

SECTION A. Project Title: Alloying Agents to Stabilize Lanthanides Against Fuel Cladding Chemical Interaction: Tellurium and Antimony Studies – Ohio State University

SECTION B. Project Description

Ohio State University proposes to develop new minor additives which can form high-temperature stabilizing compounds with lanthanide fission products during operation. The proposed additives are expected to have the capability of immobilizing lanthanide fission products and preventing their transport to the fuel surface. The proposed research focuses on the optimization of the metallic fuel alloys using an integral approach, by the following steps:

1. Available fundamental thermodynamic data in the lanthanide-Te/Sb binary systems will be collected to identify the gap of the data, then the unknown parameters (e.g. thermodynamic properties) will be experimentally measured. The microstructures of U-Zr fuel with Te and lanthanides, especially, the ternary system U-Zr/Te/lanthanide, will be experimentally investigated. Diffusion couple testing of selected systems will be conducted.
2. The CALPHAD (Calculation Coupling of Phase Diagrams and Thermochemistry) method will be applied to develop ternary phase diagrams based on the proposed experimental studies, as well as previous knowledge for these systems.
3. A phase field model written in MARMOT will be developed, to identify potential metallic fuel performance improvements through the optimization of the metallic fuel alloys, and to enhance the ability of MARMOT to model metallic fuel performance.

SECTION C. Environmental Aspects / Potential Sources of Impact

Radioactive Material Use/Radioactive Waste Generation/Mixed Waste Generation/Chemical Waste Disposal – The project will perform coupling diffusion tests using U-Zr alloy (depleted uranium) provided by MIT and INL. All the metallic alloys after experiments will be disposed following OSU's Environmental Health and Safety (EHS) rules. The OSU lab has the license to handle depleted uranium. All experiments will be conducted in a glove box which can effectively shield the depleted uranium radiation. All chemical wastes and mixed waste generated will be disposed following OSU EHS rules.

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 aimed at investigating the mechanisms of using minor additives to stabilize and immobilize the lanthanide fission products.

Approved by Jack Depperschmidt, DOE-ID NEPA Compliance Officer on 08/22/2016