**Department of Energy**
Argonne Site Office
9800 South Cass Avenue
Argonne, Illinois 60439

MAY 0 3 2011

Dr. Eric Isaacs
Director, Argonne National Laboratory
President, UChicago Argonne, LLC
9700 South Cass Avenue
Argonne, IL 60439

Dear Dr. Isaacs:

SUBJECT: NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) DETERMINATION FOR ARGONNE NATIONAL LABORATORY (ANL)

Argonne Site Office (ASO) has approved the following as a categorical exclusion (CX) under the category of "B 3.6 Siting/construction/operation/decommissioning of facilities for bench-scale research, conventional laboratory operations, small-scale research and development and pilot projects".

- Building 315 Experiments to Demonstrate Ex-Vessel Core Coolability under Early Cavity Flooding Conditions (ASO-CX-283)

Therefore, no further NEPA review is required. However, if any modification or an expansion of the scope is made to the above project, additional NEPA review will be necessary.

Enclosed please find a copy of the approved Environmental Review Form (ERF) for the project. If you have any questions please contact Kaushik Joshi of my staff at (630) 252-4226.

Sincerely,

for Dr. Joanna M. Livengood
Manager

Enclosure:
As Stated

cc: M. Kamiya, ANL/ESQ, 201, w/encl.
M. Farmer, ANL/NE, 206, w/encl.
W. Brocker, ANL/ESA, 208, w/encl.

## Environmental Review Form for Argonne National Laboratory

Click on the blue question marks (?) for instructions, contacts, and additional information on specific line items.

(?)**Project/Activity Title**: Experiments to Demonstrate Ex-Vessel Core Coolability under Early Cavity Flooding Conditions

(?)**ASO NEPA Tracking No**. _____ (?)**Type of Funding**: WFO
B&R Code _____

(?)**Identifying number**: _____ WFO proposal # P-11065 & P-11073 CRADA proposal # _____
Work Project # _____ ANL accounting # (item 3a in Field Work Proposal) _____
Other (explain) _____

(?)**Project Manager**: M. T. Farmer Signature: [signature] Date: 4/26/2011

(?)**NEPA Owner**: W. R. Brocker Signature: [signature] Date: 4/26/2011

ANL NEPA Reviewer: *M. A. Kamiya* Signature: [signature] Date: 4/27/2011

**I.** (?)**Description of Proposed Action:**

This project focuses on providing additional test data to illuminate a key area: demonstration that a core melt interacting with concrete can be stabilized with early direct top flooding. Test results will be compared to model results derived using severe accident codes to simulate Molten Core-Concrete Interaction (MCCI). Specific tasks are as follows:

At least two large-scale tests (~1000 kg core melt mass) will be conducted in Bldg 315, Cell 4. The core melt mass consists of depleted uranium oxide (U3O8), zirconium, and chromium (VI) oxide (CrO3) in a concrete mold with magnesium oxide sidewalls. Although the precise melt mass formulation has not yet been set, it should be on the order of 65 wt% U3O8, 19 wt% zirconium, and 12 wt% CrO3, with small quantities of other materials (Si, SiO2, Al, CaO) making up the balance. Initial heating is accomplished via the redox reaction between the main components, rapidly raising the temperature of the mass to ~2300°C. Thereafter, decay heat is simulated through the use of direct electrical heating of the oxide melt. Once the target heating power (sufficient to achieve an initial heat flux of 150 kW/square meter) is reached, the melt will be flooded with water from above. The test is run either until the melt is quenched or a maximum concrete ablation depth has been reached. At that point, heater power will be shut off.

Following the experiment, the apparatus will be disassembled to document the post-test debris configuration. Ultimately, the quenched melt and the concrete mold will be disposed of as radioactive waste, although samples may be retained for some time to facilitate further examination if necessary. The MgO sidewalls will be cleaned and reused.

The test chamber was originally designed for the Zero Power Reactor (ZPR), and has substantial safety features such as HEPA-filtered ventilation, reinforced ventilation ducts to protect against steam explosions, and three- to four-foot-thick reinforced concrete walls. A hazards analysis showed that the test chamber would survive a steam explosion caused by interaction between water and a melt massing over 2000 kg, so the proposed tests will not challenge that. In addition, tests are performed under inert cover gas purges to ensure that explosive mixtures of hydrogen will not develop during reactions between the water and the melt mass.

Ancillary tasks related to the test include preparation of the concrete mold (basemat and two sidewalls), performed in the Bldg 206 High Bay; preparation of the melt mixture, performed in the walk-in hood in Bldg 315, Cell 6; and loading the mold, performed in Bldg 315, Cell 4. If the project sponsor requests a change in the melt mixture formulation, small amounts of the new

mixture will be prepared in Bldg 206, Room B133, a radiological laboratory. These will be reacted in a ventilated chamber attached to the scrubber system in the Bldg 206 High Bay.

If necessary, additional tests will be performed.

The water used in the experiment will be captured in tanks in Cell 4 and reused in future tests, if necessary. Otherwise, it will be allowed to evaporate and any solid residue will be disposed of appropriately.

**II.** (?)**Description of Affected Environment:**

Bldg 315, Cell 4 and Cell 6; Bldg 206, B133 and High Bay. The Melt Attack Coolability Experiment (MACE) is a permitted radiological emission unit in Building 315. Cell 4 is one of the old Zero Power Reactor test chambers, with HEPA-filtered exhaust and 3-4 foot thick walls; Cell 6 is a more conventional laboratory space with a walk-in hood for operations with the loose melt mix. Building 206 room B133 is a radiological laboratory. The Bldg 206 High Bay is a standard high bay space, with a scrubber system and burn booth designed for passivation of radioactively-contaminated alkali metals.

**III.** (?)**Potential Environmental Effects:** (Attach explanation for each "yes" response. **See Instructions for Completing Environmental Review Form)**

**A. Complete Section A for all projects.**

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. Waste is minimized by reusing most test section components, by using the appropriate amounts of melt mixture, and by capturing and reusing the quench water. Yes X No ____

2. (?)Air Pollutant Emissions Yes X No ____
   Particulate emissions (sparks and smoke) will take place during the test. As noted above, gases are filtered twice in quench tanks before exiting the test chamber and exhausting through HEPA-filters, precluding significant air emissions outside the test chamber. The Melt Attack Coolability Experiment (MACE) is a permitted radiological emission unit in Building 315.

3. (?)Noise Yes X No ____
   The reaction and water quenching can be quite loud. However, no personnel are allowed to be inside the test chamber during the test, and the thick chamber walls prevent significant noise levels outside the test chamber.

4. (?)Chemical/Oil Storage/Use Yes ____ No X
   The melt constituents include depleted uranium oxide, zirconium metal, and chromium (VI) oxide, all in granular form.

5. (?)Pesticide Use Yes ____ No X

6. (?) Polychlorinated Biphenyls (PCBs) Yes ____ No X

7. (?) Biohazards Yes ____ No X

8. (?)Liquid Effluent (wastewater) — Yes X No ____

9. (?)Waste Management

   a) Construction or Demolition Waste — Yes ____ No X
   b) Hazardous Waste — Yes X No ____
   c) Radioactive Mixed Waste — Yes X No ____
   Chromium (VI) oxide is a suspect human carcinogen and hazardous waste. Although the majority of waste from handling it is mixed waste, it is possible that items may be contaminated only with chromium oxide.

   Unreacted melt mixes are both radioactive and hazardous (carcinogenic). Only the amount needed will be prepared, but approximately 5 cu. ft. mixed waste is expected. This waste is largely contaminated personal protective equipment; work on this material is performed in Tyvek suits with gloves and respirators, and the suits and gloves are disposed of afterwards as mixed waste.
   d) Radioactive Waste — Yes X No ____
   The final product is radioactive due to the presence of depleted uranium oxide, but based on the intensity of radiation will be treated as Low-Level Waste (LLW). It is no longer considered mixed waste because all of the chromium (VI) oxide reacts to form Cr metal and/or chromium (III) oxide, neither of which are carcinogenic. In previous test runs, TCLP tests have confirmed the lack of hexavalent chromium in the leachate.
   e) PCB or Asbestos Waste — Yes ____ No X
   f) Biological Waste — Yes ____ No X
   g) No Path to Disposal Waste — Yes ____ No X
   h) Nano-material Waste — Yes ____ No X

10. (?)Radiation — Yes X No ____
    Depleted uranium compounds are radioactive. All significant operations involving the use of these compounds, in melt mixes and elsewhere, take place with ESQ-Health Physics support. The samples would be stored in a radiation controlled area using the applicable LMS procedures.

11. (?)Threatened Violation of ES&H Regulations or Permit Requirements — Yes ____ No X

12. (?)New or Modified Federal or State Permits — Yes ____ No X

13. (?)Siting, Construction, or Major Modification of Facility to Recover, Treat, Store, or Dispose of Waste — Yes ____ No X

14. (?)Public Controversy — Yes ____ No X

15. (?)Historic Structures and Objects — Yes ____ No X

16. (?)Disturbance of Pre-existing Contamination — Yes ____ No X

17. (?)Energy Efficiency, Resource Conserving, and Sustainable Design Features — Yes ____ No X

**B. For projects that will occur outdoors, complete Section B as well as Section A.**

18. (?)Threatened or Endangered Species, Critical Habitats, and/or other Protected Species — Yes ____ No ____
19. (?)Wetlands — Yes ____ No ____
20. (?)Floodplain — Yes ____ No ____
21. (?)Landscaping — Yes ____ No ____
22. (?)Navigable Air Space — Yes ____ No ____
23. (?)Clearing or Excavation — Yes ____ No ____
24. (?)Archaeological Resources — Yes ____ No ____
25. (?)Underground Injection — Yes ____ No ____
26. (?)Underground Storage Tanks — Yes ____ No ____
27. (?)Public Utilities or Services — Yes ____ No ____
28. (?)Depletion of a Non-Renewable Resource — Yes ____ No ____

**C. For projects occurring outside of ANL complete Section C as well as Sections A and B.**

29. (?)Prime, Unique, or Locally Important Farmland — Yes ____ No ____
30. (?)Special Sources of Groundwater (such as sole source aquifer) — Yes ____ No ____
31. (?)Coastal Zones — Yes ____ No ____
32. (?)Areas with Special National Designations (such as National Forests, Parks, or Trails) — Yes ____ No ____
33. (?)Action of a State Agency in a State with NEPA-type Law — Yes ____ No ____
34. (?)Class I Air Quality Control Region — Yes ____ No ____

## IV. Subpart D Determination: (to be completed by DOE/ASO)

Are there any extraordinary circumstances related to the proposal that may affect the significance of the environmental effects of the proposal? — Yes ____ No X

Is the project connected to other actions with potentially significant impacts or related to other proposed action with cumulatively significant impacts? — Yes ____ No X

If yes, is a categorical exclusion determination precluded by 40 CFR 1506.1 or 10 CFR 1021.211? — Yes ____ No ____

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? — Yes X No ____

If yes, indicate the class or classes of action from Appendix A or B of Subpart D under which the project may be excluded. APPENDIX B, "B 3.6 Siting/construction/operation/ decommissioning of facilities for bench-scale research, conventional laboratory operations, small-scale research and development 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.

**ASO NEPA Coordinator Review:** Kaushik N. Joshi

Signature: KNJoshi Date: 4-29-11

**ASO NCO Approval of CX Determination:**

The preceding pages are a record of documentation that an action may be categorically excluded from further NEPA review under DOE NEPA Regulation 10 CFR Part 1021.400. I have determined that the proposed action meets the requirements for the Categorical Exclusion identified above.

Signature: Date: 4/29/11

Peter R. Siebach
Acting Argonne Site Office NCO

**ASO NCO EA or EIS Recommendation:**

Class of Action: _____

Signature: _____ Date: _____

Peter R. Siebach
Acting Argonne Site Office NCO

**Concurrence with EA or EIS Recommendation:**

**CH GLD:** _____

Signature: _____ Date: _____

**ASO Manager Approval of EA or EIS Recommendation:**

An ____ EA ____ EIS shall be prepared for the proposed _____ and

_____ shall serve as the document manager.

Signature: for Dr. Joanna M. Livengood Date: 5/3/11

Manager