



# NETL Life Cycle Inventory Data

## Process Documentation File

**Process Name:** LNG Liquefaction, Installation/Deinstallation  
**Reference Flow:** 1 piece of LNG Liquefaction, Installation/Deinstallation  
**Brief Description:** This process encompasses the installation/deinstallation of a LNG liquefaction facility.

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### Section I: Meta Data

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**Geographical Coverage:** US **Region:** N/A  
**Year Data Best Represents:** 2010  
**Process Type:** Installation Process (IP)  
**Process Scope:** Gate-to-Gate Process (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  Other  
Releases to Water:  Inorganic  Organic Emissions  Other  
Water Usage:  Water Consumption  Water Demand (throughput)  
Releases to Soil:  Inorganic Releases  Organic Releases  Other

**Adjustable Process Parameters:**

None.

**Tracked Input Flows:**

Diesel

*[Technosphere] Amount of diesel required for the installation/deinstallation of a LNG liquefaction facility.*

**Tracked Output Flows:**

LNG Liquefaction, Installation/Deinstallation [Construction] *Reference flow*

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**Section II: Process Description**

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**Associated Documentation**

This unit process is composed of this document and the data sheet (DS) *DS\_Stage 1-5\_I-D\_LNG\_Liquefaction\_Facility\_2013.01.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 associated with the installation/deinstallation of a LNG liquefaction facility. The key input is diesel. Key outputs are air emissions from the installation/deinstallation of the liquefaction facility such as carbon dioxide, nitrogen oxides, and sulfur dioxide. The unit process is based on the reference flow of one piece of LNG liquefaction facility installation/desinstallation. The relevant flows of this unit process are described below and shown in **Figure 1**.

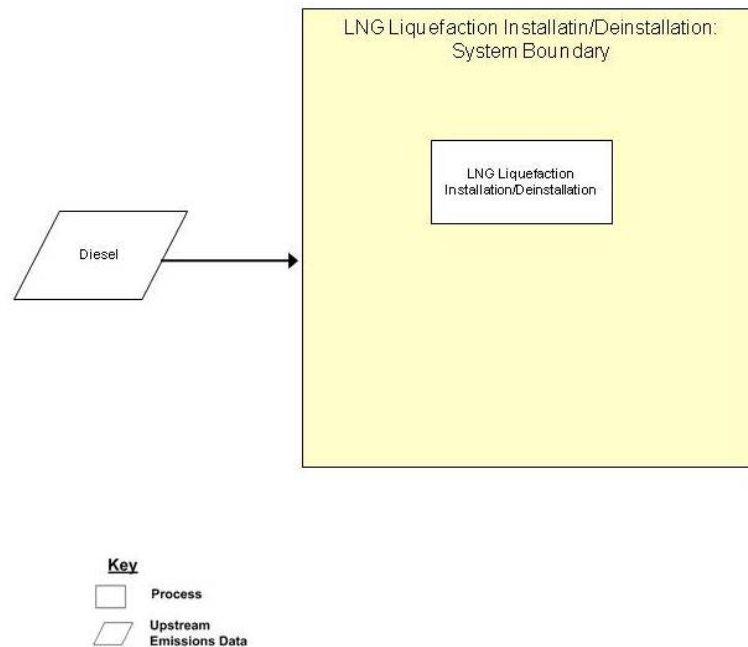
**Boundary and Description**

**Figure 1** provides an overview of the boundary of this unit process. Emissions related to the physical assembly and deinstallation of the LNG facility are not included in this study. Upstream emissions for the acquisition of raw materials used for the installation/deinstallation of the liquefaction facility (e.g. diesel) are calculated outside the boundary of this unit process.

Data for installation/deinstallation of the liquefaction facility was based on environmental records provided by the AES Corporation on their Sparrows Point LNG import and regasification facility near Baltimore, Maryland (AES Corporation, 2007). Sparrows Point is a Federal Energy Regulatory Commission (FERC) approved 1.5 billion cubic feet per day (bcfd) regasification facility slated to be operational in 2010 (FERC, 2012). Although data was available for other processes, no energy use installation data was found that was specific to a liquefaction facility. The Sparrows Point data were determined to be the best available representation and is therefore used as surrogate data to describe the installation/deinstallation of the Atlantic LNG (ALNG) facility. Energy use and emissions associated with the installation/deinstallation of the facility include preparation of the onshore and offshore areas. Onshore activities include those related to construction of the facility itself, pier rehabilitation, and pier dredging using land equipment (AES Corporation, 2007). Offshore activities include pier dredging using marine equipment (AES Corporation, 2007). It is assumed that diesel consumption

accounts for the majority of energy use and emissions during the installation of the terminal.

**Figure 1: Unit Process Scope and Boundary**



The Sparrows Point records listed the equipment, operating hours, horsepower, and diesel consumption (lbs. diesel per brake-specific horsepower-hour) for specific horsepower ranges for each installation activity as well as the following air emissions: PM, NO<sub>x</sub>, sulfur dioxide (SO<sub>2</sub>) based on a diesel sulfur content of 0.05 percent, CO, and unspecified hydrocarbons (HC) (AES Corporation, 2007). No data were provided for GHG, NH<sub>3</sub>, or Hg emissions. Emission factors were applied to the calculated diesel consumption in order to calculate the emission of carbon dioxide (CO<sub>2</sub>), N<sub>2</sub>O, CH<sub>4</sub>, NH<sub>3</sub>, and Hg (EPA 1994; Conaway, Mason et al., 2005; EIA, 2008; EPA, 2002). The emissions were adjusted on the basis of the Darwin liquefaction facility land use and LNG processing quantities (Bechtel, 2004; Hydrocarbons Technology, 2009), as Sparrows Point, as previously stated, is a regasification facility with different operations.

The Sparrows Point records express the installation activities on the basis of the installation of an entire facility (AES Corporation, 2007). Using an assumed lifetime of 30 years and a daily production rate of 1.5 bcf/d of natural gas on which the raw unadjusted emissions were based, it was calculated that Sparrows Point will have a lifetime throughput of 3.13E+11 kilograms of natural gas.

**Table 1: Unit Process Input and Output Flows**

Flow Name	Value	Units (Per Reference Flow)
<b>Inputs</b>		
Diesel	5.98E+07	kg
<b>Outputs</b>		
LNG Liquefaction, Installation/Deinstallation [Insert]	1.00E+00	piece
Mercury (+II) [Heavy metals to air]	9.36E-03	kg
Ammonia [Inorganic emissions to air]	8.04E+03	kg
Carbon dioxide [Inorganic emissions to air]	1.89E+08	kg
Carbon monoxide [Inorganic emissions to air]	1.19E+06	kg
Nitrogen oxides [Inorganic emissions to air]	1.87E+06	kg
Nitrous oxide (laughing gas) [Inorganic emissions to air]	4.79E+03	kg
Sulphur dioxide [Inorganic emissions to air]	3.76E+04	kg
VOC (unspecified) [Organic emissions to air (group VOC)]	1.08E+04	kg

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

### Embedded Unit Processes

None.

### References

AES Corporation. (2007). *Appellant's Consolidated Record Submission AES Sparrows Point FERC Application Volumes I and II, Table 9A-37a*. Office of General Counsel Coastal Zone Management Act Consistency Appeals

Federal Energy Regulatory Commission. (2012). *LNG Industry Activities*. Federal Energy Regulatory Commission. Retrieved April 30, 2012, from <http://ferc.gov/industries/gas/indus-act/lng.asp>

U.S. Environmental Protection Agency. (1994). *Development and Selection of Ammonia Emission Factors*. (EPA/600/SR-94/190). Research Triangle Park, NC: U.S. Environmental Protection Agency. Retrieved April 30, 2012, from <http://www.sraproject.net/wp-content/uploads/2007/12/developmentandselectionofammoniaemissionfactors.pdf>

Conaway, Christopher H., Mason, Robert P., Steding, Douglas J., et al. (2005). *Estimate of mercury emission from gasoline and diesel fuel consumption, San Francisco Bay area, California*. Atmospheric Environment 39 (1):101-105. <http://www.sciencedirect.com/science/article/B6VH3-4DPC3KY-2/2/f5afa2357561d9a8485df82f60084a68>

U.S. Energy Information Administration. (2008). *Fuel Emission Factors*. (DOE/EIA-0637). Washington, DC: U.S. Energy Information Administration Retrieved April

30, 2012, from  
<http://www.eia.gov/oiaf/1605/excel/Fuel%20Emission%20Factors.xls>

U.S. Environmental Protection Agency. (2002). *Control of Emissions from Compression-Ignition Marine Diesel Engines At or Above 30 Liters per Cylinder*. U.S. Environmental Protection Agency

Bechtel. (2004). *Energy Frontier: Australia's Remote North Coast is the Setting for a New Cost-efficient Liquefied Natural Gas Project* Retrieved April 30, 2012, from [http://www.bechtel.com/energy\\_frontier.html](http://www.bechtel.com/energy_frontier.html)

Hydrocarbons Technology. (2009). *Darwin LNG Project, Darwin Harbor, Australia* Retrieved April 30, 2012, from <http://www.hydrocarbons-technology.com/projects/darwin/>



**Section III: Document Control Information**

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**Section IV: Disclaimer**

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