NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Switchyard and Trunkline Operation

Reference Flow: 1 MWh of Electricity

Brief Description: SF_6 (sulfur hexafluoride) emissions from the operation of a switchyard and trunkline.

Section I: Meta Data

Geographical Coverage: US **Region:** N/A

Year Data Best Represents: 2010

Process Type: Basic Process (BP)

Process Scope: Gate-to-Gate (GG)

Allocation Applied: No

Completeness: Individual 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:

MW	*Power output of NGCC facility*
CF	*Capacity factor of NGCC facility*

Tracked Input Flows:

None.

Tracked Output Flows:

Electricity	*Reference flow; 1 MWh of electricity output*

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_Stage3_O_Switchyard_Trunkline_2010.01.xls*, which provides additional details regarding relevant calculations, data quality, and references.

Goal and Scope

This unit process accounts for the outputs for the operation of a switchyard and trunkline for an NGCC power plant. There are no inputs to this unit process; all flows are normalized to the basis of the output of 1 MWh of electricity, which is dependent on the downstream unit process of electricity transmission and distribution.

The emission of SF_6 (sulfur hexafluoride) from electrical equipment is accounted for in this unit process. No other emissions are accounted for within the boundaries of this unit process. No energy consumption is accounted for within the boundaries of this unit process. All flows are normalized to the basis of the reference flow, which is 1 MWh of electricity output.

The relevant flows of this unit process are described below and shown in **Figure 1.**

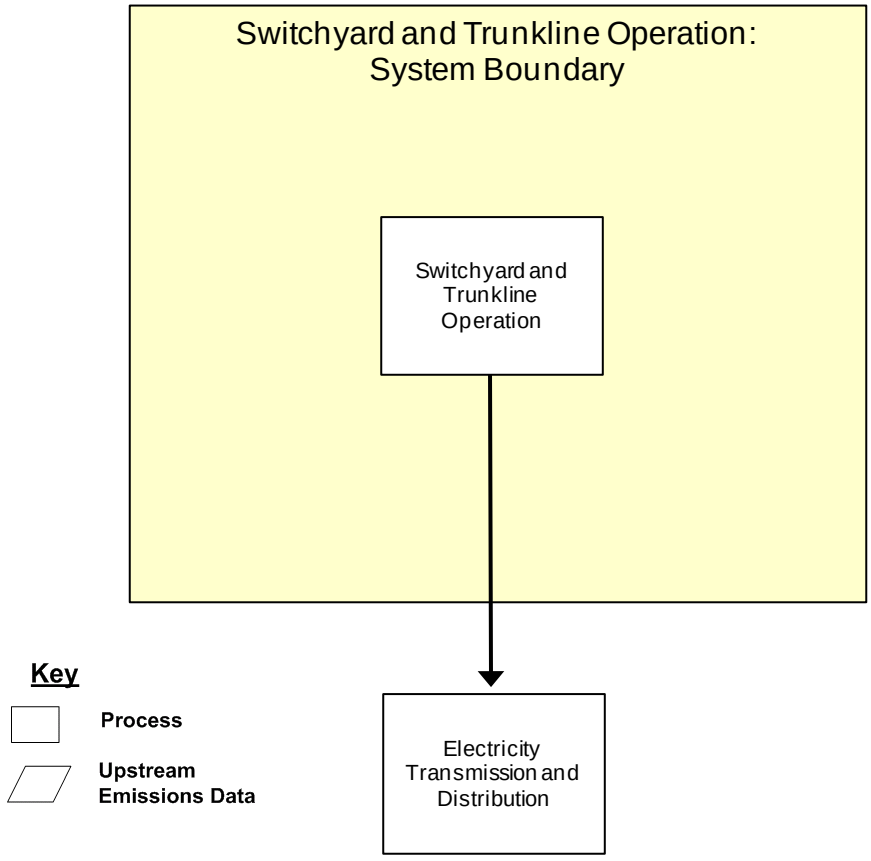
Boundary and Description

When electricity is produced at an NGCC plant, circuit breakers are used for safety during electricity transmission. This unit process assumes that 4 circuit breakers are required an NGCC (natural gas combined cycle) plant. Three breakers are required for the three generators (2 combustion turbine generators and 1 steam turbine), and one breaker is required at the end of the switchyard.

It is common practice to use sulfur hexafluoride (SF_6) gas in the breakers, which is a greenhouse gas with a high global warming potential. The amount of SF6 used in each circuit breaker is given in the literature as 313 kg; therefore the NGCC plant requires 1,252 kg of SF_6 (HVB AE Power Systems 2003). Although estimates vary, the national electrical manufacturers association states that the management guidelines for leakage of SF_6 from circuit breakers are 0.1 percent/year (Blackman and Averyt 2006). This translates to a leakage rate of 3.49E-07 kg/MWh net output. This leakage rate is a data limitation.

The trunkline consists of power lines that connect the switchyard to the electricity transmission network. In comparison to the overall distance of electricity transmission, the electricity losses from the trunkline are negligible and are not accounted for in this unit process. Similarly, the operation of the trunkline does not produce significant air emissions or other environmental releases.

Figure 1: Unit Process Scope and Boundary



Default parameters for this unit process are shown in **Table 1.** The inputs and outputs of this unit process (representative of the default values of **Table 1**) are summarized in **Table 2.**

Table 1: Default Values for Switchyard and Trunkline Operations

Property	Value	References
Number of circuit breakers	4	assumption
SF_6 capacity	313 kg per circuit breaker	HVB AE Power Systems 2003
SF_6 leak rate	0.1% per year	Blackman and Averyt 2006
Trunkline electricity loss	neglible	assumption

Table 2: Unit Process Input and Output Flows

Flow Name*	Value	Units (Per Reference Flow)
Inputs		
not applicable		
Outputs		
Electricity	1	MWh
Sulphur hexafluoride [Inorganic emissions to air]	3.49E-07	kg

* **Bold face** clarifies that the value shown *does not* include upstream environmental flows. Upstream environmental flows were added during the modeling process using GaBi modeling software, as shown in Figure 2.

Embedded Unit Processes

None.

References

(Blackman and Averyt 2006) Blackman, J., M. Averyt, Z. Taylor. 2006. *SF6 Leak Rates from High Voltage Circuit Breakers - US EPA Investigates Potential Greenhouse Gas Emissions Source*. Data from 1998-2003. http://www.epa.gov/highgwp/electricpower-sf6/documents/leakrates_circuitbreakers.pdf (accessed March 10, 2009).

(HVB AE Power Systems 2003) HVB AE Power Systems. 2003. *Dead Tank SF6 Gas Circuit Breakers*. HVB AE Power Systems. HVB AE Power Systems, Inc. http://www.hvbi.com/Products/GCB/HPI/GCB%20362kV-550%20HPI%20info_V2.pdf (accessed March 10, 2009).

Section III: Document Control Information

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