Environmental Review Form for Argonne National Laboratory

Form:	ANL-985
Version:	5
Your Form ID:	ANL-985-1753
Form Status:	Approved
Date:	4/20/2022 4:28:40 PM
Created By:	Woodford, John B.

Creator

Badge:	**51790**	Name:	**Woodford, John B.**
Cost Center:	**254**	Division:	**ESH**
Job Title:	**Safety Specialist 5**	Employee Type:	**Regular Full-Time Exempt**
Building:	**208**	Lab Extension:	**2-0910**

General Information

Project/Activity Title: A Zero-Emission Process for Direct Reduction of Iron by Hydrogen Plasma in a Rotary Kiln Reactor

ASO NEPA Tracking No.:

Type of Funding: ARPA-E

B & R Code: CJ0100000

Identifying Number: CJ0100000

SPP Proposal Number:

CRADA Proposal Number:

Work Project Number:

ANL Accounting Number:

(Item 3a in Field Work Proposal)

Other (explain): Project Code PRJ1010168

List appropriate NEPA Owners:

Division: NSE NEPA Owner:

Financial Plans

To select a Financial Plan, click the magnifying glass icon to open a search window.

Cost Center: Project: Phase: Task:

Description of Proposed Action

This project is intended to demonstrate a continuous hydrogen plasma process for reducing iron ore to iron. It would be conducted in two parts: in the first part, a hydrogen plasma nozzle, using radiofrequency (RF) between 20 kHz and 13.6 MHz to generate the plasma, would be designed and tested with small amounts (<1.5 kg) of iron ore. Once the plasma nozzle had been tested and optimized, the second part would consist of construction and testing of a rotary kiln reactor. In this design, granulated/powdered iron ore would be fed in from the top of the slanted (slant angle <20°) rotary kiln, while hydrogen gas is fed in from the bottom of the kiln. Hydrogen plasma jets would impinge on the iron ore as it slid down the rotating kiln body, reducing the iron oxide to iron metal and releasing water vapor. Iron metal sponge would exit the kiln from the bottom, while excess hydrogen and water vapor would exit from the top. The exhaust gas stream would pass through a condenser to remove water vapor for later measurement, while the remaining hydrogen would be routed to building exhaust. It is possible that nitrogen or argon would be used as a sweep gas in the exhaust stream, to ensure that the concentration of hydrogen in air did not exceed the lower explosive limit at any point. The target production rate for the rotary kiln apparatus is 1 kg iron metal per hour, over 1-2 hours. This would require up to 3.5-4 kg iron ore as feedstock, which exceeds the bench-scale weight limit. In addition to the iron ore, the rotary kiln would require 17 L hydrogen gas per minute, exhausting up to 7 L per minute. The rotary kiln would be 3.5 meters in length.

Description of Affected Environment

The research work is proposed to take place in Room G-275 in Bldg. 212. A survey by Argonne subject matter experts in fire protection, industrial hygiene, and nonionizing radiation (RF), as well as Infrastructure Services HVAC engineers have evaluated the room for suitability and have found that it has adequate power and ventilation, and the RF field should not interfere with work in the surrounding laboratories.

Potential Environmental Effects

- Attach explanation for each "yes" response near bottom of form.
- **See Instructions for Completing Environmental Review Form.**

	Section A (Complete For All Projects)	Yes	No	Explanation
1.	Project evaluated for Pollution Prevention and Waste Minimization opportunities and details provided under items 2, 4, 6, 7, 8, 16, and 20 below, as applicable	◉	○	The only emission from the rotary kiln should be excess hydrogen.
2.	Air Pollutant Emissions	◉	○	Impurities in the iron ore may react with hydrogen to form toxic materials--primarily hydrogen sulfide from sulfur compounds in the ore. The production rate of hydrogen sulfide is expected to be below EPA limits. Although the production of phosphine (PH3) from iron phosphide is not thermodynamically favored (equilibrium coefficient of 1.4E-08 at 1000°C), Argonne Industrial Hygiene would survey for it.
3.	Noise	○	◉	
4.	Chemical/Oil Storage/Use	◉	○	Hydrogen gas and iron ore would be used as feed materials, and argon or nitrogen may be used as a sweep gas in the exhaust.
5.	Pesticide Use	○	◉	
6.	**Toxic Substances Control Act (TSCA) Substances**			
6a.	Polychlorinated Biphenyls (PCBs)	○	◉	
6b.	Asbestos or Asbestos Containing Materials	○	◉	
6c.	Other TSCA Regulated Substances	○	◉	
6d.	Import or Export of Chemical Substances	○	◉	
7.	Biohazards	○	◉	
8.	Effluent/Wastewater (If yes, see question #12 and contact Peter Lynch (HSE) at 2-4582 or lynch@anl.gov)	○	◉	
9.	**Waste Management**			
9a.	Construction or Demolition Waste	○	◉	
9b.	Hazardous Waste	◉	○	If necessary, the exhaust gas would pass through a water scrubber to trap hydrogen sulfide; the scrubber contents would be disposed of as hazardous waste.
9c.	Radioactive Mixed Waste	○	◉	
9d.	Radioactive Waste	○	◉	
9e.	Asbestos Waste	○	◉	
9f.	Biological Waste	○	◉	
9g.	No Path to Disposal Waste	○	◉	
9h.	Nano-material Waste	○	◉	
10.	Radiation	○	◉	
11.	Threatened Violation of ES&H Regulations or Permit Requirement	○	◉	
12.	New or Modified Federal or State Permits	○	◉	
13.	Siting, Construction, or Major Modification of Facility to Recover,	○	◉	

	Treat, Store, or Dispose of Waste			
14.	Public Controversy	○	◉	
15.	Historic Structures and Objects	○	◉	
16.	Disturbance of Pre-existing Contamination	○	◉	
17.	Energy Efficiency, Resource Conserving, and Sustainable Design Features	◉	○	The design of the rotary kiln would minimize the need for external heating.
Section B (For Projects that Occur Outdoors)		**Yes**	**No**	
18.	Threatened or Endangered Species, Critical Habitats, and/or other Protected Species	○	○	
19.	Wetlands	○	○	
20.	Floodplain	○	○	
21.	Landscaping	○	○	
22.	Navigable Air Space	○	○	
23.	Clearing or Excavation	○	○	
24.	Archaeological Resources	○	○	
25.	Underground Injection	○	○	
26.	Underground Storage Tanks	○	○	
27.	Public Utilities or Services	○	○	
28.	Depletion of a Non-Renewable Resource	○	○	
Section C (For Projects Outside of ANL)		**Yes**	**No**	
29.	Prime, Unique, or Locally Important Farmland	○	○	
30.	Special Sources of Groundwater (such as sole source aquifer)	○	○	
31.	Coastal Zones	○	○	
32.	Areas with Special National Designations (such as National Forests, Parks, or Trails)	○	○	
33.	Action of a State Agency in a State with NEPA-type Law	○	○	
34.	Class I Air Quality Control Region	○	○	

Categorical Exclusion

Other (Use field below to enter other categorical exclusion)

App B3.6 Small-scale research and development, laboratory operations, and pilot projects

ANL NEPA Reviewer Use Only

○ My approval is the final approval necessary

◉ This form requires additional approval from DOE

To be Completed by DOE/ASO

Section D	Yes	No
Are there any extraordinary circumstances related to the proposal that may affect the significance of the environmental effects of the proposal?	○	◉
Is the project connected to other actions with potentially significant impacts or related to other proposed action with cumulatively significant impacts?	○	◉
If yes, is a categorical exclusion determination precluded by 40 CFR 1506.1 or 10 CFR 1021.211?	○	○

Can the project or activity be categorically excluded from preparation of an Environment Assessment or Environmental Impact Statement under Subpart D of the DOE NEPA Regulations?	◉	○

If yes, indicate the class or classes of action from Appendix A or B of Subpart D under which the project may be excluded:

This experiment may be excluded under the following class of action from Appendix B to 10 CFR Part 1021, Subpart D: B3.6 Small-scale research and development, laboratory operations, and pilot projects.

If no, indicate the NEPA recommendation and class(es) of action from Appendix C or D to Subpart D to Part 1021 of 10 CFR.

Attachments

File Description:

Comments

Add Approver

Approver Name	Approver Badge	Reason	Delete
Pfeiffer, Mark Albert	232188	Air emissions reviewer	
Zeng, Zuotao	52635	Co-PI	
Kopasz, John P.	35889	Co-PI	

Notifications

The approval notification email will be copied to the people listed below.

Badge	Name	Division	Delete

ASO-CX Number

ASO-CX- 394

Comments:

This DOE approval of the NEPA ERF CX is tracked as ASO-CX-394.

Approval

Approver	Action	Date Routed	Action Date	Approval Reason / Comments	Approval Type
Woodford, John B.	APPROVED	2022-05-10	2022-05-10 11:41:06.0	Creator :	PRIMARY
Woodford, John B.	APPROVED	2022-05-10	2022-05-10 11:41:06.0	Project Manager :	PRIMARY
Kopasz, John P.	APPROVED	2022-05-10	2022-05-10 13:25:08.0	Co-PI :	PRIMARY
Zeng, Zuotao	APPROVED	2022-05-10	2022-05-10 17:57:22.0	Co-PI :	PRIMARY
Pfeiffer, Mark Albert	APPROVED	2022-05-10	2022-05-11 09:06:22.0	Air emissions reviewer :	PRIMARY
Harris, Amy M.	APPROVED	2022-05-11	2022-05-11 09:23:05.0	NEPA Owner Approval for Argonne Environmental Review :	PRIMARY
Ptak, Jill S.	APPROVED	2022-05-11	2022-05-11 09:48:19.0	ANL NEPA Reviewer : **Expected project duration to be 2 years**	PRIMARY
Hellman, Karen B.	APPROVED	2022-05-11	2022-05-16 15:56:16.0	ANL-985 Review and Approval :	PRIMARY

Dunn, Michael W.	APPROVED	2022-05-16	2022-05-16 16:33:51.0	ANL-985 ANL Deputy COO Review and Approval :	PRIMARY
Joshi, Kaushik N.	APPROVED	2022-05-16	2022-05-19 11:39:39.0	ANL-985 DOE-ASO Review and Approval : **This DOE approval of NEPA ERF CX is tracked as ASO-CX-394.**	PRIMARY
Siebach, Peter Rudolf	APPROVED	2022-05-19	2022-05-22 17:55:09.0	ANL-985 DOE NEPA Compliance Officer Review and Approval :	PRIMARY