NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Gaseous Diffusion Enrichment Facility, Decommissioning

Reference Flow: 1 piece of Gaseous Diffusion Enrichment Facility, Decommissioning

Brief Description: This process accounts for the energy consumption, material requirements, and emissions for the decommissioning of a gaseous diffusion uranium enrichment plant.

Section I: Meta Data

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

Year Data Best Represents: 2005

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 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:

Tracked Input Flows:

Power [electric power]	*Amount of electricity required for decommissioning of the gaseous diffusion enrichment facility*
Diesel [Crude oil products]	*Amount of electricity required for decommissioning of the gaseous diffusion enrichment facility*

Tracked Output Flows:

Gaseous Diffusion Enrichment Facility, Decommissioning [Decommissioning]
Construction of a conversion facility

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_Stage1_C_GasDiffusion_Decommissioning_2010.01.xls*, which provides additional details regarding relevant calculations, data quality, and references.

Goal and Scope

The scope of this unit process encompasses the energy needed to decommission a gaseous diffusion enrichment facility. The facility is used to enrich the concentration of Uranium-235 in uranium hexafluoride (UF_6). This unit process is based on the reference flow of 1 piece of gaseous diffusion enrichment facility decommissioning, as described below and shown in **Figure 1**. Decommissioning activities use electricity and diesel. Air emissions are calculated for diesel combustion emissions from construction vehicles and fugitive dust. Radioactive solid waste (slag) is also inventoried. The management of depleted uranium wastes (UF6) are an operation-related activity and are outside the scope of this unit process.

This process is used during LC Stage #1 to remove the facility which was enriching the UF_6 to the state which is needed for the nuclear reactors. It is modeled in parallel to the enrichment construction and operation processes.

Boundary and Description

After the useful lifetime of the enrichment facility it is dismantled and disposed of properly. The decommissioning activities for the enrichment plant at Oak Ridge (the "K-25" plant) are assumed to be the same as those for other gaseous diffusion facilities (e.g., Paducah).

Decommissioning of a uranium enrichment facility is a multi-year process; therefore the energy for decommissioning activities are assumed to be equal to the direct energy for construction activities. Direct energy use (electricity and thermal energy) are reported by the Rotty report (1975). The thermal energy portion is assumed to be supplied by diesel combusted in construction vehicles: the amount of diesel consumed is calculated from the heating value of diesel. Air emissions associated with diesel combustion in construction vehicles were calculated using EPA's AP 42 (EPA 1995).

Electricity for operation of Paducah UF6 enrichment plant comes from Joppa steam plant, which uses 100% bituminous coal. It is assumed that the electricity demand for decommissioning is from the same plant.

Scrap metal from decommissioning of the plant can be recycled for unrestricted use. The majority of this scrap metal is carbon steel. 100% of the burdens for metal recycling are assigned to the next generation product, with exception of waste slag, which is assigned to the decommissioning activities of this unit process. The solid waste values were provided by a document which inventorying recycling scrap metals from nuclear facilities (Anigstein 2001). Any waste concrete from demolition activities is disposed onsite at the EMWMF (Environmental Management Waste Management Facility) and does not exit the boundaries of this unit process. The EMWMF facility has a capacity of nearly 1 million cubic meters (Waldman 2007).

Figure 1 provides an overview of the boundary of this unit process. The upstream emission from the production of the raw materials used for the energy sources (e.g., electricity and diesel) are calculated outside the boundary of this unit process, based on proprietary profiles available within the GaBi model.

Table 1 provides a summary of modeled input and output flows. Additional detail regarding input and output flows, including calculation methods, is contained in the associated DS sheet.

Figure 1. Unit Process Scope and Boundary

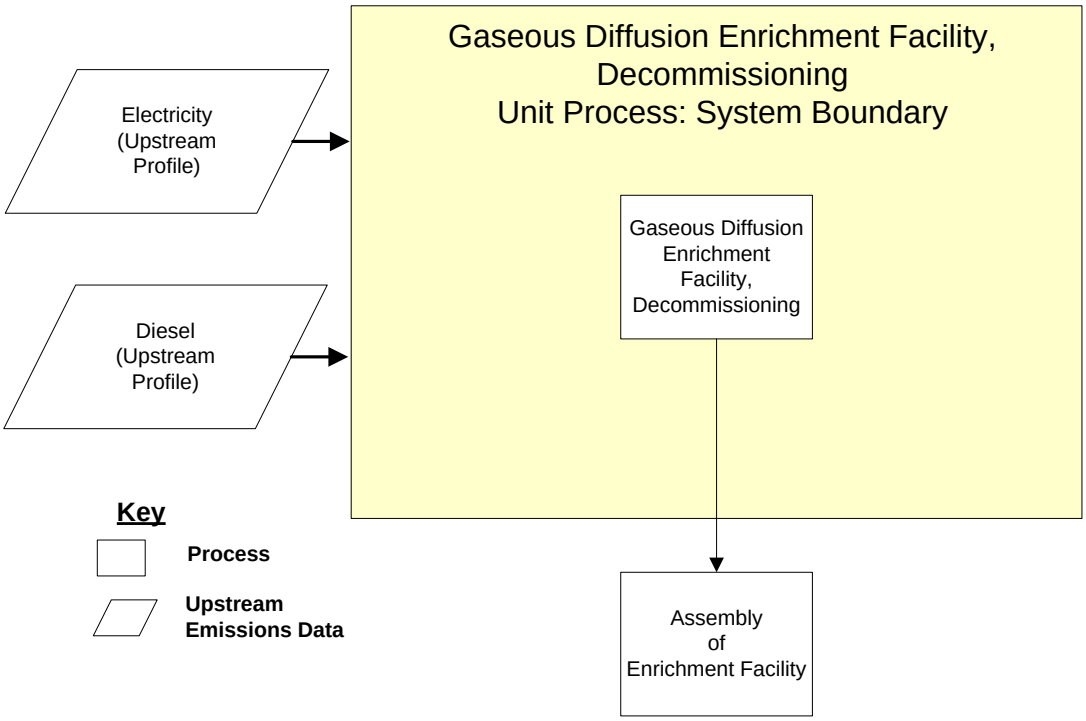

Table 1: Unit Process Input and Output Flows

Flow Name	Value	Units (Per Reference Flow)
Inputs		
Power [Electric power]	8.60E+04	MWh/piece
Diesel [Crude oil products]	4.34E+08	kg/piece
Outputs		
Gaseous Diffusion Enrichment Facility, Decommissioning [Decommissioning]	1.00	piece
Carbon dioxide [Inorganic emissions to air]	1.37E+09	kg/piece
Nitrogen oxides [Inorganic emissions to air]	3.69E+07	kg/piece
Carbon monoxide [Inorganic emissions to air]	7.96E+06	kg/piece
Sulphur oxides [Inorganic emissions to air]	2.43E+06	kg/piece
Dust (PM10) [Particles to air]	2.60E+06	kg/piece
NMVOC (unspecified) [Group NMVOC to air]	3.02E+06	kg/piece
waste radioactive [Radioactive Waste]	1.17E+07	kg/piece

* **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 1.

Embedded Unit Processes

None.

References

Rotty 1975 — Rotty, R.M. (1975). Net Energy From Nuclear Power. Institute for Energy Analysis. November 1975.

EPA 1995 — EPA, 1995. Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42. US EPA Office of Air Quality Planniing and Standards. Research Triangle Park, North Carolina. 1995. http://www.epa.gov/ttnchie1/ap42 (Accessed May 18, 2010)

Anigstein 2001 — Anigstein, R. (2001). Potential Recycling of Scrap Metal from Nuclear Facilities, Part I: Radiological Assessment of Exposed Individuals. http://www.epa.gov/radiation/docs/source-management/tsd/scrap_tsd_041802_vol1cvr_toc1.pdf (Accessed August 30, 2010)

Waldman 2007 — Waldman, P. (2007). Transformation of Oak Ridge. http://www.bechtel.com/transformation_of_oak_ridge.html (Accessed August 30, 2010)

Section III: Document Control Information

Date Created: November 8, 2010

Point of Contact: Timothy Skone (NETL), Timothy.Skone@NETL.DOE.GOV

Revision History:

Original/no revisions

How to Cite This Document: This document should be cited as:

NETL (2010). *NETL Life Cycle Inventory Data – Unit Process: Gaseous Diffusion Enrichment Facility, Decommissioning.* U.S. Department of Energy, National Energy Technology Laboratory. Last Updated: November 2010 (version 01). www.netl.doe.gov/energy-analyses (http://www.netl.doe.gov/energy-analyses)

Section IV: Disclaimer

Neither the U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL) nor any person acting on behalf of these organizations:

A. Makes any warranty or representation, express or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this document, or that the use of any information, apparatus, method, or process disclosed in this document may not infringe on privately owned rights; or

B. Assumes any liability with this report as to its use, or damages resulting from the use of any information, apparatus, method, or process disclosed in this document.

Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by NETL. The views and opinions of the authors expressed herein do not necessarily state or reflect those of NETL.