

DOE-ID NEPA CX DETERMINATION

SECTION A. Project Title: Recovery of Rare-Earth Elements (Nd, Gd, Sm) in Oxide Wasteform Using Liquid Metals (Bi, Sn) – Penn State University

SECTION B. Project Description

Penn State University, in collaboration with Argonne National Laboratory, proposes a new approach for recovering rare-earth fission products (Nd, Gd, and Sm) from molten chlorides (LiCl-KCl eutectic) using liquid metals (Bi and Sn). This work specifically aims to develop an efficient rare-earth recovery process by determining (1) the thermodynamic and electrochemical properties of rare-earth metals (Nd, Gd, and Sm) in liquid metals (Bi and Sn) in molten LiCl-KCl; (2) predictive thermodynamic models of multi-component alloys to identify optimal liquid metal compositions for maximum recovery yield using computational modeling (e.g., high throughput calculation of phase diagram modeling and high throughput first-principles calculations); and (3) the overall rare-earth recovery efficiency from the electrochemical separation into liquid metal electrodes to the conversion process into rare-earth oxides.

SECTION C. Environmental Aspects / Potential Sources of Impact

Chemical Use/Storage/Waste Disposal and Hazardous Waste Generation – The proposed research will use laboratory chemicals such as halide salts and rare-earth metals for electrochemical experiments. The moisture-sensitive chemicals of halide salts (e.g., LiCl, KCl) and rare-earth metals (Nd, Gd, and Sm) will be stored in insert, argon-filled gloveboxes. Non-reactive chemicals, such as bismuth, tin, tungsten, and platinum metals, will be stored in a flammable resistant cabinet and will be used in a chemical fume hood. The chemical inventory will be updated periodically to ensure safe use and handling of chemicals. Typical electrochemical experiments will use approximately 50 grams of halide salt mixture (LiCl-KCl), 10 grams of metal (Bi and Sn), and 2 grams of rare-earth metals (Nd, Gd, and Sm). The preparation and measurement of the experiments will be performed under an inert argon atmosphere. The chemical waste generation and disposal will be conducted under the procedures and guidelines of the Environmental Health and Safety (ESH) Policy at Penn State University and the partnering institutions.

SECTION D. Determine the Level of Environmental Review (or Documentation) and Reference(s): Identify the applicable categorical exclusion from 10 CFR 1021, Appendix B, give the appropriate justification, and the approval date.

Note: For Categorical Exclusions (CXs) the proposed action must not: 1) threaten a violation of applicable statutory, regulatory, or permit requirements for environmental, safety, and health, including requirements of DOE orders; 2) require siting and construction or major expansion of waste storage, disposal, recovery, or treatment facilities; 3) disturb hazardous substances, pollutants, contaminants, or CERCLA-excluded petroleum and natural gas products that pre-exist in the environment such that there would be uncontrolled or unpermitted releases; 4) adversely affect environmentally sensitive resources. In addition, no extraordinary circumstances related to the proposal exist which would affect the significance of the action, and the action is not “connected” nor “related” (40 CFR 1508.25(a)(1) and (2), respectively) to other actions with potentially or cumulatively significant impacts.

References: B3.6 Siting, construction, modification, operation, and decommissioning of facilities for small-scale research and development projects; conventional laboratory operations (such as preparation of chemical standards and sample analysis); and small-scale pilot projects (generally less than 2 years) frequently conducted to verify a concept before demonstration actions, provided that construction or modification would be within or contiguous to a previously disturbed or developed area (where active utilities and currently used roads are readily accessible). Not included in this category are demonstration actions, meaning actions that are undertaken at a scale to show whether a technology would be viable on a larger scale and suitable for commercial development.

Justification: The activity consists of university-scale research activities to accelerate the development of rare-earth recovery processes.

Is the project funded by the American Recovery and Reinvestment Act of 2009 (Recovery Act) Yes No

Approved by Jason Sturm, DOE-ID NEPA Compliance Officer on 08/03/2018