engine is blowndown 3 times per month and each facility ESDs 4 times per year.
** Assume Density of natural gas is 0.05 lbs/scf
*** Welling is piped so that high pressure gas is fed back into inlet of station until pressures are equalized,
Once pressures are equalized then the remaining blowdown gas is vented to atmosphere.

Constituent	Wt% in gas	Total tpy released
VOC	24.501	5.405
Benzene	0.014	0.003
Toluene	0.033	0.007
N-Hexane	1.288	0.284
E-Benzene	0.001	0.000
Xylenes	0.016	0.004
CO2	0.258	0.057
Methane	54.07	11.929

Smith Condensate Tank Emissions from HYSYS Outputs 130 mmscfd

Season	Days	bbls Condensate/Day	Mass Loading VOC lb/hr		HAPs lb/hr	% VOC as HAPs
Spring/Fall	183	36.29	4.68		0.11	0.02
Winter	91	154.31	30.08		0.60	0.02
Summer	91	14.31	1.56		0.04	0.02
Annual Total	365	21985.17	89668.57	lb/yr		0.02
			44.83	ton/yr		
			0.90	Controlled ton/yr		
			0.93	HAPs tpy		
			0.02	Controlled HAPs tpy		

Smith Flare Emission Summary

Pilot Light

AP-42 Emission Factors Section 1.4

NOx (lb/10^6 scf)	CO (lb/10^6 scf)
100	84

Estimated Pilot Gas = 14 scf/hr = 122,640 scf/yr = 0.1226 10^6scf/yr

Estimated Pilot Gas Emissions

NOx = 100 lb/10^6 scf x 0.1226 10^6 scf/yr = 12.3 lbs/yr = **0.006 tpy**
CO = 84 lb/10^6 scf x 0.1226 10^6 scf/yr = 10.3 lbs/yr = **0.005 tpy**

Emissions from Combustion of VOCs

AP-42 Emission Factors Section 13.5

NOx (lb/10^6 btu)	CO (lb/10^6 btu)
0.068	0.37

From GRI-Glycalc Total HC Burned in Flare = 233 lb/hr = 2041080 lb/yr
Density of Nat. Gas. = 0.05 lb/scf = 40,821,600 scf/yr
Heat Content of Gas = 1339 btu/scf = 54,660 mmbtu/yr

Estimated emissions from combustion of VOCs

NOx = 0.068 lb/mmbtu x 54,600 mmbtu/yr = 3712 lbs/yr = **1.86 tpy**
CO = 0.37 lb/mmbtu x 54,660 mmbtu/yr = 20224 lbs/yr = **10.11 tpy**

Total Emissions from Pilot and Combustibles

NOx = 0.006 + 1.86 = 0.64 tpy
CO = 0.005 + 10.11 = 10.11 tpy

LAFAYETTE LABORATORY
500 AMBASSADOR CAFFERY PKWY.
SCOTT, LOUISIANA 70583-1790
PHONE (337) 237-4775
FAX (337) 237-8005

Certificate of Analysis Number: **2010120258-005A**

FOR: Gas Analytical Services
Chuck Honaker
PO Box 1028

Bridgeport, WV 26330

CUSTOMER: Gas Analytical Services
FIELD : Mark West
LOCATION : Fulton Discharge
SAMPLE POINT: Master Meter
REPORT DATE: 12/30/2010
SAMPLE DATE: 12/21/2010 16:13
SAMPLED BY: JM - GAS
MEMO:

TYPE: Gas
REPORT: C10+ (GPA Method 2286)
CYLINDER: GAS
PRESSURE: 950
TEMPERATURE: N.G.

COMPONENT	MOL %	WEIGHT %	GPM's @ 15.025
N2	0.398	0.502	
METHANE	74.575	54.070	
CO2	0.129	0.258	
ETHANE	15.209	20.669	4.148
PROPANE	5.324	10.612	1.496
I-BUTANE	0.647	1.699	0.216
N-BUTANE	1.639	4.307	0.527
I-PENTANE	0.391	1.275	0.146
N-PENTANE	0.522	1.704	0.193
I-HEXANES	0.365	1.410	0.151
N-HEXANE	0.332	1.288	0.138
BENZENE	0.004	0.014	0.001
CYCLOHEXANE	0.036	0.137	0.012
I-HEPTANES	0.168	0.763	0.078
N-HEPTANE	0.099	0.449	0.046
TOLUENE	0.008	0.033	0.003
I-OCTANES	0.111	0.543	0.052
N-OCTANE	0.018	0.091	0.009
*E-BENZENE	NIL	0.001	NIL
*m,o,&p-XYLENE	0.002	0.016	0.001
I-NONANES	0.014	0.078	0.007
N-NONANE	0.002	0.012	0.001
I-DECANES	NIL	0.012	0.001
N-DECANE	NIL	0.003	NIL
I-UNDECANES +	0.007	0.054	0.005
TOTALS	100.000	100.000	7.231

GRI-GLYCalc VERSION 4.0 - AGGREGATE CALCULATIONS REPORT

Case Name: Smith
File Name: C:\Program Files\GRI-GLYCalc4\Smith 6-29-2012.ddf
Date: June 27, 2012

DESCRIPTION:

Description: One Smith 130 mmscf/d dehy unit

Annual Hours of Operation: 8760.0 hours/yr

EMISSIONS REPORTS:

CONTROLLED REGENERATOR EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	1.9095	45.827	8.3635
Ethane	0.7800	18.721	3.4166
Propane	0.4526	10.863	1.9826
Isobutane	0.0794	1.905	0.3477
n-Butane	0.2234	5.362	0.9785
Isopentane	0.0650	1.560	0.2846
n-Pentane	0.0962	2.309	0.4215
n-Hexane	0.0884	2.122	0.3873
Cyclohexane	0.0269	0.647	0.1180
Other Hexanes	0.0855	2.053	0.3746
Heptanes	0.1102	2.646	0.4829
Benzene	0.0237	0.569	0.1039
Toluene	0.0700	1.680	0.3065
Xylenes	0.0331	0.796	0.1452
C8+ Heavies	0.1698	4.075	0.7436
Total Emissions	4.2139	101.134	18.4570
Total Hydrocarbon Emissions	4.2139	101.134	18.4570
Total VOC Emissions	1.5244	36.586	6.6769
Total HAP Emissions	0.2153	5.167	0.9429
Total BTEX Emissions	0.1269	3.045	0.5556

UNCONTROLLED REGENERATOR EMISSIONS

Component	lbs/hr	lbs/day	tons/yr

Methane	95.4735	2291.364	418.1739
Ethane	39.0023	936.055	170.8301
Propane	22.6320	543.168	99.1281
Isobutane	3.9696	95.270	17.3867
n-Butane	11.1702	268.084	48.9253
Isopentane	3.2493	77.983	14.2319
n-Pentane	4.8111	115.467	21.0728
n-Hexane	4.4210	106.104	19.3639
Cyclohexane	1.3470	32.328	5.8999
Other Hexanes	4.2765	102.636	18.7311
Heptanes	5.5120	132.288	24.1425
Benzene	1.1864	28.473	5.1963
Toluene	3.4990	83.975	15.3255
Xylenes	1.6574	39.779	7.2596
C8+ Heavies	8.4890	203.737	37.1819
Total Emissions	210.6963	5056.710	922.8496
Total Hydrocarbon Emissions	210.6963	5056.710	922.8496
Total VOC Emissions	76.2204	1829.291	333.8455
Total HAP Emissions	10.7638	258.331	47.1453
Total BTEX Emissions	6.3428	152.227	27.7814

FLASH GAS EMISSIONS

Note: Flash Gas Emissions are zero with the Recycle/recompression control option.

FLASH TANK OFF GAS

Component	lbs/hr	lbs/day	tons/yr
Methane	9.6354	231.250	42.2031
Ethane	7.7670	186.409	34.0197
Propane	3.9760	95.425	17.4150
Isobutane	0.5775	13.861	2.5296
n-Butane	1.4995	35.987	6.5677
Isopentane	0.3384	8.122	1.4823
n-Pentane	0.4592	11.020	2.0112
n-Hexane	0.2681	6.435	1.1744
Cyclohexane	0.0378	0.908	0.1657
Other Hexanes	0.3106	7.453	1.3602
Heptanes	0.1853	4.448	0.8117
Benzene	0.0035	0.083	0.0152
Toluene	0.0059	0.143	0.0260
Xylenes	0.0009	0.022	0.0040

C8+ Heavies	0.0692	1.662	0.3032
Total Emissions	25.1345	603.227	110.0890
Total Hydrocarbon Emissions	25.1345	603.227	110.0890
Total VOC Emissions	7.7320	185.568	33.8662
Total HAP Emissions	0.2784	6.683	1.2196
Total BTEX Emissions	0.0103	0.247	0.0452

EQUIPMENT REPORTS:

COMBUSTION DEVICE

Ambient Temperature: 70.00 deg. F
Excess Oxygen: 30.00 %
Combustion Efficiency: 98.00 %
Supplemental Fuel Requirement: 1.24e+000 MM BTU/hr

Component	Emitted	Destroyed
Methane	2.00%	98.00%
Ethane	2.00%	98.00%
Propane	2.00%	98.00%
Isobutane	2.00%	98.00%
n-Butane	2.00%	98.00%
Isopentane	2.00%	98.00%
n-Pentane	2.00%	98.00%
n-Hexane	2.00%	98.00%
Cyclohexane	2.00%	98.00%
Other Hexanes	2.00%	98.00%
Heptanes	2.00%	98.00%
Benzene	2.00%	98.00%
Toluene	2.00%	98.00%
Xylenes	2.00%	98.00%
C8+ Heavies	2.00%	98.00%

ABSORBER

NOTE: Because the Calculated Absorber Stages was below the minimum allowed, GRI-GLYCalc has set the number of Absorber Stages to 1.25 and has calculated a revised Dry Gas Dew Point.

Calculated Absorber Stages:	1.25
Calculated Dry Gas Dew Point:	6.71 lbs. H2O/MMSCF
Temperature:	99.0 deg. F
Pressure:	1000.0 psig
Dry Gas Flow Rate:	130.0000 MMSCF/day
Glycol Losses with Dry Gas:	4.3784 lb/hr
Wet Gas Water Content:	Saturated
Calculated Wet Gas Water Content:	57.02 lbs. H2O/MMSCF
Calculated Lean Glycol Recirc. Ratio:	1.65 gal/lb H2O

Component	Remaining in Dry Gas	Absorbed in Glycol
Water	11.75%	88.25%
Carbon Dioxide	99.92%	0.08%
Nitrogen	99.99%	0.01%
Methane	99.99%	0.01%
Ethane	99.98%	0.02%
Propane	99.98%	0.02%
Isobutane	99.97%	0.03%
n-Butane	99.96%	0.04%
Isopentane	99.97%	0.03%
n-Pentane	99.96%	0.04%
n-Hexane	99.94%	0.06%
Cyclohexane	99.74%	0.26%
Other Hexanes	99.95%	0.05%
Heptanes	99.91%	0.09%
Benzene	97.39%	2.61%
Toluene	96.72%	3.28%
Xylenes	94.58%	5.42%
C8+ Heavies	99.82%	0.18%

FLASH TANK

Flash Control:	Recycle/recompression
Flash Temperature:	70.0 deg. F
Flash Pressure:	85.0 psig

Component	Left in Glycol	Removed in Flash Gas
Water	100.00%	0.00%
Carbon Dioxide	64.13%	35.87%
Nitrogen	7.85%	92.15%
Methane	8.60%	91.40%
Ethane	26.85%	73.15%
Propane	50.60%	49.40%

Isobutane	63.33%	36.67%
n-Butane	70.83%	29.17%
Isopentane	75.20%	24.80%
n-Pentane	80.08%	19.92%
n-Hexane	89.01%	10.99%
Cyclohexane	96.80%	3.20%
Other Hexanes	85.37%	14.63%
Heptanes	94.85%	5.15%
Benzene	99.72%	0.28%
Toluene	99.84%	0.16%
Xylenes	99.95%	0.05%
C8+ Heavies	99.06%	0.94%

REGENERATOR

Regenerator Stripping Gas:
Dry Product Gas
Stripping Gas Flow Rate: 50.0000 scfm

Component	Remaining in Glycol	Distilled Overhead
Water	18.83%	81.17%
Carbon Dioxide	0.00%	100.00%
Nitrogen	0.00%	100.00%
Methane	0.00%	100.00%
Ethane	0.00%	100.00%
Propane	0.00%	100.00%
Isobutane	0.00%	100.00%
n-Butane	0.00%	100.00%
Isopentane	0.66%	99.34%
n-Pentane	0.62%	99.38%
n-Hexane	0.56%	99.44%
Cyclohexane	3.31%	96.69%
Other Hexanes	1.17%	98.83%
Heptanes	0.53%	99.47%
Benzene	5.01%	94.99%
Toluene	7.91%	92.09%
Xylenes	12.90%	87.10%
C8+ Heavies	12.11%	87.89%

STREAM REPORTS:

WET GAS STREAM

Temperature: 99.00 deg. F
Pressure: 1014.70 psia
Flow Rate: 5.42e+006 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	1.20e-001	3.09e+002
Carbon Dioxide	1.29e-001	8.11e+002
Nitrogen	3.98e-001	1.59e+003
Methane	7.45e+001	1.71e+005
Ethane	1.52e+001	6.53e+004
Propane	5.32e+000	3.35e+004
Isobutane	6.46e-001	5.37e+003
n-Butane	1.64e+000	1.36e+004
Isopentane	3.91e-001	4.03e+003
n-Pentane	5.21e-001	5.38e+003
n-Hexane	3.32e-001	4.08e+003
Cyclohexane	3.60e-002	4.33e+002
Other Hexanes	3.65e-001	4.49e+003
Heptanes	2.67e-001	3.82e+003
Benzene	4.00e-003	4.46e+001
Toluene	7.99e-003	1.05e+002
Xylenes	2.00e-003	3.03e+001
C8+ Heavies	1.52e-001	3.70e+003
Total Components	100.00	3.17e+005

DRY GAS STREAM

Temperature: 99.00 deg. F
Pressure: 1014.70 psia
Flow Rate: 5.42e+006 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	1.41e-002	3.63e+001
Carbon Dioxide	1.29e-001	8.10e+002
Nitrogen	3.98e-001	1.59e+003
Methane	7.46e+001	1.71e+005
Ethane	1.52e+001	6.53e+004
Propane	5.32e+000	3.35e+004
Isobutane	6.47e-001	5.37e+003
n-Butane	1.64e+000	1.36e+004

Isopentane	3.91e-001	4.03e+003
n-Pentane	5.22e-001	5.37e+003
n-Hexane	3.32e-001	4.08e+003
Cyclohexane	3.59e-002	4.31e+002
Other Hexanes	3.65e-001	4.49e+003
Heptanes	2.67e-001	3.82e+003
Benzene	3.90e-003	4.34e+001
Toluene	7.74e-003	1.02e+002
Xylenes	1.89e-003	2.87e+001
C8+ Heavies	1.52e-001	3.69e+003
Total Components	100.00	3.17e+005

LEAN GLYCOL STREAM

Temperature: 99.00 deg. F
Flow Rate: 7.50e+000 gpm

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.85e+001	4.16e+003
Water	1.50e+000	6.33e+001
Carbon Dioxide	1.53e-012	6.48e-011
Nitrogen	2.74e-013	1.16e-011
Methane	8.39e-018	3.54e-016
Ethane	1.19e-007	5.01e-006
Propane	7.76e-009	3.28e-007
Isobutane	1.12e-009	4.73e-008
n-Butane	3.02e-009	1.28e-007
Isopentane	1.62e-004	6.83e-003
n-Pentane	2.73e-004	1.15e-002
n-Hexane	2.89e-004	1.22e-002
Cyclohexane	8.98e-004	3.79e-002
Other Hexanes	5.03e-004	2.12e-002
Heptanes	4.27e-004	1.80e-002
Benzene	1.45e-003	6.14e-002
Toluene	7.01e-003	2.96e-001
Xylenes	5.76e-003	2.43e-001
C8+ Heavies	2.10e-002	8.88e-001
Total Components	100.00	4.22e+003

RICH GLYCOL STREAM

Temperature: 99.00 deg. F

Pressure: 1014.70 psia
Flow Rate: 8.17e+000 gpm
NOTE: Stream has more than one phase.

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.12e+001	4.15e+003
Water	7.38e+000	3.36e+002
Carbon Dioxide	1.42e-002	6.48e-001
Nitrogen	2.54e-003	1.15e-001
Methane	2.32e-001	1.05e+001
Ethane	2.33e-001	1.06e+001
Propane	1.77e-001	8.05e+000
Isobutane	3.46e-002	1.58e+000
n-Butane	1.13e-001	5.14e+000
Isopentane	3.00e-002	1.36e+000
n-Pentane	5.06e-002	2.31e+000
n-Hexane	5.36e-002	2.44e+000
Cyclohexane	2.60e-002	1.18e+000
Other Hexanes	4.66e-002	2.12e+000
Heptanes	7.91e-002	3.60e+000
Benzene	2.70e-002	1.23e+000
Toluene	8.22e-002	3.74e+000
Xylenes	4.14e-002	1.89e+000
C8+ Heavies	1.63e-001	7.40e+000
Total Components	100.00	4.55e+003

FLASH TANK OFF GAS STREAM

Temperature: 70.00 deg. F
Pressure: 99.70 psia
Flow Rate: 3.85e+002 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	6.39e-002	1.17e-002
Carbon Dioxide	5.20e-001	2.32e-001
Nitrogen	3.74e-001	1.06e-001
Methane	5.92e+001	9.64e+000
Ethane	2.54e+001	7.77e+000
Propane	8.88e+000	3.98e+000
Isobutane	9.79e-001	5.78e-001
n-Butane	2.54e+000	1.50e+000
Isopentane	4.62e-001	3.38e-001
n-Pentane	6.27e-001	4.59e-001

n-Hexane	3.06e-001	2.68e-001
Cyclohexane	4.43e-002	3.78e-002
Other Hexanes	3.55e-001	3.11e-001
Heptanes	1.82e-001	1.85e-001
Benzene	4.37e-003	3.46e-003
Toluene	6.35e-003	5.94e-003
Xylenes	8.44e-004	9.10e-004
C8+ Heavies	4.00e-002	6.92e-002
Total Components	100.00	2.55e+001

FLASH TANK GLYCOL STREAM

Temperature: 70.00 deg. F
Flow Rate: 8.11e+000 gpm

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.17e+001	4.15e+003
Water	7.43e+000	3.36e+002
Carbon Dioxide	9.18e-003	4.15e-001
Nitrogen	2.00e-004	9.06e-003
Methane	2.00e-002	9.07e-001
Ethane	6.30e-002	2.85e+000
Propane	9.00e-002	4.07e+000
Isobutane	2.20e-002	9.97e-001
n-Butane	8.04e-002	3.64e+000
Isopentane	2.27e-002	1.03e+000
n-Pentane	4.08e-002	1.85e+000
n-Hexane	4.80e-002	2.17e+000
Cyclohexane	2.53e-002	1.15e+000
Other Hexanes	4.00e-002	1.81e+000
Heptanes	7.55e-002	3.42e+000
Benzene	2.70e-002	1.22e+000
Toluene	8.26e-002	3.74e+000
Xylenes	4.16e-002	1.88e+000
C8+ Heavies	1.62e-001	7.33e+000
Total Components	100.00	4.53e+003

FLASH GAS EMISSIONS

Control Method: Recycle/recompression
Control Efficiency: 100.00

Note: Flash Gas Emissions are zero with the

Recycle/recompression control option.

REGENERATOR OVERHEADS STREAM

Temperature: 212.00 deg. F
Pressure: 14.70 psia
Flow Rate: 8.97e+003 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	6.41e+001	2.73e+002
Carbon Dioxide	8.31e-002	8.64e-001
Nitrogen	1.35e-001	8.90e-001
Methane	2.52e+001	9.55e+001
Ethane	5.49e+000	3.90e+001
Propane	2.17e+000	2.26e+001
Isobutane	2.89e-001	3.97e+000
n-Butane	8.13e-001	1.12e+001
Isopentane	1.91e-001	3.25e+000
n-Pentane	2.82e-001	4.81e+000
n-Hexane	2.17e-001	4.42e+000
Cyclohexane	6.77e-002	1.35e+000
Other Hexanes	2.10e-001	4.28e+000
Heptanes	2.33e-001	5.51e+000
Benzene	6.43e-002	1.19e+000
Toluene	1.61e-001	3.50e+000
Xylenes	6.61e-002	1.66e+000
C8+ Heavies	2.11e-001	8.49e+000
Total Components	100.00	4.85e+002

COMBUSTION DEVICE OFF GAS STREAM

Temperature: 1000.00 deg. F
Pressure: 14.70 psia
Flow Rate: 6.39e+001 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Methane	7.06e+001	1.91e+000
Ethane	1.54e+001	7.80e-001
Propane	6.09e+000	4.53e-001
Isobutane	8.11e-001	7.94e-002
n-Butane	2.28e+000	2.23e-001
Isopentane	5.35e-001	6.50e-002

n-Pentane	7.91e-001	9.62e-002
n-Hexane	6.09e-001	8.84e-002
Cyclohexane	1.90e-001	2.69e-002
Other Hexanes	5.89e-001	8.55e-002
Heptanes	6.53e-001	1.10e-001
Benzene	1.80e-001	2.37e-002
Toluene	4.51e-001	7.00e-002
Xylenes	1.85e-001	3.31e-002
C8+ Heavies	5.92e-001	1.70e-001
Total Components	100.00	4.21e+000

aspen

MARKWEST HYDROCARBON, IN
Burlington, MA
USA

Case Name: Smith HYSYS 130 MMSCFD 6-29-2012.hsc

Unit Set: NewUser

Date/Time: Wed Jun 27 16:00:53 2012

Material Stream: Spring/Fall Flow to VRU

Fluid Package: Basis-1

Property Package: Peng-Robinson

CONDITIONS

	Overall	Vapour Phase	Liquid Phase	Aqueous Phase
Vapour / Phase Fraction	1.0000	1.0000	0.0000	0.0000
Temperature: (F)	78.97	78.97	78.97	78.97
Pressure: (psia)	14.10	14.10	14.10	14.10
Molar Flow (MMSCFD)	2.012e-003	2.012e-003	0.0000	0.0000
Mass Flow (lb/hr)	7.708	7.708	0.0000	0.0000
Std Ideal Liq Vol Flow (barrel/day)	1.176	1.176	0.0000	0.0000
Molar Enthalpy (Btu/lbmole)	-4.366e+004	-4.366e+004	-1.210e+005	-1.230e+005
Molar Entropy (Btu/lbmole-F)	45.53	45.53	50.29	12.90
Heat Flow (Btu/hr)	-9648	-9648	0.0000	0.0000
Liq Vol Flow @Std Cond (barrel/day)	1.265 *	1.265	0.0000	0.0000

PROPERTIES

	Overall	Vapour Phase	Liquid Phase	Aqueous Phase
Molecular Weight	34.88	34.88	133.4	18.02
Molar Density (lbmole/ft3)	2.464e-003	2.464e-003	0.3377	3.488
Mass Density (lb/ft3)	8.593e-002	8.593e-002	45.06	62.83
Act. Volume Flow (barrel/day)	383.4	383.4	0.0000	0.0000
Mass Enthalpy (Btu/lb)	-1252	-1252	-906.8	-6828
Mass Entropy (Btu/lb-F)	1.305	1.305	0.3769	0.7158
Heat Capacity (Btu/lbmole-F)	14.94	14.94	66.40	18.56
Mass Heat Capacity (Btu/lb-F)	0.4284	0.4284	0.4976	1.030
Lower Heating Value (Btu/lbmole)	6.884e+005	6.884e+005	2.559e+006	6.118e-004
Mass Lower Heating Value (Btu/lb)	1.974e+004	1.974e+004	1.918e+004	3.396e-005
Phase Fraction [Vol. Basis]	---	1.000	---	---
Phase Fraction [Mass Basis]	2.122e-314	1.000	0.0000	0.0000
Partial Pressure of CO2 (psia)	1.971e-002	---	---	---
Cost Based on Flow (Cost/s)	0.0000	0.0000	0.0000	0.0000
Act. Gas Flow (ACFM)	1.495	1.495	---	---
Avg. Liq. Density (lbmole/ft3)	0.8035	0.8035	0.3390	3.458
Specific Heat (Btu/lbmole-F)	14.94	14.94	66.40	18.56
Std. Gas Flow (MMSCFD)	2.013e-003	2.013e-003	0.0000	0.0000
Std. Ideal Liq. Mass Density (lb/ft3)	28.03	28.03	45.23	62.30
Act. Liq. Flow (USGPM)	0.0000	---	---	0.0000
Z Factor	---	0.9901	7.223e-003	6.994e-004
Watson K	15.86	15.86	12.65	8.515
User Property	---	---	---	---
Partial Pressure of H2S (psia)	0.0000	---	---	---
Cp/(Cp - R)	1.153	1.153	1.031	1.120
Cp/Cv	1.160	1.160	1.031	1.148
Heat of Vap. (Btu/lbmole)	1.189e+004	---	---	---
Kinematic Viscosity (cSt)	6.892	6.892	1.064	0.8630
Liq. Mass Density (Std. Cond) (lb/ft3)	26.04	26.04	45.58	63.33
Liq. Vol. Flow (Std. Cond) (barrel/day)	1.265	1.265	0.0000	0.0000
Liquid Fraction	0.0000	0.0000	1.000	1.000
Molar Volume (ft3/lbmole)	405.9	405.9	2.961	0.2867
Mass Heat of Vap. (Btu/lb)	340.9	---	---	---
Phase Fraction [Molar Basis]	1.0000	1.0000	0.0000	0.0000
Surface Tension (dyne/cm)	---	---	21.34	71.91
Thermal Conductivity (Btu/hr-ft-F)	1.273e-002	1.273e-002	7.252e-002	0.3540
Viscosity (cP)	9.486e-003	9.486e-003	0.7682	0.8686
Cv (Semi-Ideal) (Btu/lbmole-F)	12.96	12.96	64.41	16.57
Mass Cv (Semi-Ideal) (Btu/lb-F)	0.3714	0.3714	0.4828	0.9200
Cv (Btu/lbmole-F)	12.88	12.88	64.41	16.17

* Specified by user.

Material Stream: Spring/Fall Flow to VRU (con

Fluid Package: Basis-1
Property Package: Peng-Robinson

PROPERTIES

		Overall	Vapour Phase	Liquid Phase	Aqueous Phase
Mass Cv	(Btu/lb-F)	0.3694	0.3694	0.4828	0.8976
Cv (Ent. Method)	(Btu/lbmole-F)	---	---	---	15.80
Mass Cv (Ent. Method)	(Btu/lb-F)	---	---	---	0.8770
Cp/Cv (Ent. Method)		---	---	---	1.175
Reid VP at 37.8 C	(psia)	651.3	651.3	8.854	---
True VP at 37.8 C	(psia)	1133	1133	17.10	5.715
Liq. Vol. Flow - Sum(Std. Cond)	(barrel/day)	1.265	1.265	0.0000	0.0000
Viscosity Index		---	---	-1.193	-0.6629

COMPOSITION

Overall Phase

Vapour Fraction 1.0000

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
Methane	0.0680	0.3076	1.0903	0.1415	0.2494	0.2121
Ethane	0.0593	0.2682	1.7820	0.2312	0.3431	0.2918
Propane	0.0459	0.2076	2.0230	0.2625	0.2734	0.2326
I-Butane	0.0071	0.0319	0.4101	0.0532	0.0500	0.0425
n-Butane	0.0182	0.0826	1.0603	0.1376	0.1245	0.1059
i-Pentane	0.0042	0.0191	0.3043	0.0395	0.0334	0.0284
n-Pentane	0.0054	0.0243	0.3870	0.0502	0.0421	0.0358
3-Mhexane	0.0011	0.0049	0.1074	0.0139	0.0107	0.0091
n-Hexane	0.0011	0.0052	0.0982	0.0127	0.0101	0.0086
Benzene	0.0000	0.0001	0.0010	0.0001	0.0001	0.0001
Cyclohexane	0.0002	0.0007	0.0129	0.0017	0.0011	0.0010
23-Mpentane	0.0009	0.0040	0.0890	0.0115	0.0087	0.0074
n-Heptane	0.0006	0.0025	0.0558	0.0072	0.0056	0.0047
Toluene	0.0001	0.0002	0.0046	0.0006	0.0004	0.0003
2-Mheptane	0.0007	0.0033	0.0835	0.0108	0.0082	0.0069
n-Octane	0.0002	0.0007	0.0175	0.0023	0.0017	0.0014
E-Benzene	0.0000	0.0001	0.0013	0.0002	0.0001	0.0001
o-Xylene	0.0000	0.0001	0.0025	0.0003	0.0002	0.0002
n-Nonane	0.0001	0.0004	0.0110	0.0014	0.0010	0.0009
n-Decane	0.0000	0.0002	0.0049	0.0006	0.0005	0.0004
n-C11	0.0000	0.0000	0.0017	0.0002	0.0002	0.0001
n-C12	0.0000	0.0001	0.0047	0.0006	0.0004	0.0004
H2O	0.0076	0.0342	0.1363	0.0177	0.0094	0.0080
Nitrogen	0.0002	0.0007	0.0046	0.0006	0.0004	0.0003
CO2	0.0003	0.0014	0.0136	0.0018	0.0011	0.0010
Oxygen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.2210	1.0000	7.7076	1.0000	1.1755	1.0000

Vapour Phase

Phase Fraction 1.000

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
Methane	0.0680	0.3076	1.0903	0.1415	0.2494	0.2121
Ethane	0.0593	0.2682	1.7820	0.2312	0.3431	0.2918
Propane	0.0459	0.2076	2.0230	0.2625	0.2734	0.2326
i-Butane	0.0071	0.0319	0.4101	0.0532	0.0500	0.0425
n-Butane	0.0182	0.0826	1.0603	0.1376	0.1245	0.1059
i-Pentane	0.0042	0.0191	0.3043	0.0395	0.0334	0.0284
n-Pentane	0.0054	0.0243	0.3870	0.0502	0.0421	0.0358
3-Mhexane	0.0011	0.0049	0.1074	0.0139	0.0107	0.0091

Material Stream: Spring/Fall Flow to VRU (con

Fluid Package: Basis-1
Property Package: Peng-Robinson

COMPOSITION

Vapour Phase (continued)

Phase Fraction 1.000

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
n-Hexane	0.0011	0.0052	0.0982	0.0127	0.0101	0.0086
Benzene	0.0000	0.0001	0.0010	0.0001	0.0001	0.0001
Cyclohexane	0.0002	0.0007	0.0129	0.0017	0.0011	0.0010
23-Mpentane	0.0009	0.0040	0.0890	0.0115	0.0087	0.0074
n-Heptane	0.0006	0.0025	0.0558	0.0072	0.0056	0.0047
Toluene	0.0001	0.0002	0.0046	0.0006	0.0004	0.0003
2-Mheptane	0.0007	0.0033	0.0835	0.0108	0.0082	0.0069
n-Octane	0.0002	0.0007	0.0175	0.0023	0.0017	0.0014
E-Benzene	0.0000	0.0001	0.0013	0.0002	0.0001	0.0001
o-Xylene	0.0000	0.0001	0.0025	0.0003	0.0002	0.0002
n-Nonane	0.0001	0.0004	0.0110	0.0014	0.0010	0.0009
n-Decane	0.0000	0.0002	0.0049	0.0006	0.0005	0.0004
n-C11	0.0000	0.0000	0.0017	0.0002	0.0002	0.0001
n-C12	0.0000	0.0001	0.0047	0.0006	0.0004	0.0004
H2O	0.0076	0.0342	0.1363	0.0177	0.0094	0.0080
Nitrogen	0.0002	0.0007	0.0046	0.0006	0.0004	0.0003
CO2	0.0003	0.0014	0.0136	0.0018	0.0011	0.0010
Oxygen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.2210	1.0000	7.7076	1.0000	1.1755	1.0000

Liquid Phase

Phase Fraction 0.0000

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
Methane	0.0000	0.0015	0.0000	0.0002	0.0000	0.0004
Ethane	0.0000	0.0073	0.0000	0.0017	0.0000	0.0034
Propane	0.0000	0.0207	0.0000	0.0069	0.0000	0.0098
i-Butane	0.0000	0.0083	0.0000	0.0036	0.0000	0.0047
n-Butane	0.0000	0.0302	0.0000	0.0131	0.0000	0.0163
i-Pentane	0.0000	0.0181	0.0000	0.0098	0.0000	0.0114
n-Pentane	0.0000	0.0307	0.0000	0.0166	0.0000	0.0191
3-Mhexane	0.0000	0.0503	0.0000	0.0377	0.0000	0.0396
n-Hexane	0.0000	0.0218	0.0000	0.0141	0.0000	0.0154
Benzene	0.0000	0.0002	0.0000	0.0001	0.0000	0.0001
Cyclohexane	0.0000	0.0036	0.0000	0.0022	0.0000	0.0021
23-Mpentane	0.0000	0.0379	0.0000	0.0285	0.0000	0.0296
n-Heptane	0.0000	0.0344	0.0000	0.0258	0.0000	0.0272
Toluene	0.0000	0.0033	0.0000	0.0022	0.0000	0.0019
2-Mheptane	0.0000	0.1027	0.0000	0.0880	0.0000	0.0909
n-Octane	0.0000	0.0304	0.0000	0.0260	0.0000	0.0267
E-Benzene	0.0000	0.0024	0.0000	0.0019	0.0000	0.0016
o-Xylene	0.0000	0.0061	0.0000	0.0048	0.0000	0.0040
n-Nonane	0.0000	0.0522	0.0000	0.0501	0.0000	0.0504
n-Decane	0.0000	0.0629	0.0000	0.0671	0.0000	0.0664
n-C11	0.0000	0.0608	0.0000	0.0712	0.0000	0.0695
n-C12	0.0000	0.4136	0.0000	0.5280	0.0000	0.5093
H2O	0.0000	0.0005	0.0000	0.0001	0.0000	0.0000
Nitrogen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
CO2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Oxygen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000

Material Stream: Spring/Fall Flow to VRU (con

Fluid Package: Basis-1
Property Package: Peng-Robinson

COMPOSITION

Aqueous Phase

Phase Fraction 0.0000

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
Methane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Ethane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Propane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
i-Butane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Butane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
i-Pentane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Pentane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3-Mhexane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Hexane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Benzene	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Cyclohexane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
23-Mpentane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Heptane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Toluene	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2-Mheptane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Octane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
E-Benzene	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
o-Xylene	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Nonane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Decane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-C11	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-C12	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
H2O	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000
Nitrogen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
CO2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Oxygen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000

Material Stream: Winter Flow to VRU @TPL4

Fluid Package: Basis-1
Property Package: Peng-Robinson

CONDITIONS

		Overall	Vapour Phase	Liquid Phase	Aqueous Phase	
Vapour / Phase Fraction		1.0000	1.0000	0.0000	0.0000	
Temperature:	(F)	46.05	46.05	46.05	46.05	
Pressure:	(psia)	14.10	14.10	14.10	14.10	
Molar Flow	(MMSCFD)	1.278e-002	1.278e-002	0.0000	0.0000	
Mass Flow	(lb/hr)	49.43	49.43	0.0000	0.0000	
Std Ideal Liq Vol Flow	(barrel/day)	7.632	7.632	0.0000	0.0000	
Molar Enthalpy	(Btu/lbmole)	-4.248e+004	-4.248e+004	-1.003e+005	-1.236e+005	
Molar Entropy	(Btu/lbmole-F)	44.42	44.42	33.62	11.72	
Heat Flow	(Btu/hr)	-5.963e+004	-5.963e+004	0.0000	0.0000	
Liq Vol Flow @Std Cond	(barrel/day)	8.263 *	8.263	0.0000	0.0000	

PROPERTIES

		Overall	Vapour Phase	Liquid Phase	Aqueous Phase	
Molecular Weight		35.22	35.22	104.9	18.02	
Molar Density	(lbmole/ft3)	2.630e-003	2.630e-003	0.4213	3.535	
Mass Density	(lb/ft3)	9.261e-002	9.261e-002	44.18	63.68	
Act. Volume Flow	(barrel/day)	2281	2281	0.0000	0.0000	

Material Stream: Winter Flow to VRU @TPL4 (

Fluid Package: Basis-1
Property Package: Peng-Robinson

PROPERTIES

	Overall	Vapour Phase	Liquid Phase	Aqueous Phase
Mass Enthalpy (Btu/lb)	-1206	-1206	-956.2	-6862
Mass Entropy (Btu/lb-F)	1.261	1.261	0.3205	0.6508
Heat Capacity (Btu/lbmole-F)	14.45	14.45	50.78	18.59
Mass Heat Capacity (Btu/lb-F)	0.4102	0.4102	0.4842	1.032
Lower Heating Value (Btu/lbmole)	7.044e+005	7.044e+005	2.019e+006	1.762e-004
Mass Lower Heating Value (Btu/lb)	2.000e+004	2.000e+004	1.925e+004	9.782e-006
Phase Fraction [Vol. Basis]	---	1.000	---	---
Phase Fraction [Mass Basis]	2.122e-314	1.000	0.0000	0.0000
Partial Pressure of CO2 (psia)	1.556e-002	---	---	---
Cost Based on Flow (Cost/s)	0.0000	0.0000	0.0000	0.0000
Act. Gas Flow (ACFM)	8.895	8.895	---	---
Avg. Liq. Density (lbmole/ft3)	0.7860	0.7860	0.4130	3.458
Specific Heat (Btu/lbmole-F)	14.45	14.45	50.78	18.59
Std. Gas Flow (MMSCFD)	1.278e-002	1.278e-002	0.0000	0.0000
Std. Ideal Liq. Mass Density (lb/ft3)	27.68	27.68	43.32	62.30
Act. Liq. Flow (USGPM)	0.0000	---	---	0.0000
Z Factor	---	0.9880	6.167e-003	7.349e-004
Watson K	15.95	15.95	12.65	8.509
User Property	---	---	---	---
Partial Pressure of H2S (psia)	0.0000	---	---	---
Cp/(Cp - R)	1.159	1.159	1.041	1.120
Cp/Cv	1.167	1.167	1.041	1.135
Heat of Vap. (Btu/lbmole)	1.105e+004	---	---	---
Kinematic Viscosity (cSt)	5.997	5.997	0.8001	1.355
Liq. Mass Density (Std. Cond) (lb/ft3)	25.57	25.57	43.77	63.33
Liq. Vol. Flow (Std. Cond) (barrel/day)	8.263	8.263	0.0000	0.0000
Liquid Fraction	0.0000	0.0000	1.000	1.000
Molar Volume (ft3/lbmole)	380.3	380.3	2.374	0.2829
Mass Heat of Vap. (Btu/lb)	313.7	---	---	---
Phase Fraction [Molar Basis]	1.0000	1.0000	0.0000	0.0000
Surface Tension (dyne/cm)	---	---	20.67	75.06
Thermal Conductivity (Btu/hr-ft-F)	1.153e-002	1.153e-002	7.069e-002	0.3369
Viscosity (cP)	8.897e-003	8.897e-003	0.5663	1.383
Cv (Semi-Ideal) (Btu/lbmole-F)	12.46	12.46	48.79	16.60
Mass Cv (Semi-Ideal) (Btu/lb-F)	0.3539	0.3539	0.4652	0.9215
Cv (Btu/lbmole-F)	12.38	12.38	48.79	16.38
Mass Cv (Btu/lb-F)	0.3514	0.3514	0.4652	0.9093
Cv (Ent. Method) (Btu/lbmole-F)	---	---	---	16.10
Mass Cv (Ent. Method) (Btu/lb-F)	---	---	---	0.8940
Cp/Cv (Ent. Method)	---	---	---	1.154
Reid VP at 37.8 C (psia)	631.3	631.3	15.75	---
True VP at 37.8 C (psia)	1071	1071	25.06	2.016
Liq. Vol. Flow - Sum(Std. Cond) (barrel/day)	8.263	8.263	0.0000	0.0000
Viscosity Index	---	---	-1.698	-0.2316

COMPOSITION

Overall Phase — Vapour Fraction 1.0000

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
Methane	0.4115	0.2932	6.6023	0.1336	1.5100	0.1978
Ethane	0.4119	0.2935	12.3871	0.2506	2.3847	0.3124
Propane	0.3164	0.2255	13.9544	0.2823	1.8858	0.2471

Material Stream: Winter Flow to VRU @TPL4 (

Fluid Package: Basis-1
Property Package: Peng-Robinson

COMPOSITION

Overall Phase (continued)

Vapour Fraction 1.0000

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
i-Butane	0.0461	0.0329	2.6819	0.0543	0.3268	0.0428
n-Butane	0.1172	0.0835	6.8126	0.1378	0.7998	0.1048
i-Pentane	0.0258	0.0184	1.8632	0.0377	0.2046	0.0268
n-Pentane	0.0324	0.0231	2.3374	0.0473	0.2542	0.0333
3-Mhexane	0.0056	0.0040	0.5624	0.0114	0.0558	0.0073
n-Hexane	0.0065	0.0046	0.5574	0.0113	0.0576	0.0075
Benzene	0.0001	0.0001	0.0057	0.0001	0.0004	0.0001
Cyclohexane	0.0009	0.0006	0.0723	0.0015	0.0063	0.0008
23-Mpentane	0.0047	0.0034	0.4717	0.0095	0.0463	0.0061
n-Heptane	0.0028	0.0020	0.2806	0.0057	0.0280	0.0037
Toluene	0.0002	0.0002	0.0230	0.0005	0.0018	0.0002
2-Mheptane	0.0031	0.0022	0.3500	0.0071	0.0342	0.0045
n-Octane	0.0006	0.0004	0.0650	0.0013	0.0063	0.0008
E-Benzene	0.0000	0.0000	0.0046	0.0001	0.0004	0.0000
o-Xylene	0.0001	0.0001	0.0082	0.0002	0.0006	0.0001
n-Nonane	0.0002	0.0001	0.0229	0.0005	0.0022	0.0003
n-Decane	0.0000	0.0000	0.0049	0.0001	0.0005	0.0001
n-C11	0.0000	0.0000	0.0008	0.0000	0.0001	0.0000
n-C12	0.0000	0.0000	0.0016	0.0000	0.0001	0.0000
H2O	0.0149	0.0106	0.2682	0.0054	0.0184	0.0024
Nitrogen	0.0008	0.0006	0.0219	0.0004	0.0019	0.0002
CO2	0.0015	0.0011	0.0681	0.0014	0.0057	0.0007
Oxygen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	1.4035	1.0000	49.4286	1.0000	7.6324	1.0000

Vapour Phase

Phase Fraction 1.000

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
Methane	0.4115	0.2932	6.6023	0.1336	1.5100	0.1978
Ethane	0.4119	0.2935	12.3871	0.2506	2.3847	0.3124
Propane	0.3164	0.2255	13.9544	0.2823	1.8858	0.2471
i-Butane	0.0461	0.0329	2.6819	0.0543	0.3268	0.0428
n-Butane	0.1172	0.0835	6.8126	0.1378	0.7998	0.1048
i-Pentane	0.0258	0.0184	1.8632	0.0377	0.2046	0.0268
n-Pentane	0.0324	0.0231	2.3374	0.0473	0.2542	0.0333
3-Mhexane	0.0056	0.0040	0.5624	0.0114	0.0558	0.0073
n-Hexane	0.0065	0.0046	0.5574	0.0113	0.0576	0.0075
Benzene	0.0001	0.0001	0.0057	0.0001	0.0004	0.0001
Cyclohexane	0.0009	0.0006	0.0723	0.0015	0.0063	0.0008
23-Mpentane	0.0047	0.0034	0.4717	0.0095	0.0463	0.0061
n-Heptane	0.0028	0.0020	0.2806	0.0057	0.0280	0.0037
Toluene	0.0002	0.0002	0.0230	0.0005	0.0018	0.0002
2-Mheptane	0.0031	0.0022	0.3500	0.0071	0.0342	0.0045
n-Octane	0.0006	0.0004	0.0650	0.0013	0.0063	0.0008
E-Benzene	0.0000	0.0000	0.0046	0.0001	0.0004	0.0000
o-Xylene	0.0001	0.0001	0.0082	0.0002	0.0006	0.0001
n-Nonane	0.0002	0.0001	0.0229	0.0005	0.0022	0.0003
n-Decane	0.0000	0.0000	0.0049	0.0001	0.0005	0.0001
n-C11	0.0000	0.0000	0.0008	0.0000	0.0001	0.0000
n-C12	0.0000	0.0000	0.0016	0.0000	0.0001	0.0000

Material Stream: Winter Flow to VRU @TPL4 (

Fluid Package: Basis-1
Property Package: Peng-Robinson

COMPOSITION

Vapour Phase (continued)

Phase Fraction 1.000

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
H2O	0.0149	0.0106	0.2682	0.0054	0.0184	0.0024
Nitrogen	0.0008	0.0006	0.0219	0.0004	0.0019	0.0002
CO2	0.0015	0.0011	0.0681	0.0014	0.0057	0.0007
Oxygen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	1.4035	1.0000	49.4286	1.0000	7.6324	1.0000

Liquid Phase

Phase Fraction 0.0000

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
Methane	0.0000	0.0017	0.0000	0.0003	0.0000	0.0006
Ethane	0.0000	0.0113	0.0000	0.0033	0.0000	0.0063
Propane	0.0000	0.0365	0.0000	0.0154	0.0000	0.0210
i-Butane	0.0000	0.0152	0.0000	0.0084	0.0000	0.0104
n-Butane	0.0000	0.0568	0.0000	0.0315	0.0000	0.0374
i-Pentane	0.0000	0.0352	0.0000	0.0242	0.0000	0.0270
n-Pentane	0.0000	0.0616	0.0000	0.0424	0.0000	0.0467
3-Mhexane	0.0000	0.1063	0.0000	0.1016	0.0000	0.1021
n-Hexane	0.0000	0.0462	0.0000	0.0380	0.0000	0.0397
Benzene	0.0000	0.0005	0.0000	0.0004	0.0000	0.0003
Cyclohexane	0.0000	0.0076	0.0000	0.0061	0.0000	0.0054
23-Mpentane	0.0000	0.0803	0.0000	0.0767	0.0000	0.0763
n-Heptane	0.0000	0.0718	0.0000	0.0686	0.0000	0.0693
Toluene	0.0000	0.0069	0.0000	0.0061	0.0000	0.0049
2-Mheptane	0.0000	0.1908	0.0000	0.2078	0.0000	0.2057
n-Octane	0.0000	0.0522	0.0000	0.0569	0.0000	0.0560
E-Benzene	0.0000	0.0042	0.0000	0.0043	0.0000	0.0034
o-Xylene	0.0000	0.0098	0.0000	0.0099	0.0000	0.0078
n-Nonane	0.0000	0.0555	0.0000	0.0679	0.0000	0.0654
n-Decane	0.0000	0.0349	0.0000	0.0474	0.0000	0.0449
n-C11	0.0000	0.0188	0.0000	0.0280	0.0000	0.0262
n-C12	0.0000	0.0953	0.0000	0.1548	0.0000	0.1430
H2O	0.0000	0.0002	0.0000	0.0000	0.0000	0.0000
Nitrogen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
CO2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Oxygen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000

Aqueous Phase

Phase Fraction 0.0000

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
Methane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Ethane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Propane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
i-Butane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Butane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
i-Pentane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Pentane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3-Mhexane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Hexane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Benzene	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Material Stream: Winter Flow to VRU @TPL4 (

Fluid Package: Basis-1
Property Package: Peng-Robinson

COMPOSITION

Aqueous Phase (continued)

Phase Fraction 0.0000

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
Cyclohexane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
23-Mpentane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Heptane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Toluene	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2-Mheptane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Octane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
E-Benzene	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
o-Xylene	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Nonane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Decane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-C11	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-C12	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
H2O	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000
Nitrogen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
CO2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Oxygen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000

Material Stream: Summer Flow to VRU @TPL3

Fluid Package: Basis-1
Property Package: Peng-Robinson

CONDITIONS

	Overall	Vapour Phase	Liquid Phase	Aqueous Phase	
Vapour / Phase Fraction	1.0000	1.0000	0.0000	0.0000	
Temperature: (F)	94.09	94.09	94.09	94.09	
Pressure: (psia)	14.10	14.10	14.10	14.10	
Molar Flow (MMSCFD)	6.913e-004	6.913e-004	0.0000	0.0000	
Mass Flow (lb/hr)	2.610	2.610	0.0000	0.0000	
Std Ideal Liq Vol Flow (barrel/day)	0.3956	0.3956	0.0000	0.0000	
Molar Enthalpy (Btu/lbmole)	-4.479e+004	-4.479e+004	-1.280e+005	-1.227e+005	
Molar Entropy (Btu/lbmole-F)	46.04	46.04	56.77	13.41	
Heat Flow (Btu/hr)	-3400	-3400	0.0000	0.0000	
Liq Vol Flow @Std Cond (barrel/day)	0.4228 *	0.4228	0.0000	0.0000	

PROPERTIES

	Overall	Vapour Phase	Liquid Phase	Aqueous Phase	
Molecular Weight	34.39	34.39	143.6	18.02	
Molar Density (lbmole/ft3)	2.394e-003	2.394e-003	0.3142	3.466	
Mass Density (lb/ft3)	8.232e-002	8.232e-002	45.13	62.44	
Act. Volume Flow (barrel/day)	135.5	135.5	0.0000	0.0000	
Mass Enthalpy (Btu/lb)	-1303	-1303	-891.1	-6813	
Mass Entropy (Btu/lb-F)	1.339	1.339	0.3952	0.7443	
Heat Capacity (Btu/lbmole-F)	15.02	15.02	72.53	18.56	
Mass Heat Capacity (Btu/lb-F)	0.4368	0.4368	0.5050	1.030	
Lower Heating Value (Btu/lbmole)	6.704e+005	6.704e+005	2.753e+006	1.023e-003	
Mass Lower Heating Value (Btu/lb)	1.949e+004	1.949e+004	1.916e+004	5.678e-005	
Phase Fraction [Vol. Basis]	---	1.000	---	---	
Phase Fraction [Mass Basis]	2.122e-314	1.000	0.0000	0.0000	
Partial Pressure of CO2 (psia)	2.487e-002	---	---	---	
Cost Based on Flow (Cost/s)	0.0000	0.0000	0.0000	0.0000	

* Specified by user.

Material Stream: Summer Flow to VRU @TPL3

Fluid Package: Basis-1
Property Package: Peng-Robinson

PROPERTIES

	Overall	Vapour Phase	Liquid Phase	Aqueous Phase
Act. Gas Flow (ACFM)	0.5285	0.5285	---	---
Avg. Liq. Density (lbmole/ft3)	0.8203	0.8203	0.3186	3.458
Specific Heat (Btu/lbmole-F)	15.02	15.02	72.53	18.56
Std. Gas Flow (MMSCFD)	6.914e-004	6.914e-004	0.0000	0.0000
Std. Ideal Liq. Mass Density (lb/ft3)	28.21	28.21	45.76	62.30
Act. Liq. Flow (USGPM)	0.0000	---	---	0.0000
Z Factor	---	0.9911	7.551e-003	6.846e-004
Watson K	15.84	15.84	12.67	8.521
User Property	---	---	---	---
Partial Pressure of H2S (psia)	0.0000	---	---	---
Cp/(Cp - R)	1.152	1.152	1.028	1.120
Cp/Cv	1.158	1.158	1.028	1.153
Heat of Vap. (Btu/lbmole)	1.239e+004	---	---	---
Kinematic Viscosity (cSt)	7.395	7.395	1.113	0.7257
Liq. Mass Density (Std. Cond) (lb/ft3)	26.39	26.39	46.05	63.33
Liq. Vol. Flow (Std. Cond) (barrel/day)	0.4228	0.4228	0.0000	0.0000
Liquid Fraction	0.0000	0.0000	1.000	1.000
Molar Volume (ft3/lbmole)	417.7	417.7	3.183	0.2885
Mass Heat of Vap. (Btu/lb)	360.2	---	---	---
Phase Fraction [Molar Basis]	1.0000	1.0000	0.0000	0.0000
Surface Tension (dyne/cm)	---	---	21.40	70.45
Thermal Conductivity (Btu/hr-ft-F)	1.330e-002	1.330e-002	7.294e-002	0.3608
Viscosity (cP)	9.751e-003	9.751e-003	0.8045	0.7259
Cv (Semi-Ideal) (Btu/lbmole-F)	13.03	13.03	70.54	16.58
Mass Cv (Semi-Ideal) (Btu/lb-F)	0.3791	0.3791	0.4911	0.9202
Cv (Btu/lbmole-F)	12.97	12.97	70.54	16.10
Mass Cv (Btu/lb-F)	0.3771	0.3771	0.4911	0.8939
Cv (Ent. Method) (Btu/lbmole-F)	---	---	---	15.69
Mass Cv (Ent. Method) (Btu/lb-F)	---	---	---	0.8707
Cp/Cv (Ent. Method)	---	---	---	1.183
Reid VP at 37.8 C (psia)	666.4	666.4	6.937	---
True VP at 37.8 C (psia)	1165	1165	14.82	10.48
Liq. Vol. Flow - Sum(Std. Cond) (barrel/day)	0.4228	0.4228	0.0000	0.0000
Viscosity Index	---	---	-1.129	-0.8612

COMPOSITION

Overall Phase — Vapour Fraction 1.0000

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
Methane	0.0236	0.3114	0.3792	0.1453	0.0867	0.2192
Ethane	0.0194	0.2559	0.5842	0.2238	0.1125	0.2843
Propane	0.0150	0.1972	0.6601	0.2529	0.0892	0.2255
i-Butane	0.0023	0.0309	0.1361	0.0522	0.0166	0.0419
n-Butane	0.0061	0.0803	0.3542	0.1357	0.0416	0.1051
i-Pentane	0.0014	0.0189	0.1035	0.0396	0.0114	0.0287
n-Pentane	0.0018	0.0241	0.1321	0.0506	0.0144	0.0363
3-Mhexane	0.0004	0.0049	0.0375	0.0144	0.0037	0.0094
n-Hexane	0.0004	0.0052	0.0340	0.0130	0.0035	0.0089
Benzene	0.0000	0.0001	0.0003	0.0001	0.0000	0.0001
Cyclohexane	0.0001	0.0007	0.0045	0.0017	0.0004	0.0010
23-Mpentane	0.0003	0.0041	0.0310	0.0119	0.0030	0.0077
n-Heptane	0.0002	0.0026	0.0195	0.0075	0.0019	0.0049

Material Stream: Summer Flow to VRU @TPL3

Fluid Package: Basis-1
Property Package: Peng-Robinson

COMPOSITION

Overall Phase (continued)

Vapour Fraction 1.0000

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
Toluene	0.0000	0.0002	0.0016	0.0006	0.0001	0.0003
2-Mheptane	0.0003	0.0034	0.0296	0.0113	0.0029	0.0073
n-Octane	0.0001	0.0007	0.0063	0.0024	0.0006	0.0015
E-Benzene	0.0000	0.0001	0.0005	0.0002	0.0000	0.0001
o-Xylene	0.0000	0.0001	0.0009	0.0003	0.0001	0.0002
n-Nonane	0.0000	0.0004	0.0042	0.0016	0.0004	0.0010
n-Decane	0.0000	0.0002	0.0021	0.0008	0.0002	0.0005
n-C11	0.0000	0.0001	0.0010	0.0004	0.0001	0.0002
n-C12	0.0000	0.0003	0.0041	0.0016	0.0004	0.0009
H2O	0.0042	0.0556	0.0761	0.0291	0.0052	0.0132
Nitrogen	0.0001	0.0009	0.0019	0.0007	0.0002	0.0004
CO2	0.0001	0.0018	0.0059	0.0023	0.0005	0.0012
Oxygen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0759	1.0000	2.6103	1.0000	0.3956	1.0000

Vapour Phase

Phase Fraction 1.000

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
Methane	0.0236	0.3114	0.3792	0.1453	0.0867	0.2192
Ethane	0.0194	0.2559	0.5842	0.2238	0.1125	0.2843
Propane	0.0150	0.1972	0.6601	0.2529	0.0892	0.2255
I-Butane	0.0023	0.0309	0.1361	0.0522	0.0166	0.0419
n-Butane	0.0061	0.0803	0.3542	0.1357	0.0416	0.1051
i-Pentane	0.0014	0.0189	0.1035	0.0396	0.0114	0.0287
n-Pentane	0.0018	0.0241	0.1321	0.0506	0.0144	0.0363
3-Mhexane	0.0004	0.0049	0.0375	0.0144	0.0037	0.0094
n-Hexane	0.0004	0.0052	0.0340	0.0130	0.0035	0.0089
Benzene	0.0000	0.0001	0.0003	0.0001	0.0000	0.0001
Cyclohexane	0.0001	0.0007	0.0045	0.0017	0.0004	0.0010
23-Mpentane	0.0003	0.0041	0.0310	0.0119	0.0030	0.0077
n-Heptane	0.0002	0.0026	0.0195	0.0075	0.0019	0.0049
Toluene	0.0000	0.0002	0.0016	0.0006	0.0001	0.0003
2-Mheptane	0.0003	0.0034	0.0296	0.0113	0.0029	0.0073
n-Octane	0.0001	0.0007	0.0063	0.0024	0.0006	0.0015
E-Benzene	0.0000	0.0001	0.0005	0.0002	0.0000	0.0001
o-Xylene	0.0000	0.0001	0.0009	0.0003	0.0001	0.0002
n-Nonane	0.0000	0.0004	0.0042	0.0016	0.0004	0.0010
n-Decane	0.0000	0.0002	0.0021	0.0008	0.0002	0.0005
n-C11	0.0000	0.0001	0.0010	0.0004	0.0001	0.0002
n-C12	0.0000	0.0003	0.0041	0.0016	0.0004	0.0009
H2O	0.0042	0.0556	0.0761	0.0291	0.0052	0.0132
Nitrogen	0.0001	0.0009	0.0019	0.0007	0.0002	0.0004
CO2	0.0001	0.0018	0.0059	0.0023	0.0005	0.0012
Oxygen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0759	1.0000	2.6103	1.0000	0.3956	1.0000

Liquid Phase

Phase Fraction 0.0000

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
Methane	0.0000	0.0015	0.0000	0.0002	0.0000	0.0004

Material Stream: Summer Flow to VRU @TPL3

Fluid Package: Basis-1
Property Package: Peng-Robinson

COMPOSITION

Liquid Phase (continued)

Phase Fraction 0.0000

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
Ethane	0.0000	0.0061	0.0000	0.0013	0.0000	0.0026
Propane	0.0000	0.0163	0.0000	0.0050	0.0000	0.0072
i-Butane	0.0000	0.0064	0.0000	0.0026	0.0000	0.0034
n-Butane	0.0000	0.0229	0.0000	0.0093	0.0000	0.0117
i-Pentane	0.0000	0.0135	0.0000	0.0068	0.0000	0.0080
n-Pentane	0.0000	0.0226	0.0000	0.0114	0.0000	0.0132
3-Mhexane	0.0000	0.0347	0.0000	0.0242	0.0000	0.0257
n-Hexane	0.0000	0.0155	0.0000	0.0093	0.0000	0.0103
Benzene	0.0000	0.0002	0.0000	0.0001	0.0000	0.0001
Cyclohexane	0.0000	0.0025	0.0000	0.0015	0.0000	0.0014
23-Mpentane	0.0000	0.0263	0.0000	0.0184	0.0000	0.0193
n-Heptane	0.0000	0.0235	0.0000	0.0164	0.0000	0.0175
Toluene	0.0000	0.0022	0.0000	0.0014	0.0000	0.0012
2-Mheptane	0.0000	0.0690	0.0000	0.0549	0.0000	0.0574
n-Octane	0.0000	0.0202	0.0000	0.0161	0.0000	0.0167
E-Benzene	0.0000	0.0016	0.0000	0.0012	0.0000	0.0010
o-Xylene	0.0000	0.0040	0.0000	0.0030	0.0000	0.0025
n-Nonane	0.0000	0.0350	0.0000	0.0313	0.0000	0.0318
n-Decane	0.0000	0.0467	0.0000	0.0463	0.0000	0.0463
n-C11	0.0000	0.0590	0.0000	0.0642	0.0000	0.0633
n-C12	0.0000	0.5695	0.0000	0.6754	0.0000	0.6590
H2O	0.0000	0.0007	0.0000	0.0001	0.0000	0.0001
Nitrogen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
CO2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Oxygen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000

Aqueous Phase

Phase Fraction 0.0000

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
Methane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Ethane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Propane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
i-Butane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Butane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
i-Pentane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Pentane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3-Mhexane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Hexane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Benzene	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Cyclohexane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
23-Mpentane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Heptane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Toluene	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2-Mheptane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Octane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
E-Benzene	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
o-Xylene	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Nonane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Decane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Material Stream: Summer Flow to VRU @TPL3

Fluid Package: Basis-1
Property Package: Peng-Robinson

COMPOSITION

Aqueous Phase (continued)

Phase Fraction 0.0000

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
n-C11	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-C12	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
H2O	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000
Nitrogen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
CO2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Oxygen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000

Material Stream: Spring/Fall Liquid Flow to Stc

Fluid Package: Basis-1
Property Package: Peng-Robinson

CONDITIONS

	Overall	Vapour Phase	Liquid Phase	Aqueous Phase	
Vapour / Phase Fraction	0.0035	0.0035	0.0452	0.9513	
Temperature: (F)	78.97	78.97	78.97	78.97	
Pressure: (psia)	14.10	14.10	14.10	14.10	
Molar Flow (MMSCFD)	0.5795	2.012e-003	2.621e-002	0.5513	
Mass Flow (lb/hr)	1482	7.708	384.0	1090	
Std Ideal Liq Vol Flow (barrel/day)	112.3	1.176	36.29	74.82	
Molar Enthalpy (Btu/lbmole)	-1.226e+005	-4.366e+004	-1.210e+005	-1.230e+005	
Molar Entropy (Btu/lbmole-F)	14.70	45.53	50.29	12.90	
Heat Flow (Btu/hr)	-7.804e+006	-9648	-3.482e+005	-7.446e+006	
Liq Vol Flow @Std Cond (barrel/day)	106.1 *	1.265	36.01	73.61	

PROPERTIES

	Overall	Vapour Phase	Liquid Phase	Aqueous Phase	
Molecular Weight	23.29	34.68	133.4	18.02	
Molar Density (lbmole/ft3)	0.5506	2.464e-003	0.3377	3.488	
Mass Density (lb/ft3)	12.82	8.593e-002	45.06	62.83	
Act. Volume Flow (barrel/day)	494.0	383.4	36.43	74.18	
Mass Enthalpy (Btu/lb)	-5265	-1252	-906.8	-6828	
Mass Entropy (Btu/lb-F)	0.6311	1.305	0.3769	0.7158	
Heat Capacity (Btu/lbmole-F)	20.71	14.94	66.40	18.56	
Mass Heat Capacity (Btu/lb-F)	0.8891	0.4284	0.4976	1.030	
Lower Heating Value (Btu/lbmole)	1.182e+005	6.884e+005	2.559e+006	6.118e-004	
Mass Lower Heating Value (Btu/lb)	5073	1.974e+004	1.918e+004	3.396e-005	
Phase Fraction [Vol. Basis]	1.047e-002	1.047e-002	0.3232	0.6663	
Phase Fraction [Mass Basis]	5.200e-003	5.200e-003	0.2591	0.7357	
Partial Pressure of CO2 (psia)	1.971e-002	---	---	---	
Cost Based on Flow (Cost/s)	0.0000	0.0000	0.0000	0.0000	
Act. Gas Flow (ACFM)	---	1.495	---	---	
Avg. Liq. Density (lbmole/ft3)	2.422	0.8035	0.3390	3.458	
Specific Heat (Btu/lbmole-F)	20.71	14.94	66.40	18.56	
Std. Gas Flow (MMSCFD)	0.5795	2.013e-003	2.621e-002	0.5513	
Std. Ideal Liq. Mass Density (lb/ft3)	56.43	28.03	45.23	62.30	
Act. Liq. Flow (USGPM)	3.226	---	1.063	2.164	
Z Factor	---	0.9901	7.223e-003	6.994e-004	
Watson K	12.68	15.86	12.65	8.515	
User Property	---	---	---	---	
Partial Pressure of H2S (psia)	0.0000	---	---	---	

* Specified by user.

Material Stream: Spring/Fall Liquid Flow to Stc

Fluid Package: Basis-1
Property Package: Peng-Robinson

PROPERTIES

	Overall	Vapour Phase	Liquid Phase	Aqueous Phase
Cp/(Cp - R)	1.106	1.153	1.031	1.120
Cp/Cv	1.000	1.160	1.031	1.148
Heat of Vap. (Btu/lbmole)	2.486e+004	---	---	---
Kinematic Viscosity (cSt)	---	6.892	1.064	0.8630
Liq. Mass Density (Std. Cond) (lb/ft3)	59.73	26.04	45.58	63.33
Liq. Vol. Flow (Std. Cond) (barrel/day)	106.1	1.265	36.01	73.61
Liquid Fraction	0.9965	0.0000	1.000	1.000
Molar Volume (ft3/lbmole)	1.816	405.9	2.961	0.2867
Mass Heat of Vap. (Btu/lb)	1067	---	---	---
Phase Fraction [Molar Basis]	0.0035	0.0035	0.0452	0.9513
Surface Tension (dyne/cm)	---	---	21.34	71.91
Thermal Conductivity (Btu/hr-ft-F)	---	1.273e-002	7.252e-002	0.3540
Viscosity (cP)	---	9.486e-003	0.7682	0.8686
Cv (Semi-Ideal) (Btu/lbmole-F)	18.73	12.96	64.41	16.57
Mass Cv (Semi-Ideal) (Btu/lb-F)	0.8039	0.3714	0.4828	0.9200
Cv (Btu/lbmole-F)	20.70	12.88	64.41	16.17
Mass Cv (Btu/lb-F)	0.8888	0.3694	0.4828	0.8976
Cv (Ent. Method) (Btu/lbmole-F)	---	---	---	15.80
Mass Cv (Ent. Method) (Btu/lb-F)	---	---	---	0.8772
Cp/Cv (Ent. Method)	---	---	---	1.174
Reid VP at 37.8 C (psia)	26.83	651.3	8.854	---
True VP at 37.8 C (psia)	100.6	1133	17.10	5.715
Liq. Vol. Flow - Sum(Std. Cond) (barrel/day)	110.9	1.265	36.01	73.61
Viscosity Index	---	---	-1.193	-0.6629

COMPOSITION

Overall Phase

Vapour Fraction 0.0035

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
Methane	0.0723	0.0011	1.1605	0.0008	0.2654	0.0024
Ethane	0.0804	0.0013	2.4170	0.0016	0.4653	0.0041
Propane	0.1055	0.0017	4.6543	0.0031	0.6280	0.0056
i-Butane	0.0310	0.0005	1.8027	0.0012	0.2196	0.0020
n-Butane	0.1051	0.0017	6.1073	0.0041	0.7170	0.0064
i-Pentane	0.0563	0.0009	4.0653	0.0027	0.4465	0.0040
n-Pentane	0.0938	0.0015	6.7702	0.0046	0.7361	0.0066
3-Mhexane	0.1457	0.0023	14.6027	0.0099	1.4487	0.0129
n-Hexane	0.0640	0.0010	5.5119	0.0037	0.5695	0.0051
Benzene	0.0007	0.0000	0.0543	0.0000	0.0042	0.0000
Cyclohexane	0.0104	0.0002	0.8752	0.0006	0.0767	0.0007
23-Mpentane	0.1101	0.0017	11.0335	0.0074	1.0823	0.0096
n-Heptane	0.0995	0.0016	9.9654	0.0067	0.9935	0.0088
Toluene	0.0094	0.0001	0.8679	0.0006	0.0683	0.0006
2-Mheptane	0.2964	0.0047	33.8597	0.0228	3.3082	0.0295
n-Octane	0.0877	0.0014	10.0139	0.0068	0.9721	0.0087
E-Benzene	0.0070	0.0001	0.7417	0.0005	0.0584	0.0005
o-Xylene	0.0175	0.0003	1.8583	0.0013	0.1441	0.0013
n-Nonane	0.1502	0.0024	19.2663	0.0130	1.8316	0.0163
n-Decane	0.1812	0.0028	25.7836	0.0174	2.4095	0.0215
n-C11	0.1750	0.0028	27.3610	0.0185	2.5220	0.0225
n-C12	1.1904	0.0187	202.7764	0.1368	18.4847	0.1646
H2O	60.5396	0.9514	1090.6264	0.7358	74.8290	0.6664

Material Stream: Spring/Fall Liquid Flow to Stc

Fluid Package: Basis-1
Property Package: Peng-Robinson

COMPOSITION

Overall Phase (continued)

Vapour Fraction 0.0035

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
Nitrogen	0.0002	0.0000	0.0047	0.0000	0.0004	0.0000
CO2	0.0004	0.0000	0.0178	0.0000	0.0015	0.0000
Oxygen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	63.6299	1.0000	1482.1980	1.0000	112.2836	1.0000

Vapour Phase

Phase Fraction 3.473e-003

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
Methane	0.0680	0.3076	1.0903	0.1415	0.2494	0.2121
Ethane	0.0593	0.2682	1.7820	0.2312	0.3431	0.2918
Propane	0.0459	0.2076	2.0230	0.2625	0.2734	0.2326
i-Butane	0.0071	0.0319	0.4101	0.0532	0.0500	0.0425
n-Butane	0.0182	0.0826	1.0603	0.1376	0.1245	0.1059
i-Pentane	0.0042	0.0191	0.3043	0.0395	0.0334	0.0284
n-Pentane	0.0054	0.0243	0.3870	0.0502	0.0421	0.0358
3-Mhexane	0.0011	0.0049	0.1074	0.0139	0.0107	0.0091
n-Hexane	0.0011	0.0052	0.0982	0.0127	0.0101	0.0086
Benzene	0.0000	0.0001	0.0010	0.0001	0.0001	0.0001
Cyclohexane	0.0002	0.0007	0.0129	0.0017	0.0011	0.0010
23-Mpentane	0.0009	0.0040	0.0890	0.0115	0.0087	0.0074
n-Heptane	0.0006	0.0025	0.0558	0.0072	0.0056	0.0047
Toluene	0.0001	0.0002	0.0046	0.0006	0.0004	0.0003
2-Mheptane	0.0007	0.0033	0.0835	0.0108	0.0082	0.0069
n-Octane	0.0002	0.0007	0.0175	0.0023	0.0017	0.0014
E-Benzene	0.0000	0.0001	0.0013	0.0002	0.0001	0.0001
o-Xylene	0.0000	0.0001	0.0025	0.0003	0.0002	0.0002
n-Nonane	0.0001	0.0004	0.0110	0.0014	0.0010	0.0009
n-Decane	0.0000	0.0002	0.0049	0.0006	0.0005	0.0004
n-C11	0.0000	0.0000	0.0017	0.0002	0.0002	0.0001
n-C12	0.0000	0.0001	0.0047	0.0006	0.0004	0.0004
H2O	0.0076	0.0342	0.1363	0.0177	0.0094	0.0080
Nitrogen	0.0002	0.0007	0.0046	0.0006	0.0004	0.0003
CO2	0.0003	0.0014	0.0136	0.0018	0.0011	0.0010
Oxygen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.2210	1.0000	7.7076	1.0000	1.1755	1.0000

Liquid Phase

Phase Fraction 4.523e-002

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
Methane	0.0044	0.0015	0.0702	0.0002	0.0160	0.0004
Ethane	0.0211	0.0073	0.6350	0.0017	0.1222	0.0034
Propane	0.0597	0.0207	2.6312	0.0069	0.3556	0.0098
i-Butane	0.0240	0.0083	1.3926	0.0036	0.1697	0.0047
n-Butane	0.0868	0.0302	5.0469	0.0131	0.5925	0.0163
i-Pentane	0.0521	0.0181	3.7611	0.0098	0.4131	0.0114
n-Pentane	0.0885	0.0307	6.3831	0.0166	0.6941	0.0191
3-Mhexane	0.1447	0.0503	14.4952	0.0377	1.4380	0.0396
n-Hexane	0.0628	0.0218	5.4138	0.0141	0.5594	0.0154
Benzene	0.0007	0.0002	0.0532	0.0001	0.0041	0.0001
Cyclohexane	0.0102	0.0036	0.8623	0.0022	0.0755	0.0021

Material Stream: Spring/Fall Liquid Flow to Stc

Fluid Package: Basis-1
Property Package: Peng-Robinson

COMPOSITION

Liquid Phase (continued)

Phase Fraction 4.523e-002

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
23-Mpentane	0.1092	0.0379	10.9445	0.0285	1.0736	0.0296
n-Heptane	0.0989	0.0344	9.9096	0.0258	0.9880	0.0272
Toluene	0.0094	0.0033	0.8633	0.0022	0.0679	0.0019
2-Mheptane	0.2957	0.1027	33.7762	0.0880	3.3001	0.0909
n-Octane	0.0875	0.0304	9.9964	0.0260	0.9704	0.0267
E-Benzene	0.0070	0.0024	0.7404	0.0019	0.0583	0.0016
o-Xylene	0.0175	0.0061	1.8558	0.0048	0.1439	0.0040
n-Nonane	0.1501	0.0522	19.2553	0.0501	1.8306	0.0504
n-Decane	0.1812	0.0629	25.7787	0.0671	2.4090	0.0664
n-C11	0.1750	0.0608	27.3593	0.0712	2.5219	0.0695
n-C12	1.1804	0.4136	202.7717	0.5280	18.4843	0.5093
H2O	0.0014	0.0005	0.0256	0.0001	0.0018	0.0000
Nitrogen	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000
CO2	0.0001	0.0000	0.0025	0.0000	0.0002	0.0000
Oxygen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	2.8783	1.0000	384.0242	1.0000	36.2901	1.0000

Aqueous Phase

Phase Fraction 0.9513

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
Methane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Ethane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Propane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
i-Butane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Butane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
i-Pentane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Pentane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3-Mhexane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Hexane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Benzene	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Cyclohexane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
23-Mpentane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Heptane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Toluene	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2-Mheptane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Octane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
E-Benzene	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
o-Xylene	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Nonane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Decane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-C11	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-C12	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
H2O	60.5306	1.0000	1090.4645	1.0000	74.8179	1.0000
Nitrogen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
CO2	0.0000	0.0000	0.0017	0.0000	0.0001	0.0000
Oxygen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	60.5306	1.0000	1090.4662	1.0000	74.8180	1.0000

Material Stream: Winter Liquids To Storage @

Fluid Package: Basis-1
Property Package: Peng-Robinson

CONDITIONS

	Overall	Vapour Phase	Liquid Phase	Aqueous Phase
Vapour / Phase Fraction	0.0164	0.0164	0.1743	0.8093
Temperature: (F)	46.05	46.05	46.05	46.05
Pressure: (psia)	14.10	14.10	14.10	14.10
Molar Flow (MMSCFD)	0.7790	1.278e-002	0.1358	0.6304
Mass Flow (lb/hr)	2860	49.43	1564	1247
Std Ideal Liq Vol Flow (barrel/day)	247.5	7.632	154.3	85.56
Molar Enthalpy (Btu/lbmole)	-1.182e+005	-4.248e+004	-1.003e+005	-1.236e+005
Molar Entropy (Btu/lbmole-F)	16.08	44.42	33.62	11.72
Heat Flow (Btu/hr)	-1.011e+007	-5.963e+004	-1.495e+006	-8.558e+006
Liq Vol Flow @Std Cond (barrel/day)	228.8 *	8.263	152.7	84.18

PROPERTIES

	Overall	Vapour Phase	Liquid Phase	Aqueous Phase
Molecular Weight	33.44	35.22	104.9	18.02
Molar Density (lbmole/ft3)	0.1453	2.630e-003	0.4213	3.535
Mass Density (lb/ft3)	4.859	9.261e-002	44.18	63.68
Act. Volume Flow (barrel/day)	2516	2281	151.3	83.70
Mass Enthalpy (Btu/lb)	-3536	-1206	-956.2	-6862
Mass Entropy (Btu/lb-F)	0.4808	1.261	0.3205	0.6508
Heat Capacity (Btu/lbmole-F)	24.13	14.45	50.78	18.59
Mass Heat Capacity (Btu/lb-F)	0.7216	0.4102	0.4842	1.032
Lower Heating Value (Btu/lbmole)	3.635e+005	7.044e+005	2.019e+006	1.762e-004
Mass Lower Heating Value (Btu/lb)	1.087e+004	2.000e+004	1.925e+004	9.782e-006
Phase Fraction [Vol. Basis]	3.084e-002	3.084e-002	0.6235	0.3457
Phase Fraction [Mass Basis]	1.728e-002	1.728e-002	0.5467	0.4360
Partial Pressure of CO2 (psia)	1.556e-002	---	---	---
Cost Based on Flow (Cost/s)	0.0000	0.0000	0.0000	0.0000
Act. Gas Flow (ACFM)	---	8.895	---	---
Avg. Liq. Density (lbmole/ft3)	1.477	0.7860	0.4130	3.458
Specific Heat (Btu/lbmole-F)	24.13	14.45	50.78	18.59
Std. Gas Flow (MMSCFD)	0.7790	1.278e-002	0.1358	0.6305
Std. Ideal Liq. Mass Density (lb/ft3)	49.40	27.68	43.32	62.30
Act. Liq. Flow (USGPM)	6.854	---	4.412	2.441
Z Factor	---	0.9880	6.167e-003	7.349e-004
Watson K	12.72	15.95	12.65	8.509
User Property	---	---	---	---
Partial Pressure of H2S (psia)	0.0000	---	---	---
Cp/(Cp - R)	1.090	1.159	1.041	1.120
Cp/Cv	1.001	1.167	1.041	1.135
Heat of Vap. (Btu/lbmole)	2.548e+004	---	---	---
Kinematic Viscosity (cSt)	---	5.997	0.8001	1.355
Liq. Mass Density (Std. Cond) (lb/ft3)	53.44	25.57	43.77	63.33
Liq. Vol. Flow (Std. Cond) (barrel/day)	228.8	8.263	152.7	84.18
Liquid Fraction	0.9836	0.0000	1.000	1.000
Molar Volume (ft3/lbmole)	6.882	380.3	2.374	0.2829
Mass Heat of Vap. (Btu/lb)	762.0	---	---	---
Phase Fraction [Molar Basis]	0.0164	0.0164	0.1743	0.8093
Surface Tension (dyne/cm)	---	---	20.67	75.06
Thermal Conductivity (Btu/hr-ft-F)	---	1.153e-002	7.069e-002	0.3369
Viscosity (cP)	---	8.897e-003	0.5663	1.383
Cv (Semi-Ideal) (Btu/lbmole-F)	22.14	12.46	48.79	16.60
Mass Cv (Semi-Ideal) (Btu/lb-F)	0.6622	0.3539	0.4652	0.9215
Cv (Btu/lbmole-F)	24.09	12.38	48.79	16.38

* Specified by user.

Material Stream: Winter Liquids To Storage @

Fluid Package: Basis-1
Property Package: Peng-Robinson

PROPERTIES

		Overall	Vapour Phase	Liquid Phase	Aqueous Phase	
Mass Cv	(Btu/lb-F)	0.7205	0.3514	0.4652	0.9093	
Cv (Ent. Method)	(Btu/lbmole-F)	---	---	---	16.10	
Mass Cv (Ent. Method)	(Btu/lb-F)	---	---	---	0.8936	
Cp/Cv (Ent. Method)		---	---	---	1.155	
Reid VP at 37.8 C	(psia)	40.39	631.3	15.75	---	
True VP at 37.8 C	(psia)	120.9	1071	25.08	2.016	
Liq. Vol. Flow - Sum(Std. Cond)	(barrel/day)	245.2	8.263	152.7	84.18	
Viscosity Index		---	---	-1.698	-0.2316	

COMPOSITION

Overall Phase

Vapour Fraction 0.0164

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
Methane	0.4364	0.0051	7.0011	0.0024	1.6012	0.0065
Ethane	0.5810	0.0068	17.4715	0.0061	3.3634	0.0136
Propane	0.8612	0.0101	37.9781	0.0133	5.1324	0.0207
i-Butane	0.2730	0.0032	15.8657	0.0055	1.9332	0.0078
n-Butane	0.9636	0.0113	56.0091	0.0196	6.5757	0.0266
i-Pentane	0.5510	0.0064	39.7528	0.0139	4.3661	0.0176
n-Pentane	0.9511	0.0111	68.6211	0.0240	7.4614	0.0301
3-Mhexane	1.5911	0.0186	159.4350	0.0557	15.8171	0.0639
n-Hexane	0.6951	0.0081	59.9004	0.0209	6.1895	0.0250
Benzene	0.0078	0.0001	0.6082	0.0002	0.0472	0.0002
Cyclohexane	0.1149	0.0013	9.6704	0.0034	0.8469	0.0034
23-Mpentane	1.2019	0.0141	120.4332	0.0421	11.8136	0.0477
n-Heptane	1.0736	0.0126	107.5807	0.0376	10.7254	0.0433
Toluene	0.1037	0.0012	9.5590	0.0033	0.7523	0.0030
2-Mheptane	2.8477	0.0333	325.3004	0.1137	31.7831	0.1284
n-Octane	0.7792	0.0091	89.0138	0.0311	8.6408	0.0349
E-Benzene	0.0633	0.0007	6.7164	0.0023	0.5286	0.0021
o-Xylene	0.1458	0.0017	15.4754	0.0054	1.1999	0.0048
n-Nonane	0.8283	0.0097	106.2343	0.0371	10.0995	0.0408
n-Decane	0.5210	0.0061	74.1352	0.0259	6.9279	0.0280
n-C11	0.2801	0.0033	43.7872	0.0153	4.0361	0.0163
n-C12	1.4214	0.0166	242.1215	0.0847	22.0713	0.0892
H2O	69.2406	0.8095	1247.3772	0.4361	85.5838	0.3458
Nitrogen	0.0008	0.0000	0.0223	0.0000	0.0019	0.0000
CO2	0.0019	0.0000	0.0836	0.0000	0.0069	0.0000
Oxygen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	85.5355	1.0000	2860.1535	1.0000	247.5053	1.0000

Vapour Phase

Phase Fraction 1.641e-002

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
Methane	0.4115	0.2932	6.6023	0.1336	1.5100	0.1978
Ethane	0.4119	0.2935	12.3871	0.2506	2.3847	0.3124
Propane	0.3164	0.2255	13.9544	0.2823	1.8858	0.2471
i-Butane	0.0461	0.0329	2.6819	0.0543	0.3268	0.0428
n-Butane	0.1172	0.0835	6.8126	0.1378	0.7998	0.1048
i-Pentane	0.0258	0.0184	1.8632	0.0377	0.2046	0.0268
n-Pentane	0.0324	0.0231	2.3374	0.0473	0.2542	0.0333
3-Mhexane	0.0056	0.0040	0.5624	0.0114	0.0558	0.0073

* Specified by user.

Material Stream: Winter Liquids To Storage @

Fluid Package: Basis-1
Property Package: Peng-Robinson

COMPOSITION

Vapour Phase (continued)

Phase Fraction 1.641e-002

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
n-Hexane	0.0065	0.0046	0.5574	0.0113	0.0576	0.0075
Benzene	0.0001	0.0001	0.0057	0.0001	0.0004	0.0001
Cyclohexane	0.0009	0.0006	0.0723	0.0015	0.0063	0.0008
23-Mpentane	0.0047	0.0034	0.4717	0.0095	0.0463	0.0061
n-Heptane	0.0028	0.0020	0.2806	0.0057	0.0280	0.0037
Toluene	0.0002	0.0002	0.0230	0.0005	0.0018	0.0002
2-Mheptane	0.0031	0.0022	0.3500	0.0071	0.0342	0.0045
n-Octane	0.0006	0.0004	0.0650	0.0013	0.0063	0.0008
E-Benzene	0.0000	0.0000	0.0046	0.0001	0.0004	0.0000
o-Xylene	0.0001	0.0001	0.0082	0.0002	0.0006	0.0001
n-Nonane	0.0002	0.0001	0.0229	0.0005	0.0022	0.0003
n-Decane	0.0000	0.0000	0.0049	0.0001	0.0005	0.0001
n-C11	0.0000	0.0000	0.0008	0.0000	0.0001	0.0000
n-C12	0.0000	0.0000	0.0016	0.0000	0.0001	0.0000
H2O	0.0149	0.0106	0.2682	0.0054	0.0184	0.0024
Nitrogen	0.0008	0.0006	0.0219	0.0004	0.0019	0.0002
CO2	0.0015	0.0011	0.0681	0.0014	0.0057	0.0007
Oxygen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	1.4035	1.0000	49.4286	1.0000	7.6324	1.0000

Liquid Phase

Phase Fraction 0.1743

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
Methane	0.0249	0.0017	0.3988	0.0003	0.0912	0.0006
Ethane	0.1691	0.0113	5.0843	0.0033	0.9788	0.0063
Propane	0.5448	0.0365	24.0237	0.0154	3.2466	0.0210
I-Butane	0.2268	0.0152	13.1838	0.0084	1.6064	0.0104
n-Butane	0.8464	0.0568	49.1966	0.0315	5.7759	0.0374
i-Pentane	0.5251	0.0352	37.8895	0.0242	4.1614	0.0270
n-Pentane	0.9187	0.0616	66.2836	0.0424	7.2073	0.0467
3-Mhexane	1.5855	0.1063	158.8726	0.1016	15.7613	0.1021
n-Hexane	0.6886	0.0462	59.3429	0.0380	6.1319	0.0397
Benzene	0.0077	0.0005	0.6025	0.0004	0.0468	0.0003
Cyclohexane	0.1140	0.0076	9.5981	0.0061	0.8406	0.0054
23-Mpentane	1.1972	0.0803	119.9615	0.0767	11.7673	0.0763
n-Heptane	1.0708	0.0718	107.3001	0.0686	10.6974	0.0693
Toluene	0.1035	0.0069	9.5361	0.0061	0.7505	0.0049
2-Mheptane	2.8447	0.1908	324.9504	0.2078	31.7489	0.2057
n-Octane	0.7787	0.0522	88.9488	0.0569	8.6345	0.0560
E-Benzene	0.0632	0.0042	6.7117	0.0043	0.5282	0.0034
o-Xylene	0.1457	0.0098	15.4673	0.0099	1.1992	0.0078
n-Nonane	0.8281	0.0555	106.2114	0.0679	10.0974	0.0654
n-Decane	0.5210	0.0349	74.1303	0.0474	6.9275	0.0449
n-C11	0.2801	0.0188	43.7863	0.0280	4.0361	0.0262
n-C12	1.4214	0.0953	242.1199	0.1548	22.0711	0.1430
H2O	0.0029	0.0002	0.0522	0.0000	0.0036	0.0000
Nitrogen	0.0000	0.0000	0.0004	0.0000	0.0000	0.0000
CO2	0.0003	0.0000	0.0130	0.0000	0.0011	0.0000
Oxygen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	14.9091	1.0000	1563.6657	1.0000	154.3109	1.0000

Material Stream: Winter Liquids To Storage @

Fluid Package: Basis-1
Property Package: Peng-Robinson

COMPOSITION

Aqueous Phase

Phase Fraction 0.8093

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
Methane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Ethane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Propane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
i-Butane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Butane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
i-Pentane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Pentane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3-Mhexane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Hexane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Benzene	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Cyclohexane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
23-Mpentane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Heptane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Toluene	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2-Mheptane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Octane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
E-Benzene	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
o-Xylene	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Nonane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Decane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-C11	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-C12	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
H2O	69.2229	1.0000	1247.0568	1.0000	85.5618	1.0000
Nitrogen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
CO2	0.0001	0.0000	0.0025	0.0000	0.0002	0.0000
Oxygen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	69.2229	1.0000	1247.0592	1.0000	85.5620	1.0000

Material Stream: Summer Liquid to Storage @

Fluid Package: Basis-1
Property Package: Peng-Robinson

CONDITIONS

		Overall	Vapour Phase	Liquid Phase	Aqueous Phase	
Vapour / Phase Fraction		0.0015	0.0015	0.0207	0.9778	
Temperature:	(F)	94.09	94.09	94.09	94.09	
Pressure:	(psia)	14.10	14.10	14.10	14.10	
Molar Flow	(MMSCFD)	0.4689	6.913e-004	9.709e-003	0.4585	
Mass Flow	(lb/hr)	1063	2.610	153.1	906.9	
Std Ideal Liq Vol Flow	(barrel/day)	76.93	0.3956	14.31	62.23	
Molar Enthalpy	(Btu/lbmole)	-1.227e+005	-4.479e+004	-1.280e+005	-1.227e+005	
Molar Entropy	(Btu/lbmole-F)	14.35	46.04	56.77	13.41	
Heat Flow	(Btu/hr)	-6.319e+006	-3400	-1.365e+005	-6.179e+006	
Liq Vol Flow @Std Cond	(barrel/day)	73.86 *	0.4228	14.21	61.22	

PROPERTIES

		Overall	Vapour Phase	Liquid Phase	Aqueous Phase	
Molecular Weight		20.64	34.39	143.6	18.02	
Molar Density	(lbmole/ft3)	1.037	2.394e-003	0.3142	3.466	
Mass Density	(lb/ft3)	21.41	8.232e-002	45.13	62.44	
Act. Volume Flow	(barrel/day)	212.1	135.5	14.50	62.09	

aspen

MARKWEST HYDROCARBON, IN
Burlington, MA
USA

Case Name: Smith HYSYS 130 MMSCFD 6-29-2012.hsc

Unit Set: NewUser

Date/Time: Wed Jun 27 16:00:53 2012

Material Stream: Summer Liquid to Storage @

Fluid Package: Basis-1

Property Package: Peng-Robinson

PROPERTIES

	Overall	Vapour Phase	Liquid Phase	Aqueous Phase
Mass Enthalpy (Btu/lb)	-5946	-1303	-891.1	-6813
Mass Entropy (Btu/lb-F)	0.6955	1.339	0.3952	0.7443
Heat Capacity (Btu/lbmole-F)	19.68	15.02	72.53	18.56
Mass Heat Capacity (Btu/lb-F)	0.9532	0.4368	0.5050	1.030
Lower Heating Value (Btu/lbmole)	5.799e+004	6.704e+005	2.753e+006	1.023e-003
Mass Lower Heating Value (Btu/lb)	2809	1.949e+004	1.916e+004	5.678e-005
Phase Fraction [Vol. Basis]	5.143e-003	5.143e-003	0.1860	0.8089
Phase Fraction [Mass Basis]	2.456e-003	2.456e-003	0.1441	0.8534
Partial Pressure of CO2 (psia)	2.487e-002	---	---	---
Cost Based on Flow (Cost/s)	0.0000	0.0000	0.0000	0.0000
Act. Gas Flow (ACFM)	---	0.5285	---	---
Avg. Liq. Density (lbmole/ft3)	2.861	0.8203	0.3186	3.458
Specific Heat (Btu/lbmole-F)	19.68	15.02	72.53	18.56
Std. Gas Flow (MMSCFD)	0.4689	6.914e-004	9.709e-003	0.4585
Std. Ideal Liq. Mass Density (lb/ft3)	59.05	28.21	45.76	62.30
Act. Liq. Flow (USGPM)	2.234	---	0.4230	1.811
Z Factor	---	0.9911	7.551e-003	6.846e-004
Watson K	12.69	15.84	12.67	8.521
User Property	---	---	---	---
Partial Pressure of H2S (psia)	0.0000	---	---	---
Cp/(Cp - R)	1.112	1.152	1.028	1.120
Cp/Cv	1.000	1.158	1.028	1.153
Heat of Vap. (Btu/lbmole)	2.451e+004	---	---	---
Kinematic Viscosity (cSt)	---	7.395	1.113	0.7257
Liq. Mass Density (Std. Cond) (lb/ft3)	61.50	26.39	46.05	63.33
Liq. Vol. Flow (Std. Cond) (barrel/day)	73.86	0.4228	14.21	61.22
Liquid Fraction	0.9985	0.0000	1.000	1.000
Molar Volume (ft3/lbmole)	0.9639	417.7	3.183	0.2885
Mass Heat of Vap. (Btu/lb)	1188	---	---	---
Phase Fraction [Molar Basis]	0.0015	0.0015	0.0207	0.9778
Surface Tension (dyne/cm)	---	---	21.40	70.45
Thermal Conductivity (Btu/hr-ft-F)	---	1.330e-002	7.294e-002	0.3608
Viscosity (cP)	---	9.751e-003	0.8045	0.7259
Cv (Semi-Ideal) (Btu/lbmole-F)	17.69	13.03	70.54	16.58
Mass Cv (Semi-Ideal) (Btu/lb-F)	0.8570	0.3791	0.4911	0.9202
Cv (Btu/lbmole-F)	19.67	12.97	70.54	16.10
Mass Cv (Btu/lb-F)	0.9530	0.3771	0.4911	0.8939
Cv (Ent. Method) (Btu/lbmole-F)	---	---	---	15.76
Mass Cv (Ent. Method) (Btu/lb-F)	---	---	---	0.8747
Cp/Cv (Ent. Method)	---	---	---	1.178
Reid VP at 37.8 C (psia)	22.83	666.4	6.937	---
True VP at 37.8 C (psia)	93.61	1165	14.82	10.48
Liq. Vol. Flow - Sum(Std. Cond) (barrel/day)	75.86	0.4228	14.21	61.22
Viscosity Index	---	---	-1.129	-0.8612

COMPOSITION

Overall Phase

Vapour Fraction 0.0015

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
Methane	0.0252	0.0005	0.4042	0.0004	0.0924	0.0012
Ethane	0.0260	0.0005	0.7806	0.0007	0.1503	0.0020
Propane	0.0323	0.0006	1.4252	0.0013	0.1926	0.0025

* Specified by user.

Material Stream: Summer Liquid to Storage @

Fluid Package: Basis-1
Property Package: Peng-Robinson

COMPOSITION

Overall Phase (continued)

Vapour Fraction 0.0015

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
i-Butane	0.0092	0.0002	0.5325	0.0005	0.0649	0.0008
n-Butane	0.0305	0.0006	1.7743	0.0017	0.2083	0.0027
i-Pentane	0.0158	0.0003	1.1425	0.0011	0.1255	0.0016
n-Pentane	0.0259	0.0005	1.8722	0.0018	0.2036	0.0026
3-Mhexane	0.0374	0.0007	3.7437	0.0035	0.3714	0.0048
n-Hexane	0.0169	0.0003	1.4564	0.0014	0.1505	0.0020
Benzene	0.0002	0.0000	0.0143	0.0000	0.0011	0.0000
Cyclohexane	0.0027	0.0001	0.2305	0.0002	0.0202	0.0003
23-Mpentane	0.0284	0.0006	2.8429	0.0027	0.2789	0.0036
n-Heptane	0.0252	0.0005	2.5289	0.0024	0.2521	0.0033
Toluene	0.0024	0.0000	0.2197	0.0002	0.0173	0.0002
2-Mheptane	0.0738	0.0014	8.4300	0.0079	0.8236	0.0107
n-Octane	0.0216	0.0004	2.4693	0.0023	0.2397	0.0031
E-Benzene	0.0017	0.0000	0.1818	0.0002	0.0143	0.0002
o-Xylene	0.0043	0.0001	0.4546	0.0004	0.0352	0.0005
n-Nonane	0.0374	0.0007	4.7950	0.0045	0.4559	0.0059
n-Decane	0.0498	0.0010	7.0879	0.0067	0.6624	0.0086
n-C11	0.0629	0.0012	9.8315	0.0093	0.9062	0.0118
n-C12	0.6072	0.0118	103.4217	0.0973	9.4277	0.1226
H2O	50.3480	0.9779	907.0248	0.8535	62.2319	0.8090
Nitrogen	0.0001	0.0000	0.0019	0.0000	0.0002	0.0000
CO2	0.0002	0.0000	0.0084	0.0000	0.0007	0.0000
Oxygen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	51.4851	1.0000	1062.6748	1.0000	76.9268	1.0000

Vapour Phase

Phase Fraction 1.474e-003

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
Methane	0.0236	0.3114	0.3792	0.1453	0.0867	0.2192
Ethane	0.0194	0.2559	0.5842	0.2238	0.1125	0.2843
Propane	0.0150	0.1972	0.6601	0.2529	0.0892	0.2255
i-Butane	0.0023	0.0309	0.1361	0.0522	0.0166	0.0419
n-Butane	0.0061	0.0803	0.3542	0.1357	0.0416	0.1051
i-Pentane	0.0014	0.0189	0.1035	0.0396	0.0114	0.0287
n-Pentane	0.0018	0.0241	0.1321	0.0506	0.0144	0.0363
3-Mhexane	0.0004	0.0049	0.0375	0.0144	0.0037	0.0094
n-Hexane	0.0004	0.0052	0.0340	0.0130	0.0035	0.0089
Benzene	0.0000	0.0001	0.0003	0.0001	0.0000	0.0001
Cyclohexane	0.0001	0.0007	0.0045	0.0017	0.0004	0.0010
23-Mpentane	0.0003	0.0041	0.0310	0.0119	0.0030	0.0077
n-Heptane	0.0002	0.0026	0.0195	0.0075	0.0019	0.0049
Toluene	0.0000	0.0002	0.0016	0.0006	0.0001	0.0003
2-Mheptane	0.0003	0.0034	0.0296	0.0113	0.0029	0.0073
n-Octane	0.0001	0.0007	0.0063	0.0024	0.0006	0.0015
E-Benzene	0.0000	0.0001	0.0005	0.0002	0.0000	0.0001
o-Xylene	0.0000	0.0001	0.0009	0.0003	0.0001	0.0002
n-Nonane	0.0000	0.0004	0.0042	0.0016	0.0004	0.0010
n-Decane	0.0000	0.0002	0.0021	0.0008	0.0002	0.0005
n-C11	0.0000	0.0001	0.0010	0.0004	0.0001	0.0002
n-C12	0.0000	0.0003	0.0041	0.0016	0.0004	0.0009

* Specified by user.

Material Stream: Summer Liquid to Storage @

Fluid Package: Basis-1
Property Package: Peng-Robinson

COMPOSITION

Vapour Phase (continued)

Phase Fraction 1.474e-003

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
H2O	0.0042	0.0556	0.0761	0.0291	0.0052	0.0132
Nitrogen	0.0001	0.0009	0.0019	0.0007	0.0002	0.0004
CO2	0.0001	0.0018	0.0059	0.0023	0.0005	0.0012
Oxygen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0759	1.0000	2.6103	1.0000	0.3956	1.0000

Liquid Phase

Phase Fraction 2.071e-002

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
Methane	0.0016	0.0015	0.0249	0.0002	0.0057	0.0004
Ethane	0.0065	0.0061	0.1964	0.0013	0.0378	0.0026
Propane	0.0174	0.0163	0.7651	0.0050	0.1034	0.0072
i-Butane	0.0068	0.0064	0.3964	0.0026	0.0483	0.0034
n-Butane	0.0244	0.0229	1.4201	0.0093	0.1667	0.0117
i-Pentane	0.0144	0.0135	1.0391	0.0068	0.1141	0.0080
n-Pentane	0.0241	0.0226	1.7401	0.0114	0.1892	0.0132
3-Mhexane	0.0370	0.0347	3.7062	0.0242	0.3677	0.0257
n-Hexane	0.0165	0.0155	1.4224	0.0093	0.1470	0.0103
Benzene	0.0002	0.0002	0.0139	0.0001	0.0011	0.0001
Cyclohexane	0.0027	0.0025	0.2260	0.0015	0.0198	0.0014
23-Mpentane	0.0281	0.0263	2.8119	0.0184	0.2758	0.0193
n-Heptane	0.0250	0.0235	2.5094	0.0164	0.2502	0.0175
Toluene	0.0024	0.0022	0.2181	0.0014	0.0172	0.0012
2-Mheptane	0.0735	0.0690	8.4004	0.0549	0.8208	0.0574
n-Octane	0.0216	0.0202	2.4630	0.0161	0.2391	0.0167
E-Benzene	0.0017	0.0016	0.1814	0.0012	0.0143	0.0010
o-Xylene	0.0043	0.0040	0.4537	0.0030	0.0352	0.0025
n-Nonane	0.0374	0.0350	4.7908	0.0313	0.4555	0.0318
n-Decane	0.0498	0.0467	7.0857	0.0463	0.6622	0.0463
n-C11	0.0629	0.0590	9.8305	0.0642	0.9061	0.0633
n-C12	0.6071	0.5695	103.4176	0.6754	9.4273	0.6590
H2O	0.0008	0.0007	0.0140	0.0001	0.0010	0.0001
Nitrogen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
CO2	0.0000	0.0000	0.0011	0.0000	0.0001	0.0000
Oxygen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	1.0661	1.0000	153.1283	1.0000	14.3054	1.0000

Aqueous Phase

Phase Fraction 0.9778

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
Methane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Ethane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Propane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
i-Butane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Butane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
i-Pentane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Pentane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3-Mhexane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Hexane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Benzene	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Material Stream: Summer Liquid to Storage @

Fluid Package: Basis-1
Property Package: Peng-Robinson

COMPOSITION

Aqueous Phase (continued)

Phase Fraction 0.9778

COMPONENTS	MOLAR FLOW (lbmole/hr)	MOLE FRACTION	MASS FLOW (lb/hr)	MASS FRACTION	LIQUID VOLUME FLOW (barrel/day)	LIQUID VOLUME FRACTION
Cyclohexane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
23-Mpentane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Heptane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Toluene	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2-Mheptane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Octane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
E-Benzene	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
o-Xylene	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Nonane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-Decane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-C11	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-C12	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
H2O	50.3430	1.0000	906.9347	1.0000	62.2257	1.0000
Nitrogen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
CO2	0.0000	0.0000	0.0015	0.0000	0.0001	0.0000
Oxygen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	50.3431	1.0000	906.9362	1.0000	62.2258	1.0000

Section 7

Equipment Specifications

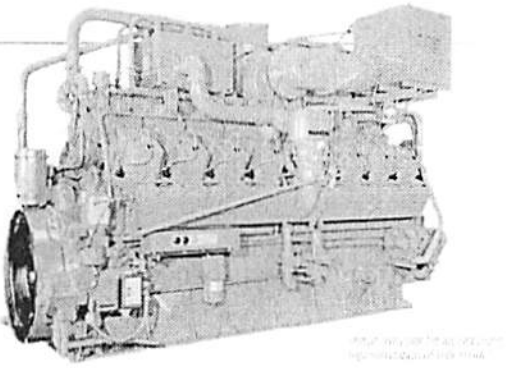
DRESSER Waukesha

P9390GSI

VHP® Series Gas Engine
1320 - 1980 BHP (984 - 1476 kWb)

Specifications

Cylinders: V16
Piston Displacement: 9388 cu. in. (154 l)
Bore & Stroke: 9.375" x 8.5" (238 x 216 mm)
Compression Ratio: 8:1
Jacket Water System Capacity: 148 gal. (560 L)
Lube Oil Capacity: 165 gal. (625 L)
Starting System: 125 - 150 psi air/gas 24V electric
Dry Weight: 28,750 lb.(13,041 kg)



Standard Equipment

AIR CLEANER – Engine mounted. Dry type, including pad type precleaner and service indicator. For sheltered installation and average dust environment.

BARRING DEVICE – Manual.

BEARINGS – Heavy duty, replaceable, precision type.

BREATHER – Ejector type, extractor, plumbed into exhaust stream.

CONNECTING RODS – Drop forged steel, rifle drilled.

CONTROL SYSTEM – Pneumatic. Includes pilot operated valves for air start and prelube. Engine mounted control panel with two push button valves. Pilot operated air start valves omitted when starter is not furnished by Waukesha.

CRANKCASE – Integral crankcase and cylinder frame. Main bearing caps drilled and tapped for temperature sensors. Does not include sensors.

CRANKSHAFT – Counterweighted, forged steel, ten main bearings, and dynamically balanced.

CRANKSHAFT PULLEY, FRONT SEGMENT – Ten inch (254 mm) pitch diameter pulley, with six c–section drive grooves, front end drive assembly, and outboard bearing. Outboard bearing not mounted. Includes engine mounted stub shaft and coupling guard.

CYLINDERS – Removable wet type bainitic cast iron cylinder liners, chrome plated on outer diameter.

CYLINDER HEADS – Sixteen interchangeable. Two hard faced intake and two hard faced exhaust valves per cylinder. Hard faced intake and exhaust valve seat inserts. Roller valve lifters and hydraulic push rods.

ENGINE ROTATION – Counterclockwise when facing flywheel.

EXHAUST OUTLET – Single vertical at center. Flexible stainless steel connection with 14" (356 mm) flanges.

FLYWHEEL – Approx. WR^2 = 155000 lb-in²; with ring gear (208 teeth), machined to accept two drive adapters; 31.88" (810 mm) pilot bore, 30.25" (768 mm) bolt circle, (12) .75" – 10 tapped holes, or 28.86" (734 mm) pilot bore, 27.25" (692 mm) bolt circle, (12) 0.625" – 11 tapped holes and (12) 0.75"–10 tapped holes.

FLYWHEEL GUARD

FUEL SYSTEM – Dual, natural gas, 4" (102 mm) duplex downdraft. Two mounted Fisher 99, 2" (51 mm) gas regulators, 30 - 60 psi (207 - 414 kPa) inlet pressure required.

GOVERNOR – Woodward UG–8LD hydraulic lever type, with friction type speed control. Mounted on right hand side.

IGNITION – Waukesha Custom Engine Control Ignition Module. Electronic digital ignition system. 24V DC power required.

INSTRUMENT PANEL – Engine mounted, includes jacket water temperature, lube oil pressure, lube oil temperature, intake manifold compound vacuum pressure, intake manifold temperature gauges, and digital electronic tachometer.

INTERCOOLER – Air–to–water.

LEVELING BOLTS

LIFTING EYES

LUBRICATION – Full pressure. Gear type pump. Full flow filter, 45 gallon (170 litres) capacity, not mounted. Includes lube oil strainer (mounted on engine) and flexible connections (shipped loose). Air/gas motor driven prelube pump. Requires final piping.

MANIFOLDS – Exhaust, (2) water cooled

OIL COOLER – With thermostatic temperature controller and pressure regulating valve. Not mounted.

OIL PAN – Base type. 165 gallon (625 litres) capacity including filter and cooler.

PAINT – Oilfield orange primer.

PISTONS – Aluminum with floating pin. Oil cooled.

SHIPPING SKID – For domestic truck or rail.

TURBOCHARGERS – Two with water cooled bearing housings. Wastegate controlled.

VIBRATION DAMPER – Viscous type. Guard included with remote mounted radiator or no radiator.

WATER CIRCULATING SYSTEM, AUXILIARY CIRCUIT – Belt driven water circulating high capacity pump for intercooler and lube oil cooler. See S6535-14 performance curve for use with standard 10" diameter crankshaft pulley.

WATER CIRCULATING SYSTEM, ENGINE JACKET – Belt driven water circulating pump, 175 – 180° F (79 – 82° C) individual cylinder thermostats, full flow bypass. Flange connections and mating flanges for (2) 4.5" (114 mm) inlets and (1) 6" (152 mm) outlet.

POWER RATINGS: P9390GSI VHP Series Gas Engines

Model	C.R.	Bore & Stroke in. (mm)	Displ. cu. in. (litres)	Brake Horsepower (kWb Output) 130°F (54°C) I.C. Water Temperature							
				1200 RPM		1000 RPM		900 RPM		800 RPM	
				C	I	C	I	C	I	C	I
P9390GSI	8:1	9.375" x 8.5" (238 x 216)	9388 (154)	1980 (1476)	2447 (1825)	1650 (1230)	2039 (1520)	1485 (1107)	1835 (1368)	1320 (984)	1631 (1216)

		1200 rpm		1000 rpm	
		C	I	C	I
	Power bhp (kWb)	1980 (1476)	2447 (1825)	1650 (1230)	2039 (1520)
	BSFC (LHV) Btu/bhp-hr (kJ/kWh)	7792 (11027)	7763 (10979)	7648 (10823)	7405 (10682)
	Fuel Consumption Btu/hr x 1000 (kW)	15428 (4521)	18997 (5566)	12619 (3698)	15099 (4510)
Emissions	NOx g/bhp-hr (mg/nm³ @ 5% O_2)	13.00 (4815)	13.00 (4815)	13.00 (4815)	13.00 (4815)
Emissions	CO g/bhp-hr (mg/nm³ @ 5% O_2)	9.00 (3333)	9.00 (3333)	9.00 (3333)	9.00 (3333)
Emissions	THC g/bhp-hr (mg/nm³ @ 5% O_2)	2.00 (741)	2.00 (741)	2.00 (741)	2.00 (741)
Emissions	NMHC g/bhp-hr (mg/nm³ @ 5% O_2)	0.30 (111)	0.30 (111)	0.30 (111)	0.30 (111)
Heat Balance	Heat to Jacket Water Btu/hr x 1000 (kW)	4901 (1436)	5920 (1735)	4187 (1227)	4760 (1394)
Heat Balance	Heat to Lube Oil Btu/hr x 1000 (kW)	510 (150)	595 (174)	453 (133)	514 (151)
Heat Balance	Heat to Intercooler Btu/hr x 1000 (kW)	314 (92)	466 (136)	210 (61)	273 (80)
Heat Balance	Heat to Radiation Btu/hr x 1000 (kW)	715 (209)	846 (248)	638 (187)	777 (228)
Heat Balance	Total Exhaust Heat Btu/hr x 1000 (kW)	4527 (1327)	5665 (1661)	3404 (998)	4260 (1248)
Intake/ Exhaust System	Induction Air Flow scfm (Nm³/hr)	3081 (4735)	3505 (5384)	2520 (3873)	2745 (4222)
Intake/ Exhaust System	Exhaust Flow lb/hr (kg/hr)	13713 (6220)	16320 (7403)	11216 (5088)	12810 (5810)
Intake/ Exhaust System	Exhaust Temperature °F (°C)	1177 (636)	1250 (677)	1109 (599)	1192 (644)

Typical heat data is shown, however no guarantee is expressed or implied. Consult your Dresser Waukesha Application Engineering Department for system application assistance.

All natural gas engine ratings are based on a fuel of 900 Btu/ft³ (35.3 MJ/nm³) SLHV, with a 91 WKI®. For conditions or fuels other than standard, consult the Dresser Waukesha Application Engineering Department.

Data based on standard conditions of 77°F (25°C) ambient temperature, 29.53 inches Hg (100kPa) barometric pressure, 30% relative humidity (0.3 inches HG / 1 kPa water vapor pressure).

Fuel consumption based on ISO3046/1-1995 with a tolerance of +5% for commercial quality natural gas having a 900 BTU/ft³ (35.3 MJ/nm³) SLHV.

Heat data based on fuel consumption +2%.

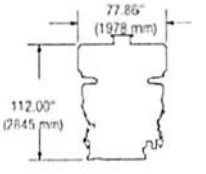
Heat rejection based on cooling exhaust temperature to 77°F (25°C).

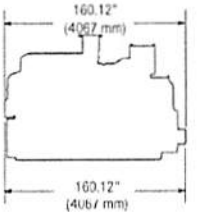
Rating Standard: All models - Ratings are based on ISO 3046/1-1986 with mechanical efficiency of 90% and Tcra (clause 10.1) as specified above limited to ± 10° F (5° C). Ratings are also valid for SAE J1349, BS5514, DIN6271 and AP17D-11C standard atmospheric conditions.

C = ISO Standard Power/Continuous Power Rating: The highest load and speed which can be applied 24 hours per day, seven days per week, 365 days per year except for normal maintenance. It is permissible to operate the engine at up to 10% overload, or a maximum load indicated by the intermittent rating, whichever is lower, for two hours in every 24 hour period.

I = Intermittent Service Rating: The highest load and speed that can be applied in variable speed mechanical system application only. Operation at this rating is limited to a maximum of 3500 hours per year.

Consult your local Waukesha representative for system application assistance. The manufacturer reserves the right to change or modify without notice, the design or equipment specifications as herein set forth without incurring any obligation either with respect to equipment previously sold or in the process of construction except where otherwise specifically guaranteed by the manufacturer.





Dresser, Inc.
Dresser Waukesha
1101 West St. Paul Avenue
Waukesha, WI 53188-4999
T. 262 547 3311
F. 262 549 2795

DRESSER Waukesha

Bulletin 7012 0710

www.dresser.com/waukesha

VHP EMISSIONS LEVELS

MODEL	CARBURETOR SETTING	GRAMS/BHP-HR				% OBSERVED DRY		MASS AFR[3]	VOLUME AFR[3]	EXCESS AIR RATIO
		NO_x [1]	CO	NMHC [4]	THC	CO	O_2			
G, GSI	Lowest Manifold (Best Power)	8.5	32.0	0.35	2.3	1.15	0.30	15.5:1	9.3:1	0.97
	Equal NOx & CO	12.0	12.0	0.35	2.3	0.46	0.30	15.9:1	9.6:1	0.99
	Catalytic Conv. Input (3-way[3])	13.0	9.0	0.30	2.0	0.38	0.30	15.95:1	9.6:1	0.99
	Standard (Best Economy)	22.0	1.5	0.25	1.5	0.02	1.35	17.0:1	10.2:1	1.06
F3514GSI F3524GSI L7044GSI	Equal NOx & CO	14.0	14.0	0.26	1.1	0.45	0.30	15.85:1	9.5:1	0.99
	Catalytic Conv. Input (3-way[3])	15.0	13.0	0.20	1.0	0.38	0.30	15.95:1	9.6:1	0.99
L5794GSI	Equal NOx & CO	13.5	13.5	0.45	3.0	0.45	0.30	15.85:1	9.6:1	0.99
	Catalytic Conv. Input (3-way[3])	14.5	11.0	0.45	2.9	0.38	0.30	15.95:1	9.6:1	0.99
GL	Standard	1.5	2.85	1.0	5.5	0.06	9.8	28.0:1	16.8:1	1.74
L5774LT[#]	Standard	2.6	2.0	0.60	4.0	0.04	8.0	24.7:1	14.8:1	1.64
L5794LT[#]	Standard	2.6	2.0	0.60	4.0	0.04	7.8	24.5:1	14.7:1	1.52

[#] L5774LT and L5794LT emission levels are based on 1000 – 1200 rpm operation. For information at all other speeds Contact Waukesha's Sales Application Engineering Department.

275GL/AT-GL EMISSION LEVELS [‡]

MODEL	CARBURETOR SETTING	GRAMS/BHP-HR				% OBSERVED DRY		MASS AFR [2]	VOLUME AFR [2]	EXCESS AIR RATIO
		NO_x [1]	CO	NMHC [4]	THC	CO	O_2			
275GL/AT27GL	32:1	2.0	1.5	0.40	3.5	0 05	11.2	32.0:1	19.2:1	2.00
275GL+	34:1	0 5	1.6	0.6	6.0	0.04	11.6	34:1	20.4	2.12

[‡] These AT-GL emission levels are based on 900 – 1000 rpm operation. For information at all other speeds contact Waukesha's Sales Application Engineering Department.

NOTE: The above table indicates emission levels that are valid for new engines for the duration of the standard warranty period and are attainable by an engine in good operating condition running on commercial quality natural gas of 900 BTU/ft^3 (35.38 MJ/m^3 [25, V(0; 101.325)]) SLHV, Waukesha Knock Index® of 91 or higher, 93% methane content by volume, and at ISO standard conditions. Emissions are based on standard engine timing at 91 WKI® with an absolute humidity of 42 grains/lb. Refer to engine specific WKI® Power & Timing curves for standard timing. Unless otherwise noted these emission levels can be achieved across the continuous duty speed range and from 75% to 110% of the ISO Standard Power (continuous duty) rating. ***Contact your local Waukesha representative or Waukesha's Sales Application Engineering Department for emission values which can be obtained on a case-by-case basis for specific ratings, fuels, and site conditions.***

FORMALDEHYDE EMISSION LEVELS

The following table provides formaldehyde (CH_2O) levels that are valid for new engines for the duration of the standard warranty period and are attainable by an engine in good operating condition running on commercial quality natural gas of 900 BTU/ft^3 (35.38 MJ/m^3 [25, V(0; 101.325)]) SLHV, Waukesha Knock Index® of 91 or higher, 93% methane content by volume, and at ISO standard conditions. Values are based on standard engine timing at 91 WKI® with an absolute humidity of 42 grains/lb. Refer to engine specific WKI® Power & Timing curves for standard timing. Unless otherwise noted, these emission levels can be achieved across the continuous duty speed range at the load levels tabulated. ***Contact the local Waukesha representative or Waukesha's Sales Application Engineering Department for emission values which can be obtained on a case-by-case basis for specific ratings, fuels, and site conditions.***

MODEL	CARB. SETTING	CH_2O GRAMS/ BHP-HR		% OBSERVED DRY		MASS AFR(2)	VOLUME AFR(2)	EXCESS AIR RATIO
		PERCENT LOAD		CO	O_2			
		100%	75%					
275GL/AT27GL	Lean Burn	0.18	0.20	0.06	9.8	28.0:1	16.8:1	1.74
	Ultra Lean	0.18	0.20	0.05	11.2	32.0:1	19.2:1	2.00
12V220GL/APG2000 18V220GL/APG3000	Ultra Lean	0.23	0.29	0.09 – 0.15	12.3 – 13.4	32.1 – 35.3	19.3 – 21.2	2.03 – 2.20
16V150LTD/APG1000	Lean Burn	0.14	0.15	0.07	9.5 – 9.6	26.9 – 27.2	16.2 – 16.4	1.68 – 1.7
VHP G, GSI	Rich Burn	0.05	0.05	0.02 – 1.15	0.30 – 1.35	15.5:1 – 17.0:1	9.3:1 – 10.2:1	0.97 – 1.06
VHP Series 4 GSI	Rich Burn	0.05	0.05	0.02 – 0.45	0.30 – 1.35	15.85:1 – 17.0:1	9.5:1 – 10.2:1	0.99 – 1.06
L5774LT L5794LT	Lean Burn	0.22	0.25	0.04	7.8 – 8.0	24.5:1 – 24.7:1	14.7:1 – 14.8:1	1.52 – 1.54
VHP GL	Lean Burn	0.29	0.34	0.06	9.8	28.0:1	16.8:1	1.74
VGF G, GSID	Rich Burn	0.05	0.05	0.20 – 1.1	0.18 – 2.4	15.5:1 – 18.0:1	9.3:1 – 10.8:1	0.97 – 1.12
VGF GL, GLD, GLD/2	Lean Burn	0.19	0.22	0.03 – 0.04	7.8 – 9.0	21.5:1 – 25.4:1	13.9:1 – 15.2:1	1.53 – 1.65
VSG G, GSI, GSID	Rich Burn	0.05	0.05	0.02 – 1.15	0.29 – 2.10	15.5:1 – 17.7:1	9.3:1 – 10.6:1	0.97 – 1.10

Johnson Matthey
Catalysts

400 LAPP ROAD, MALVERN, PA. 19355 T (484) 320-2136 F (484) 320-2152 www.jmusa.com

Dearing Compressor & Pump
3974 Simon Road
Youngstown, OH 44512
Attn: Mr Mike Erickson

Date 4/8/2011
ENGINE DATA SHEET
Email: mike@dearingcomp.com
Phone: 330-599-5720
Fax: 330-599-5801

ENGINE DATA	Rich Burn
Engine Mfg:	Waukesha
Engine Model:	P9390GSI
Bhp:	1980
RPM:	1200
Load:	100%
Fuel:	Natural Gas
Temp into Catalyst, °F:	1215
Operating Hours, hrs/yr:	8760

ENGINE PERFORMANCE	
Exhaust Flow, acfm:	10214.42321
Exhaust Flow, scfm:	3171
Exhaust Flow, scfh:	190263
Exhaust Flow, lb/hr:	14343
Exhaust MW:	28.6

TYPICAL (Rich Burn)	MW		
Ar, vol %:	39.9		-
N2, vol %:	28.0		79.70
O2, vol %:	32.0		0.30
H2O, vol%:	18.0		10.00
CO2, vol %:	44.0		10.00

EMISSIONS DATA	PRE	POST	% Reduction
NOx as NO2, g/Bhp-hr:	13.00	0.15	98.8%
NOx as NO2, lb/hr:	56.76	0.65	
NOx as NO2, tons/yr:	248.59	2.87	
NOx as NO2, ppmv:	2,461.79	28.41	
NOx as NO2, ppmvd @ 15% O2:	784.69	9.05	
CO, g/Bhp-hr:	9.00	0.25	97.2%
CO, lb/hr:	39.29	1.09	
CO, tons/yr:	172.10	4.78	
CO, ppmv:	2,799.94	77.78	
CO, ppmvd @ 15% O2:	892.47	24.79	
VOC (NMNEHC), g/Bhp-hr:	0.12	0.05	60.0%
VOC (NMNEHC), lb/hr:	0.52	0.21	
VOC (NMNEHC), tons.yr.:	2.29	0.92	
VOC (NMNEHC), ppm:	65.33	26.13	
VOC (NMNEHC), ppm @ 15% o2:	20.82	8.33	
CH2O, g/Bhp-hr:	0.05	0.01	80.0%
CH2O, lb/hr:	0.22	0.04	
CH2O, tons.yr.:	0.96	0.19	
CH2O, ppm:	27.22	5.44	
CH2O, ppm @ 15% o2:	8.68	1.74	

Scope of Supply	QXH-O-90-Quad

Jack Carroll Sr. Sales Engineer phone: 484-320-2121 fax : 484-320-2152 email: carrojj@jmusa.com

Section 8

Copy of Existing GP-5

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION
SOUTHWEST REGIONAL OFFICE

March 20, 2012

CERTIFIED MAIL: 7000 1670 0004 1442 9779

Nathan Wheldon
MarkWest Liberty Midstream & Resources, LLC
1515 Arapahoe Street
Tower 1, Suite 1600
Denver, CO 80202

Re: GP5-63-00968
Smith Compressor Station
Smith Twp
Washington County

Dear Mr. Wheldon:

The Department has evaluated your application to use General Plan Approval and General Operating Permit GP-5 for *Natural Gas, Coal Bed Methane or Gob Gas Production or Recovery Facility* (GP-5) for authorization to construct and/or operate the following equipment:

- Two (2) Waukesha L7042GSI 1480-bhp rich-burn spark ignition, natural gas fired engines, each equipped with a Waukesha Engine System Manager Air Fuel Ratio (ESM-AFR) controller and a Johnson Matthey QXH-80-T-CS-EI-12 (or equivalent) three-way catalyst.
- One (1) 40 MMscfd triethylene glycol dehydration unit with a 2.0 mmBtu/hr reboiler and equipped with flash tank, flash gas recycle/recompression, and a Superior Fabrication, Inc. 48" enclosed flare rated at 2.1MMBtu/hr for VOC/HAP emissions control (98% control efficiency).
- Four (4) 400-bbl condensate storage tanks controlled by vapor recovery unit (VRU).
- One (1) 500-bbl gun-barrel condensate tank controlled by VRU.

The enclosed document shall serve as written approval pursuant to 25 PA Code § 127.621, and is effective for a five (5) year period, commencing on the authorized date. A copy of the conditions of the GP-5 is enclosed for your reference. Your attention is particularly directed to requirements related to *commencement of construction notification*, *performance testing*, and *expiration and renewal of authorization*.

Pursuant to GP-5 Condition #2, you have requested as part of the referenced application that Federally enforceable emission restrictions, applicable to the sources specified herein, be established at this facility to limit the facility's Potential-to-Emit (PTE) in accordance with the specifications in the application. Upon receipt of authorization to construct and/or operate a

natural gas, coal bed methane, or gob gas production or recovery facility under this GP-5, the following Federally enforceable emission restrictions have been established at the facility:

Table 1—Facility-Wide PTE for the Smith Compressor Station

Pollutant	Emission Rate	
	(lb/hr)	(tpy)
NOx	4.25	18.6
VOC (including HCHO)	1.83	7.9
CO	2.66	11.6
HCHO	0.07	0.28
Total HAPs	0.27	1.01
SOx (as SO2)	*neg.*	-
Particulate Matter (Filterable)	0.13	0.58[1]

[1]Based on 8,760 hours of operation per diesel-fired generator engine

Additionally, the following emission restrictions have been established for each natural gas-fired engine at this facility:

Table 2—Federally Enforceable Emission Restrictions for Each Natural Gas Engine

Engine Model	Pollutant	Emission Rate	
		(g/bhp-hr)	(lb/hr)
Waukesha L7042GSI rated @ 1480-bhp (Engines 1 and 2)	NOx	0.2	0.66
	VOC[a]	0.17	0.56
	CO	0.25	0.82
	HCHO	0.01	0.03

[a]Includes formaldehyde (HCHO).

You should read the entire document carefully; you are obligated to comply with all terms and conditions applicable to your facility. I wish to call your attention to Condition #10, where:

> "Nothing in this General Permit relieves the permittee from the obligation to comply with all applicable Federal, state and local laws and regulations."

Specific Federal regulations that may be applicable to sources at your facility include, but are not limited to, New Source Performance Standards (NSPS) under 40 CFR Part 60 Subpart JJJJ—*Standards of Performance for Stationary Spark Ignition (SI) Internal Combustion Engines (ICE)*, Subpart KKK—*Standards of Performance for Equipment Leaks of VOC From Onshore Natural Gas Processing Plants*, Subpart Kb—*Standards of Performance for Volatile Organic Liquid Storage Vessels (Including Petroleum Liquid Storage Vessels) for Which Construction, Reconstruction, or Modification Commenced After July 23, 1984*; National Emission Standards for Hazardous Air Pollutants (NESHAPS) under 40 CFR Part 63 Subpart HH—*Oil and Natural Gas Production Facilities*, and Subpart ZZZZ—*Stationary Reciprocating Internal Combustion Engines (RICE)*.

Please also note that any authorization by the Department to construct and/or operate under GP-5 may be suspended or revoked if the Department determines that, at any time, construction and/or operation is not in compliance with the terms and conditions of thereof.

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
SOUTHWEST REGION – FIELD OPERATIONS
AIR QUALITY
400 WATERFRONT DRIVE
PITTSBURGH, PENNSYLVANIA 15222-4745

GENERAL PLAN APPROVAL and/or GENERAL OPERATING PERMIT

In accordance with provisions of the Air Pollution Control Act, the Act of January 8, 1960, P.L. 2119, as amended, and after due consideration of an application received under Chapter 127 of the Rules and Regulations of the Department of Environmental Protection, the Department hereby approves the use of this permit for the operation of the air contamination sources(s) described below.

Authorization:	GP5-63-00968	Source(s):	(See Attached Letter)
Owner:	MarkWest Liberty Midstream & Resources, LLC Smith Compressor Station	Air Cleaning Devices:	(See Attached Letter)
Address:	1515 Arapahoe Street Tower I, Suite 1600 Denver, Co 80202	Location:	Smith Twp
		County:	Washington
Attention:	Nathan Wheldon Sr. Environmental Engineer		

This authorization is subject to the following conditions:

1. That the source and any associated air cleaning devices are to be:
   a. Operated in such a manner as not to cause air pollution, as defined in 25 Pa Code § 121.1
   b. Operated and maintained in a manner consistent with good operating and maintenance practices; and
   c. Operated and maintained in accordance with the manufacturer's specifications, the specifications in the Application for Authorization, to Use GP5 and the applicable terms and conditions of the General Plan Approval and General Operating Permit (BAQ-GP/GP5.
2. This authorization is valid only for the source(s), air cleaning device(s), location, and owner named above.
3. See attached.

Failure to comply with the conditions placed on this authorization is a violation of Section 127.622. Violation of this or any other provision of Article III of the Rules and Regulations of the Department of Environmental Protection will result in suspension or revocation of this permit and/or prosecution under Section 9 of the Air Pollution Control Act.

Authorized: 3/20/2012

Mark A. Wayner, P.E.
Regional Program Manager
Air Quality

AUTHORIZATION TERM: 3/20/2012 - 3/20/2017

Any person aggrieved by this action may appeal, pursuant to Section 4 of the Environmental Hearing Board Act, 35 P.S. Section 7514, and the Administrative Agency Law, 2 Pa.C.S. Chapter 5A, to the Environmental Hearing Board, Second Floor, Rachel Carson State Office Building, 400 Market Street, P.O. Box 8457, Harrisburg, PA 17105-8457, 717.787.3483.

TDD users may contact the Board through the Pennsylvania Relay Service, 800.654.5984. Appeals must be filed with the Environmental Hearing Board within 30 days of receipt of written notice of this action unless the appropriate statute provides a different time period.

Copies of the appeal form and the Board's rules of practice and procedure may be obtained from the Board. The appeal form and the Board's rules of practice and procedure are also available in braille or on audiotape from the Secretary to the Board at 717.787.3483. This paragraph does not, in and of itself, create any right of appeal beyond that permitted by applicable statutes and decisional law.

IF YOU WANT TO CHALLENGE THIS ACTION, YOUR APPEAL MUST REACH THE BOARD WITHIN 30 DAYS. YOU DO NOT NEED A LAWYER TO FILE AN APPEAL WITH THE BOARD.

IMPORTANT LEGAL RIGHTS ARE AT STAKE, HOWEVER, SO YOU SHOULD SHOW THIS DOCUMENT TO A LAWYER AT ONCE. IF YOU CANNOT AFFORD A LAWYER, YOU MAY QUALIFY FOR FREE PRO BONO REPRESENTATION. CALL THE SECRETARY TO THE BOARD (717.787.3483) FOR MORE INFORMATION

Please feel free to contact me at 412-442-5231 (phone) or 412.442.4194 (fax) if you have any questions or need additional information.

Sincerely,

Devin P. Tomko
Air Quality Engineering Specialist
Air Quality Program

Enclosure

cc: 63-968 Operations (Dennis Kozimer) Harrisburg C.O. (Permits)