NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Underground Uranium Mine, Construction

Reference Flow: 1 piece (pcs) of Underground Uranium Mine Construction/ kg Yellowcake

Brief Description: This process encompasses the materials required for the construction of a representative underground room and pillar uranium mine. Where uranium mine data were not available, surrogate data were used from the mining of Illinois No.6 coal.

Section I: Meta Data

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

Year Data Best Represents: 1983

Process Type: Manufacturing Process (MP)

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:

Cast iron [Metals]	*Amount of cast iron required for construction of an underground uranium mine, per kg yellowcake*
Concrete, ready mix, R-5-0 [Concrete_Cement]	*Amount of ready mix concrete required for construction of an underground uranium mine, per kg yellowcake*

Copper [Non renewable elements]	*Amount of copper required for the construction of an underground uranium mine, per kg yellowcake*
Aluminum [Metals]	*Amount of aluminum required for the construction of an underground uranium mine, per kg yellowcake*
Steel cold rolled (St) [Metals]	*Amount of steel required for the construction of an underground uranium mine, per kg yellowcake*
Asphalt [Concrete_Cement]	*Amount of asphalt required for the construction of an underground uranium mine, per kg yellowcake*
Hot-dip Galvanized Steel [Metals]	*Amount of hop-dipped galvanized steel required for the construction of an underground uranium mine, per kg yellowcake*
Polyvinylchloride-tube (PVC) [Plastic parts]	*Amount of PVC required for the construction of an underground uranium mine, per kg yellowcake*
Rebar Wire Rod [Metals]	*Amount of rebar required for the construction of an underground uranium mine, per kg yellowcake*
Steel plate, BF (85% Recovery Rate) [Metals]	*Amount of steel plate required for the construction of an underground uranium mine, per kg yellowcake*
Steel, Stainless, 316 2B (80% Recycled) [Metals]	*Amount of stainless steel required for the construction of an underground uranium mine, per kg yellowcake*
Styrene-butadiene-rubber (SBR) [Plastics]	*Amount of rubber required for the construction of an underground uranium mine, per kg yellowcake*

Tracked Output Flows:

Underground Mine Construction [Construction]	*Construction of an underground uranium mine (reference flow)*

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_Stage1_C_Underground_Uranium_Mine_2010.01.xls*, which provides additional details regarding relevant calculations, data quality, and references.

Goal and Scope

The scope of this unit process includes the mass of each of the materials necessary to construct a room and pillar underground uranium mine. The process is based on the reference flow of 1 piece of underground uranium mine construction per kg of yellowcake (U_3O_6), as described below and shown in **Figure 1**. The underground uranium mine is constructed of aluminum, asphalt, cast iron, concrete, copper, hot-dip galvanized steel, PVC, rebar, cold rolled steel, steel plate, stainless steel, and styrene-butadiene-rubber. All other materials as considered negligible.

This process is used during LC Stage #1 to determine the construction materials needed to build an underground uranium mine for the extraction process. It is modeled in parallel to an underground uranium mine operations unit process, as well as other relevant construction and operations unit processes contained within LC Stage #1.

Boundary and Description

Construction of the underground uranium mine is based on a material list provided in the "Energy Technology Characterizations Handbook" (ETCH 1983) in conjunction with the existing Illinois No. 6 coal mine DS and DF sheets (NETL 2010).

Figure 1 provides an overview of the boundary of this unit process. The energy inputs and construction-related emissions associated with the installation of this mine at the mine site are not included in this unit process. Upstream emissions associated with the production of the raw materials used for the construction of the underground uranium mine (e.g., steel and concrete) are calculated outside the boundary of this unit process, based on the material requirements calculated in this unit process, and on proprietary profiles available within the GaBi model.

The weights for a selection of materials were readily available. The materials include: concrete, copper, aluminum, cast iron, and steel. However, additional material values were not available, and therefore were assumed to be similar to the construction of an underground coal mine. These additional materials include asphalt, hot-dipped galvanized steel, PVC, rebar, stainless steel, and styrene-butadiene-rubber. While it is known that there must be additional materials beyond those described in this unit process, there are no readily available data to add such information. Therefore, it is assumed that other materials that are not documented in this unit process are negligible in comparison to the documented materials.

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. All materials flow values are calculated based on the number of kilograms of yellowcake which will be produced during the lifetime of the mine.

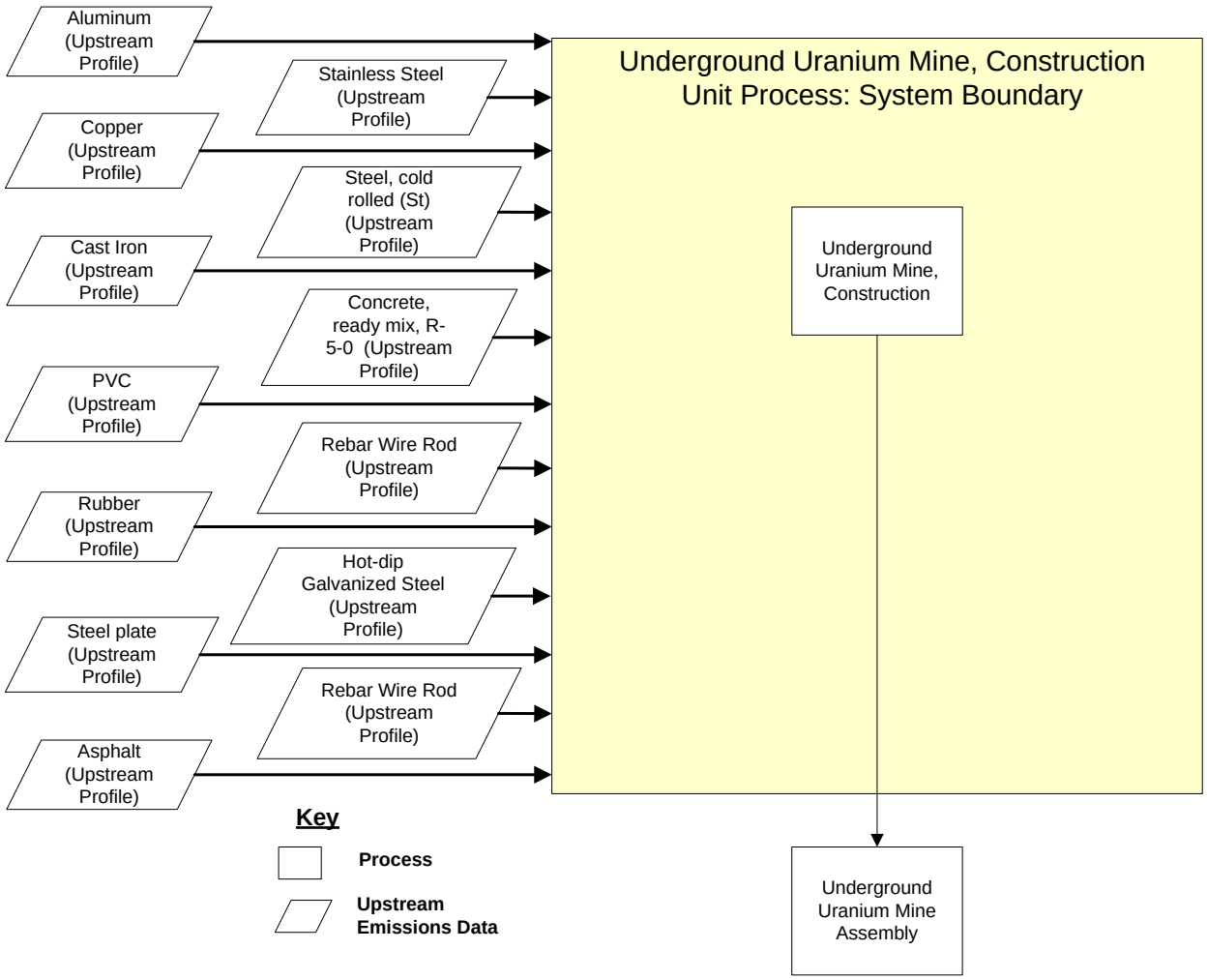

Figure 1. Unit Process Scope and Boundary

Table 1: Unit Process Input and Output Flows

Flow Name	Value	Units (Per Reference Flow)
Inputs		
Aluminum [Metals]	**2.04E-03**	**kg/kg yellowcake**
Asphalt [Concrete_Cement]	**1.11E-03**	**kg/kg yellowcake**
Cast iron [Metals]	**7.13E-03**	**kg/kg yellowcake**
Concrete, ready mix, R-5-0 [Concrete_Cement]	**8.06E-01**	**kg/kg yellowcake**
Copper [Non renewable elements]	**2.96E-03**	**kg/kg yellowcake**
Hot-dip Galvanized Steel [Metals]	**1.52E-06**	**kg/kg yellowcake**
Polyvinylchloride-tube (PVC) [Plastic parts]	**1.30E-07**	**kg/kg yellowcake**
Rebar Wire Rod [Metals]	**1.41E-06**	**kg/kg yellowcake**
Steel cold rolled (St) [Metals]	**5.15E-01**	**kg/kg yellowcake**
Steel plate, BF (85% Recovery Rate) [Metals]	**1.80E-04**	**kg/kg yellowcake**
Steel, Stainless, 316 2B (80% Recycled) [Metals]	**6.77E-08**	**kg/kg yellowcake**
Styrene-butadiene-rubber (SBR) [Plastics]	**4.45E-07**	**kg/kg yellowcake**
Outputs		
Underground Mine Construction [Construction]	1	pcs/kg yellowcake

* **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

ETCH 1983 The Aerospace Corporation and Mueller Associates, Inc. 1983. *Energy Technology Characterizations Handbook*. Department of Energy. Washington, D.C.

NETL 2010 NETL Life Cycle Inventory Data – Process Data Sheet File: *Illinois No. 6 Underground Bituminous Coal Mine Site, Construction*. U.S. Department of Energy, National Energy Technology Laboratory. Last Updated: October 2010 (version 01). www.netl.doe.gov/energy-analyses (http://www.netl.doe.gov/energy-analyses)

Section III: Document Control Information

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