NETL Life Cycle Inventory Data
Process Documentation File

Process Name:	Storage flaring
Reference Flow:	1 kg of natural gas
Brief Description:	Emissions from flare stacks at natural gas storage facilities

Section I: Meta Data

Geographical Coverage: United States   **Region:** United States

Year Data Best Represents: 2016

Process Type: Basic Process (BP)

Process Scope: Gate-to-Gate Process (GG)

Allocation Applied: No

Completeness: All Relevant Flows Captured

Flows Aggregated in Data Set:

☒ Process   ☐ Energy Use   ☐ Energy P&D   ☐ Material P&D

Relevant Output Flows Included in Data Set:

Releases to Air: ☐ Greenhouse Gases   ☐ Criteria Air Pollutants   ☐ Other

Releases to Water: ☐ Inorganic Emissions   ☐ Organic Emissions   ☐ Other

Water Usage: ☐ Water Consumption   ☐ Water Demand (throughput)

Releases to Soil: ☐ Inorganic Releases   ☐ Organic Releases   ☐ Other

Adjustable Process Parameters:

5_FLARE_CH4

[tonnes] Methane emissions from flare stacks at natural gas storage facilities.

5_storcap

[Mcf] Capacity of a storage facility (volume)

nat_mCH4

[dimensionless] Mass fraction of CH4 in natural gas

5_storcap_kg

[kg] Capacity of a storage facility (mass)

Flare_NG

>   *[kg] Natural gas flared at storage facilities. Assumes a 98% destruction efficiency in the flare.*

Tracked Input Flows:

Tracked Output Flows:

Natural Gas [intermediate flow]

>   *Reference flow*

Flare_NG [to venting and flaring]

>   *[kg] Natural gas flared at storage facilities. Assumes a 98% destruction efficiency in the flare.*

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_NG_Storage_Flaring_2018.01.xlsx*, which provides additional details regarding relevant calculations, data quality, and references.

Goal and Scope

This unit process provides a summary of relevant input and output flows for flare stacks at natural gas storage facilities. Outputs include the reference flow (1 kg of natural gas storage capacity) and the quantity of gas sent to flare stacks; gas that is flared is sent to another NETL unit process for speciation of all combustion emissions. The reference flow of this unit process is: 1 kg of natural gas

Boundary and Description

This unit process provides a summary of relevant input and output flows for flare stacks at natural gas storage facilities. Outputs include the reference flow (1 kg of natural gas storage capacity) and

the quantity of gas sent to flare stacks; gas that is flared is sent to another NETL unit process for speciation of all combustion emissions. The reference flow of this unit process is: 1 kg of natural gas

Flaring is an environmental control measure. At natural gas storage stations, flaring is used to combust methane and other natural gas components that cannot be sent to the natural gas product stream.

Figure 1 shows input and output flows of the unit process. The reference flow is 1 kg of stored natural gas.

Figure 1: Unit Process Scope and Boundary

Storage flaring: System Boundary

Emissions from flare stacks at natural gas storage facilities

Flare_NG [to venting and flaring]

Natural Gas [intermediate flow]

Key
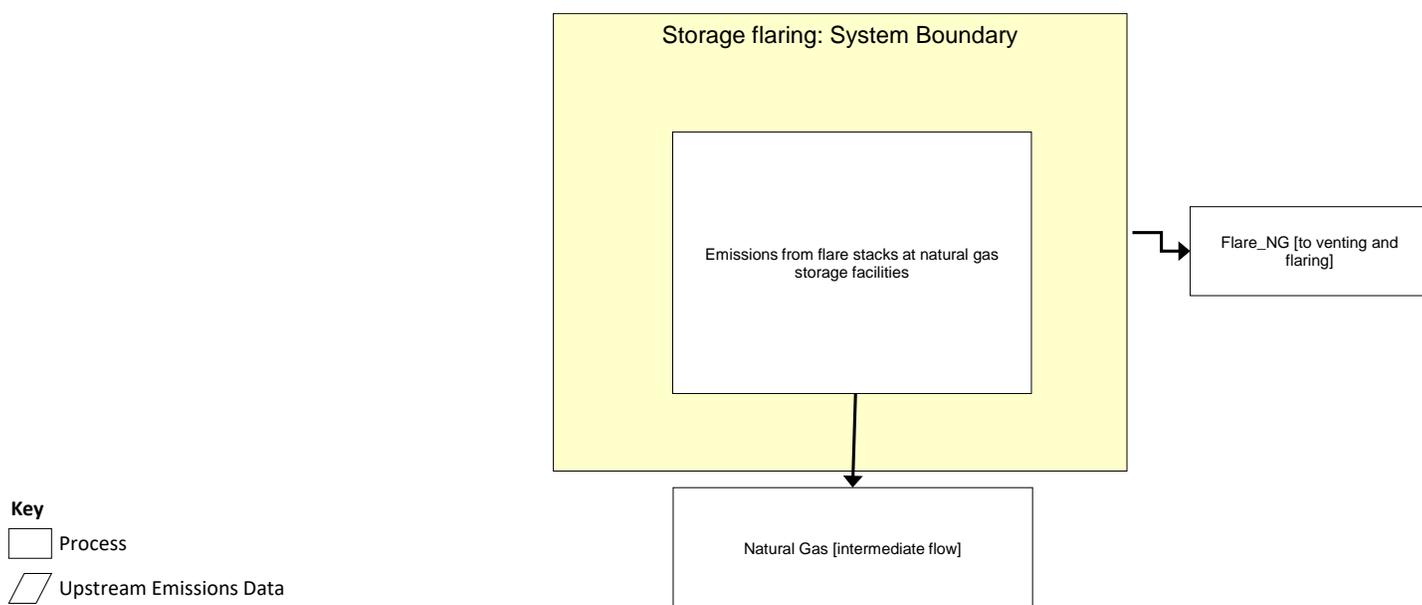
Process

Upstream Emissions Data

Table 1 shows the input parameters, which include the methane emissions from flare stacks and the natural gas throughput at a transmission facility. The methane emissions from flare stacks is based on data reported by the Greenhouse Gas Reporting Program (EPA, 2018). The low, expected, and high bounds represent the variability in the underlying data and were developed via throughput-weighted statistical bootstrapping. The bootstrapping technique allows computation of the confidence intervals around average activity factors. The DS file has a parameter scenario (PS) worksheet with 27 scenarios that match the scenarios for the onshore production unit processes, but at this stage in the supply chain, the average U.S. is the only supply chain scenario that is modeled. After natural gas is gathered, the remaining supply chain stages model it as a commodity for which the energy requirements and emissions are the same for all sources of natural gas.

Table 2 shows the values for natural gas resource inputs and flaring output for Appalachian production scenario. The natural gas resource flow accounts for the total amount of input natural gas resource that goes to product (the reference flow of 1 kg) and the flared quantity; this allows the model to account for the total amount of natural gas resource extraction associated with this process.

The flared output ("Flare [to venting and flaring]") shows the quantity of natural gas sent to a separate instance of NETL's "venting and flaring" unit processes wherein combustion chemistry and flaring effectiveness are used to convert the whole natural gas stream into speciated hydrocarbons and other components that are emitted to the atmosphere.

DF_NG_Storage_Flaring_2018.01.docx

Table 1: Input Parameters

Parameter	Expected Value	Low	High	Units	Description
5_FLARE_CH4	6.33E-01	6.98E-02	1.66E+00	tonnes	Methane emissions from flare stacks at natural gas storage facilities.
5_storcap	1.07E+08	9.32E+07	1.20E+08	Mcf	Capacity of a storage facility (volume)
nat_mCH4	7.34E-01	7.31E-01	7.38E-01	dimensionless	Mass fraction of CH4 in natural gas

Table 2: Unit Process Input and Output Flows

Flow Name	Expected Value	Minimum	Maximum	Units (Per Reference Flow)
Inputs				
Outputs				
Natural Gas [intermediate flow]	1	1	1	kg NG
Flare_NG [to venting and flaring]	2.11E-05	2.69E-06	4.95E-05	kg NG

* **Bold face** clarifies that the value shown *does not* include upstream environmental flows.

Note: Inventory items not included are assumed to be zero based on best engineering judgment or assumed to be zero because no data was available to categorize them for this unit process at the time of its creation.

Embedded Unit Processes

None.

References

EPA. 2016. Greenhouse Gas Reporting Program. Environmental Protection Agency. https://www.epa.gov/enviro/greenhouse-gas-customized-search. Accessed August 22, 2018

EPA. 2018. Inventory of U.S. Greenhouse Gas Emissions and Sinks, 1990-2016. Environmental Protection Agency. EPA 430-R-18-003. https://www.epa.gov/sites/production/files/2018-01/documents/2018_complete_report.pdf Accessed August 20, 2018

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Section III: Document Control Information

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