NETL Life Cycle Inventory Data
Process Documentation File

Process Name: In Situ Uranium Mine Construction

Reference Flow: 1 kg of Uranium Yellowcake (U_3O_8)

Brief Description: This process encompasses the materials, drilling energy, and consequent emissions for the construction of a representative in situ mine used to extract uranium, normalized to 1 kg of produced uranium.

Section I: Meta Data

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

Year Data Best Represents: 2008

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:

Drill Speed	*The speed at which the drill operates, important to determine how long it will take to drill a well*
Drill Depth	*The depth to which the well must be drilled to for extraction of the uranium*
Production Rate	*The rate at which the uranium will be extracted through the well*
Well Lifetime	*The number of years which the well is expected to produce*

Tracked Input Flows:

Polyvinylchloride part (PVC) [Plastic parts]	*Amount of polyvinylchloride pipe needed to case the well for the extraction of the uranium and any pipelines needed on the site*
Concrete, ready mix, R-5-0 [Concrete_Cement]	*Amount of concrete needed to keep the polyvinylchloride pipe in place in the well and any building foundations*
Diesel [Crude oil products]	*Diesel needed to power the drill to create the wells*

Tracked Output Flows:

Uranium Yellowcake (U_3O_8) [Construction]	*Amount of yellowcake produced from the insitu extraction and processing (reference flow)*

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_Stage1_C_In_Situ_Uranium_Extraction_2010.01.xls*, which provides additional details regarding relevant calculations, data quality, and references.

Goal and Scope

The scope of this unit process covers the elements required for the construction of an in situ leach uranium mine. The process includes a single well field and processing plant complete with polyvinylchloride (PVC) pipelines under LC Stage #1. Once the uranium is extracted by the wells, it is transported through the pipelines for processing. After processing, the yellowcake (U_3O_8) will be transported to a uranium conversion facility still contained within LC Stage #1. The well house, used to combine multiple well outputs into one flow of uranium to the processing plant, has been assumed be insignificant compared to both the construction of the wells and the construction of the pipelines and processing plant.

Boundary and Description

Figure 1 provides an overview of the boundary of this unit process. Specifications for the well field were provided in an Environmental Impact Statement for the Beverley Uranium Mine in Australia (Beverley 1998). The well

field is expected to require drilling of one thousand wells for 15 production years. Each of the wells would be drilled to a depth of roughly 110 meters. Each well will have a PVC pipe inserted into it. The pipe will be cemented for stability and longevity of the well.

A processing plant is built to separate the uranium from the extraction solution. The materials specified for the processing plant includes only the amount of concrete needed for the base (Beverley 1998). Additional requirements were not readily available. While it is known that other materials would likely be used in construction of a processing plant, the completeness of these data is considered sufficient for the low significance of this process in the lifecycle emissions of nuclear power (determined by life cycle screening of relative greenhouse gas emissions for all unit processes).

Pipelines are needed for the transportation of the uranium solution from the extraction wells through the well house to the processing plant. The pipes entering the well house will have a smaller diameter than those leaving the well house as the well house combines multiple streams into a larger stream. The pipes will be construction out of PVC (NRC 2009a).

For the drilling of the wells, it is assumed that fuel consumption is based on the brake specific power. The diesel consumption is estimated at 0.1645 kg/horsepower – hour (EPA 1995). All combustion emissions based on the diesel consumption are included.

Figure 1: Unit Process Scope and Boundary

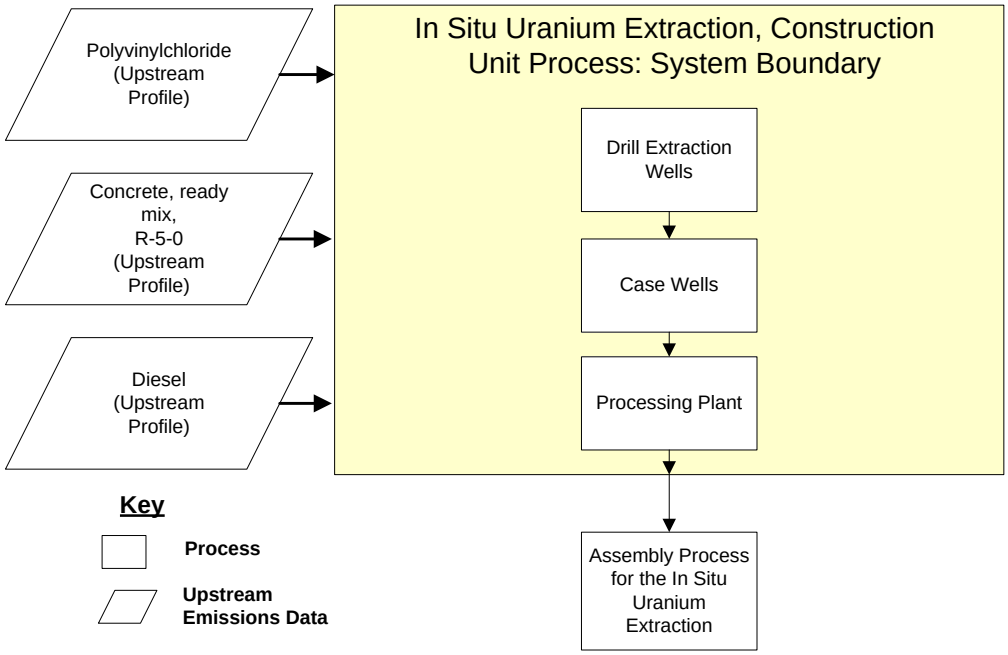

Table 1 shows the proposed ranges for the adjustable parameters as well as the default values.

Table 1: Adjustable Parameters

Material	Minimum	Default	Maximum
Drill Speed (m/h)	14.2	17.8	21.3
Drill Depth (m)	120	150	180
Production Rate (kg/d)	1245	2740	53437
Well Life (year)	12	15	18

Table 1: Properties of a Single Underground Uranium Mine

Construction and Replacement Properties		
Property	**Value**	**Reference**
Number of Wells	1000 wells	Beverley 1998
Mine Lifetime	15 years	Beverley 1998
Pipeline Depth	150 meters	Assumed
Concrete for well	5,499,803 kg	Calculated
Concrete for Processing Plant Base	36,758,880 kg	Beverley 1998
Length of Pipeline	8,210 meters	NRC 2009b

Table 2: Unit Process Input and Output Flows

Flow Name*	Value	Units (Per Reference Flow)
Inputs		
Polyvinylchloride part (PVC) [Plastic parts]	**3.03E-02**	**kg/kg yellowcake**
Concrete, ready mix, R-5-0 [Concrete_Cement]	**2.82**	**kg/kg yellowcake**
Diesel [Crude oil products]	**5.55E-05**	**kg/kg yellowcake**
Outputs		
Uranium Yellowcake (U3O8) [Construction]	1.00	kg
Carbon dioxide [Inorganic emissions to air]	1.78E-04	kg/kg yellowcake
Methane [Organic emissions to air (group VOC)]	9.71E-09	kg/kg yellowcake
Nitrogen oxides [Inorganic emissions to air]	3.67E-06	kg/kg yellowcake
Sulphur oxides [Inorganic emissions to air]	6.19E-08	kg/kg yellowcake
Carbon monoxide [Inorganic emissions to air]	8.42E-07	kg/kg yellowcake
NMVOC (unspecified) [Group NMVOC to air]	9.82E-08	kg/kg yellowcake
Dust (PM10) [Particles to air]	1.07E-07	kg/kg yellowcake

* **Bold face** clarifies that the value shown *does not* include upstream environmental flows. See also the documentation for embedded unit processes, as shown below.

Embedded Unit Processes

None.

References

Beverley 1998	Minister for Primary Industries, Natural Resources and Regional Development, 1998. Assessment Report on the Environmental Impact Statement for the Proposed Beverley Uranium Mine. Minister for Primary Industries, Natural Resources and Regional Development. http://dataserver.planning.sa.gov.au/publications/227p.pdf (Accessed June 22, 2010).
NRC 2009a	U.S. Nuclear Regulatory Commission, 2009. Environmental Impact Statement for the Moore Ranch ISR Project in Campbell County, Wyoming. Washington, D.C. U.S. Nuclear Regulatory Commission. http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1910/s1/sr1910s1.pdf (Accessed June 23, 2010).
NRC 2009b	U.S. Nuclear Regulatory Commission, 2009. Environmental Impact Statement for the Nichols Ranch ISR Project in Campbell and Johnson Counties, Wyoming. Washington, D.C. U.S. Nuclear Regulatory Commission. http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1910/s2/sr1910s2.pdf (Accessed June 23, 2010).
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)

Section III: Document Control Information

Date Created: October 25, 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 – Process Data Sheet File: In Situ Uranium Extraction, 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)

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