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ENGINEERING EVALUATION/FACT SHEET

B ACKGROUND INFORMATION

Application No.:	R13-1801G
Plant ID No.:	033-00100
Applicant:	Dominion Transmission, Inc.
Facility Name:	Bridgeport Compressor Station
Location:	Bridgeport
NAICS Code:	486210
Application Type:	Modification
Received Date:	July 22, 2014
Engineer Assigned:	Edward S. Andrews, P.E.
Fee Amount:	$1,000.00
Date Received:	July 22, 2014
Complete Date:	September 22, 2014
Due Date:	December 21, 2014
Applicant Ad Date:	July 30, 2014
Newspaper:	*The Exponent Telegram*
UTM's:	Easting: 567.1 km Northing: 4,355.4 km Zone: 17
Description:	The application is for the replacement of the existing flare used to control the emissions from the dehydration unit.

DESCRIPTION OF PROCESS

Dominion Transmission Inc. (Dominion) owns and operates the Bridgeport Compressor Station (BCS). The station services a natural gas pipeline system. The BCS stores natural gas in underground storage wells during periods of low consumer demand, and withdraws the stored gas on an as needed basis, compresses, and transmits natural gas to consumers through the TL-259 pipeline system when demand is high.

As part of operation at the BCS, Dominion utilizes a glycol dehydration unit to remove the moisture (water) out of the natural gas before it is sent to the next compressor station through TL-249. The purpose of this glycol dehydration unit is to remove water from the inlet natural gas stream. Water is removed from the wet natural gas stream via physical absorption while it

flows countercurrent to circulation of triethylene glycol (TEG) in a contactor tower. The dry natural gas then exits the BCS via transmission pipeline TL-259. The rich TEG, which is in a liquid state, is sent to a flash tank to reduce volatile hydrocarbons. The liquid enters the flash tank which allows some of the entrained hydrocarbons (methane, ethane, propane, etc.) to change to a gaseous state. The flash tank operates like a two phase separator. The vapors (gaseous hydrocarbons) from the flash tank can be directly vented to the flare as fuel gas for the flare and pilot light; used as fuel in the reboiler of the dehydration unit; and as a stripping gas in lieu of dry natural gas.

This particular configuration uses a small portion the flash tank off gas to operate an instrument gas heater, which has a heat input of 2500 Btu/hr. The purpose of this heater is to heat the fuel gas stream going to either the pilot lights for the re-boiler and flare. The flash tank gas that is used as fuel has the potential to contain some water. If not preheated, this gas stream has the potential to freeze up at the gas regulator, which is not an acceptable operational condition for the dehydration unit.

From the flash tank, the rich glycol, which is in a liquid state, is sent to the regenerator side of the reboiler. Heat energy for the reboiler heats up the rich glycol to boil out the water. The remaining entrained hydrocarbons are released from the glycol solution. The temperature of the rich glycol is below the boiling point of the glycol so than the undesired water and hydrocarbons boiled off which are vented through the still vent of the regenerator of the reboiler. These hydrocarbon vapors are sent to a flare which is destroyed through incineration. This particular dehydrator uses a stripping gas. This stripping gas improves the water removal efficiency of the regenerator.

Dominion proposes to replace the control device (flare) for the existing dehydration unit with a new enclosed flare. The new enclosed flare will be referenced as Emission Point ID FLARE01 for the purposes in this permit action. As part of the control device replacement, a heat exchanger will be installed in the exhaust stack of the glycol dehydration unit, and a blow-case will be installed between the still column and enclosed combustion device on the glycol dehydration unit. The installation of the heat exchanger and blow-case are considered part of the flare replacement, as they serve to enhance the efficiency of the replacement flare.

The replacement flare will be a new Questor Technologies Inc. Q250 enclosed flare with a minimum destruction efficiency of 98%. The supplemental fuel and pilot for this flare will be flash tank off gas.

SITE INSPECTION

This facility is an existing Title V Major Source and is routinely inspected by the DAQ to verify compliance with the facility's Title V Operating Permit. The last inspection was conducted on March 15, 2014 by Ms. Lou Ann Lee, a Compliance and Enforcement inspector of the North Central Regional Office. Ms. Lee determined that the facility was operating in compliance.

However, the permit application review discovered several irregularities between the previous permit application and actual conditions within corresponding permits. Thus, the writer conducted two site inspections of the Bridgeport Compressor Station which occurred on August 27, 2014, and October 25, 2014. The result of these inspections confirmed that the dehydration unit in place corresponded to the drawing and specifications as listed in Permit Application R13-1801E. Permits R13-1801E and R13-1801F did not reflect this. These permits had the maximum wet gas processing rate of 110 million standard cubic feet per day (MMscfd) (Condition A.1). The actual unit is rated at 80 MM scfd. Second, the permits limited the flare to only control the still vent of the regenerator (Condition A.9.). The current configuration has the flash tank off gas being controlled by the re-boiler and flare and the still vent is controlled by the flare.

The writer determined that Dominion has not made any physical changes to the actual dehydration unit since it was installed in 2004. Overall, the site was deemed acceptable for this type of operation.

ESTIMATE OF EMISSION BY REVIEWING ENGINEER

The applicant used pollutant specific emissions factors from Questor Technologies specific to their Q250 thermal oxidizer incinerating regenerator overheads. The emissions from the flare are dependent on the operation of the dehydration unit. The writer used a mass balance approach to determine the emissions of volatile organic compounds (VOCs) and total hazardous air pollutants (HAPs) from the flare. Thus, the dehydration unit was modeled using GRI-GLYCalc 4.0 to predict the streams from the flash tank off gas and still vent when the stripping gas was dry natural gas (D.G. as S.G). The following table is the summary of the streams based on operating condition.

Table #1 – Stream Summaries

Property	**Stream**	**D.G. as S.G.**
Flow Rate (scfh)	Flash Tank Off Gas	579
	Still Vent	10,100
Heat Content (MBtu/hr)	Flash Tank Off Gas	629.95
	Still Vent	9762.46
Mass Rate of Volatile Organic Compounds (lb/hr)	Flash Tank Off Gas	3.98
	Still Vent	109.16
Mass Rate of Total Hazardous Air Pollutants (HAPs) (lb/hr)	Flash Tank Off Gas	0.09
	Still Vent	31.36
Mass Rate of BTEX (lb/hr)	Flash Tank Off Gas	0.03
	Still Vent	30.67

BTEX means benzene, toluene, ethyl benzene, and xylene.

The proposed flare has a destruction efficiency of at least 98% for hydrocarbons and VOCs, which includes BTEX. Boilers in general are assumed to have a combustion efficiency of 95% for hydrocarbons and VOCs. Dominion requested a 20% margin of compliance be incorporated into the emission limits, which was conducted thought the following estimate expect for sulfur dioxide. The following is presented here to illustrate the emission rate of VOCs and HAPs by source and determine which would have the higher emission rate.

Table #2 – VOC and HAP Emissions from the Flare and Reboiler			
Pollutant	**Reboiler (95%)**	**Flare (98%)**	**Total**
VOCs (lb/hr)	0.22	2.49	2.71
Total HAPs (lb/hr)	<0.01	0.69	0.70
Benzene (lb/hr)	<0.01	0.03	0.04

Other emissions from the flare are products of combustion. The PM emission rates were estimating using AP-42 Chapter 13.5. NOx and CO were based using factors from TCEQ Publication RG-360A/11 Technical Supplement 4 for non-assisted flares low heat release rate. SO_2 was based on maximum predicted flow rate from the flash tank and still vent combined and assuming 50 grains of hydrogen sulfide per 100 cubic feet of gas. The predicted SO_2 was over estimated. Typically pipeline natural gas usual has less than 20 grains per 100 cubic feet of gas. Hydrogen sulfide is absorbed by the glycol and release like the other undesired compounds in the rich glycol. Please see the discussion on Rule 10 in the Regulatory Applicability Section of this evaluation.

Table #3 – Flare Emissions		
Pollutant	**(lb/hr)**	**Annual Rate* (TPY)**
$PM/PM_{10}/PM_{2.5}$	0.40	1.75
Sulfur Dioxide (SO_2)	0.97	4.25
Oxides of Nitrogen (NO_x)	0.80	3.50
Carbon Monoxide (CO)	6.86	30.05
Volatile Organic Compounds (VOCs)	2.49	10.91
Total Hazardous Air Pollutants (HAPs)	0.69	3.02
Carbon Dioxide Equivalent (CO_2e)	1217.82	5,334.05

Table #4 is the estimated emissions from the combustion of fuel gas in the reboiler.

Table #4 – Emissions from the Reboiler		
Pollutant	**Hourly Rates (lb/hr)**	**Annual (tpy)**
$PM/PM_{10}/PM_{2.5}$	0.01	0.04
Oxides of Nitrogen (NO_x)	0.09	0.39
Carbon Monoxide (CO)	0.07	0.31
Volatile Organic Compounds (VOCs)	0.22	0.96
Total Hazardous Air Pollutants (HAPs)	0.01	0.04
Carbon Dioxide Equivalent (CO_2e)	87.82	384.65

The following table illustrates the change in emissions from the previous flare.

Table #5 Change in Potential Emission from the Flares			
Pollutant	**Existing Flare Emissions (tpy)**	**New Flare Emissions (tpy)**	**Net Change (tpy)**
$PM/PM_{10}/PM_{2.5}$	0.86	1.75	0.89
Oxides of Nitrogen (NO_x)	1.90	3.5	1.60
Carbon Monoxide (CO)	4.26	30.05	25.79
Sulfur Dioxide (SO_2)	0.62	4.25	3.63
Volatile Organic Compounds (VOCs)	0.03	10.91	10.88
Total Hazardous Air Pollutants (HAPs)	2.11	3.02	0.91
Carbon Dioxide Equivalent (CO_2e)	N/A	5,334.05	5,334.05

REGULATORY APPLICABLILITY

The Bridgeport Compressor Station is a major source under Title V (45CSR30) and currently possesses a valid Title V Operating Permit. Under this program, new emission units have 12 months upon start-up to be incorporated in the facility's operating permit.

The facility is currently classified as a major source for NO_x, CO, and CO_2e under Prevention of Significant Deterioration (PSD). The first step in determining major modification applicability is to determine which pollutants that the project is major for, which is illustrated in the following table.

Table #6 Step One of PSD Applicability			
Pollutant	New Potential from the Replacement Flare (tpy)	Significance Threshold (tpy)	Significance Trigger (Yes/No)
PM	1.75	25	No
PM_{10}	1.75	15	No
$PM_{2.5}$ Direct	1.75	10	No
NO_x (precursor of Ozone and $PM_{2.5}$)	3.5	40	No
SO_2	4.25	40	No
CO	30.05	100	No
VOCs	10.91	40	No

This project does not represent a "significant emission increase" (45CSR§14-2.75) for any NSR pollutant. Thus, no further review is required.

With regards to the National Ambient Air Quality Standards, Wayne County is classified as attainment for all pollutants. Thus, no further review of this application with regards to 45 CSR 19, West Virginia Non-Attainment Permitting Rule is required.

The replacement flare is subject to Rules 6 & 10 (WV State Rules on PM and SO_2). 45 CSR §6-4.1. sets an allowable emission limit for PM from this flare at 0.68 pounds per hour. The effluent to this flare should not cause the PM emissions to increase beyond this allowable, with the predicted potential being at 0.40 pounds of PM per hour. 45 CSR §6-4.3 limits visible emission from incinerators to less than 20% opacity. A visible indicator of proper operation of a flare is no visible emissions (zero opacity). Dominion plans on operating this particular flare in such a manner.

45 CSR §10-5 established a hydrogen sulfide (H_2S) limit on the combustion of process gas streams to 50 grains of H_2S per 100 cubic feet of carrier gas. Dominion's Bridgeport Station only receives pipeline quality natural gas, which is required to only have a maximum of 20 grains of sulfur per 100 cubic feet of natural gas. This H_2S loading is Dominion's tariff limit for their pipeline.

To prove that this tariff limit satisfies the 50 grain standard for the flare, the writer converted the tariff limit to a percentage, which can be used as the wet gas component in Glycalc. Glycalc was used to predict H_2S concentration at the outlet of the still vent, which was at the maximum glycol circulation rate using dry gas as striping gas in the regenerator. The result of this simulation was over the 50 grain standard. Thus, several additional runs were conducted to determine at what inlet concentration would be acceptable. The results of these additional simulation runs are presented in Table #7.

Table #7 Inlet H_2S concentration to Achieve Compliance with the 50 grain Standard				
Inlet Conc. (grains/100 scf)	Wet Gas (% by Vol.)	Still Vent (% by Vol.)	Still Vent (grains/100 scf)	Level of Compliance (% of the allowable)
20	0.0329	0.126	76.5	153%
15	0.0246	0.942	57.0	114%
10	0.0164	0.0628	38	76%
0.7295*	0.0012	0.0046	2.8	6%

* Existing Permit Limit, Condition B.7. of Permit R13-1801F.

At 10 grains of H_2S per 100 cubic feet in the wet natural gas being processed by the dehydration unit, the outlet concentration from the still vent would be 38 grains per 100 cubic feet of carrier gas (effluent). The flash tank off gas would only have a concentration of 6 grains of H_2S per 100 cubic feet. Overall, the maximum concentration of H_2S in the stream to the flare would be 44 grains of H_2S per 100 cubic feet of carrier gas.

Dominion currently measures the inlet concentration of hydrogen sulfide on an annual basis. This analysis is conducted to demonstrate compliance with Condition B.7. of Permit R13-1801G. At 10 grains of H_2S per 100 cubic feet of gas, the flare would have the potential to emit 0.97 pounds of sulfur dioxide. Typically, the inlet gas to the station has less than 0.7295 grains per 100 cubic feet of gas.

The writer recommends setting an inlet concentration for gas coming into the dehydration unit at 10 grains per 100 cubic feet of gas or 1 grain per one cubic foot of gas for the purpose of demonstrating compliance with 45 CSR §10-5.1. (50 grain standard).

The Bridgeport Compressor Station is classified as a natural gas transmission facility. Under the Subpart HHH – National Emission Standards for Hazardous Air Pollutants from Natural Gas Transmission and Storage Facility of Part 63, the applicability of a major source in this subpart only considers the glycol dehydration unit(s) in determining if the affected source is a major source or area source of HAPs. The facility's dehydration unit is currently classified as a synthetic area source of HAPs, which means the facility has the potential to emit less than 10 tons of any single HAP and 25 tons of combined HAPs per year. Based on the HAP emission prediction with controls in Table 6, the glycol dehydration at the Bridgeport Compressor Station will remain as a synthetic area source of HAPs and is not classified as an affected source under Subpart HHH of Part 63.

Dominion prepared and submitted a complete application, paid the filing fee, and published a Class I Legal ad in *The Exponent Telegram* on July 30, 2014, which is required under Rule 13 for a modification permit. The facility currently holds a valid Title V Operating Permit and included Attachment S of the application for a significant modification of this operating permit.

TOXICITY OF NON-CRITERIA REGULATED POLLUTANTS

The new replacement flare will not emit any pollutants that aren't already being emitted by another emission source at the facility. Therefore, no information about the toxicity of the hazardous air pollutants (HAPs) is presented in this evaluation.

AIR QUALITY IMPACT ANALYSIS

The writer deemed that an air dispersion modeling study or analysis was not necessary, because the proposed modification does not meet the definition of a major modification of a major source as defined in 45CSR14.

MONITORING OF OPERATIONS

For this flare, the writer recommends monitoring effluent going unit to the flare and ensuring proper operation of the flare. The effluent generated by the dehydration is greatly affected by the amount of wet gas processed, circulation rate of the glycol and compensation of the wet gas. The writer recommends the following parameters to be monitored of the dehydrator:

- Wet gas processing rate on a daily basis;
- Monitoring the pilot light for the re-boiler.

The facility has a flow meter measuring the amount of flash gas sent to the reboiler and flare. The writer does not see any value with measuring the flash gas in ensuring compliance or maintaining the synthetic area source status for the dehydration unit. This data might be useful in enhancing the determination of actual emissions for the re-boiler but it does not count the flow rate of the effluent from the still vent. Thus, it is not recommended to be used to determinate compliance as part of this permit.

Dominion included an analysis of the heat content of the effluent from the still vent to demonstrate that this effluent does not require any supplementary fuel to ensure a destruction efficiency of 98 % in accordance with 40 CFR §60.18(f) (U.S. EPA's compliance criteria for flares), which is 200 Btu per standard cubic foot of effluent or greater.

Dominion's proposed new flare is a non-assisted, enclosed flare, which is a Questor Q250. Based on the applicant's Flare Determination Sheet, the predicted flow velocity for the flare is less than the maximum permitted velocity, which was determined using 40 CFR §60.18(f)(5). Thus, the flare should achieve a destruction efficiency of no less than 98%. Questor claimed a destruction efficiency of greater than 99.99% in their product information sheet.

The monitoring of the flare should focus on ensuring good operation of the flare, which would be a function of being in compliance with the VOC and HAP emission limits. The writer recommends requiring the applicant to conduct an initial 2-hour Method 22 observation of visible emissions to ensure proper operation. For follow-up demonstrations, the writer recommends quarterly one hour observations. Other key parameter is verifying that a flame is presence. To determine presence of flame in the flare, the applicant plans on using a thermocouple or flame rod. For compliance purpose, the applicant only needs to record the time period that no flame was presence with the dehydration unit was operating.

CHANGE TO PERMIT R13-1801F

Permit R13-1801F made the existing flare enforceable, which limits the potential to emit of total HAPs from the dehydration unit. The conditions in this permit mandate that the flare will achieve a minimum destruction efficiency of 98% for HAPs. Other than wet gas throughput, the permit mandates that the flare will satisfy the criteria of 40 CFR 60.18(f), which is the general performance requirement for flares under Part 60. These criteria (heat content tip velocity) were evaluated several times and at different operating conditions. The writer determined that the proposed new flare with existing dehydration unit would satisfy the criteria to be capable of achieving a destruction efficiency of 98%.

The proposed replacement flare is an enclosed flare. A natural draft is used to introduce combustion air at the base of the flare. Effluent and supplementary fuel, which is not required for this particular application, is vented into the flare just above the inlet for the combustion air. The ignitor and pilot light are in the same general location, at the base of the flare. There is no actual flare tip in this particular design.

For tip diameter, the writer used the most restrictive section of the Questor Q250 flare, which was the inner diameter of the refractory section of the flare (I.D. 28.3 inches). Questor claimed a combustion efficiency rating of 99.99%. The approach that is currently available to evaluate destruction efficiency for flares is the outline in 40 CFR 60.18(f). This approach is a yes or no check for determining if the flare meets or does not meet 98% destruction efficiency.

The writer believes that the approach outlined in 60.18(f) was not intended to be used to evaluate enclosed flares. However, there is no guidance that suggests other acceptable approaches to evaluate the destruction efficiency of an enclosed flare. Therefore, the writer recommends replacing the destruction efficiency for the flare and conditions relying on the flare evaluation criteria of 40 CFR 60.18(f) with mass emission limits for VOCs and total HAPs (BTEX) on the flare and reboiler.

The current permit cited applicable sections of Rule 6 and 10. The permit does not state how to demonstrate compliance for PM and visible emissions under Rule 6. The actual PM limit will be established and zero visible emissions will be used as one of the two indictors for proper operation of the flare.

The current permit cited the manufacturing process and refinery/process gas standards of Rule 10. For demonstration purposes, the permit required annual gas sampling analysis for total sulfur and hydrogen sulfide. 45 CSR §10-10.1. exempts any fuel burning unit having a design heat input of less than 10 MMBTU/hr. Thus, the reboiler and pilot light fuel gas heater are exempt from the SO_2 standard of 45 CSR §10-3.3.f. and this rule citation should not be in Permit R13-1801F.

Condition B.7. of R13-1801G establishes an inlet wet gas limit of 0.7295 grains per 100 cubic feet of natural gas. The writer could not find any analysis supporting compliance with wet gas inlet concentration. Therefore, GLYCalc 4.0 was used to predict the hydrogen sulfide concentration rate at the outlet of the still vent. Please see Table 7 and the corresponding discussion in the State and Federal rule and Regulation Section of this evaluation for the writer's recommendations for changes to Condition B.7.

RECOMMENDATION TO DIRECTOR

The information provided in the permit application indicates the proposed modification of the facility will meet all the requirements of the applicable rules and regulations when operated in accordance with the permit application. Therefore, the writer recommends granting Dominion Transmission, LLC a Rule 13 modification permit for their Bridgeport Compressor Station located in Bridgeport, WV.

Edward S. Andrews, P.E.
Engineer

May 1, 2015
Date