DOE-ID NEPA CX DETERMINATION
Idaho National Laboratory

CX Posting No.: DOE-ID-INL-20-013

SECTION A. Project Title: Installing and Operating the TerraPower Flow Loop

SECTION B. Project Description and Purpose:

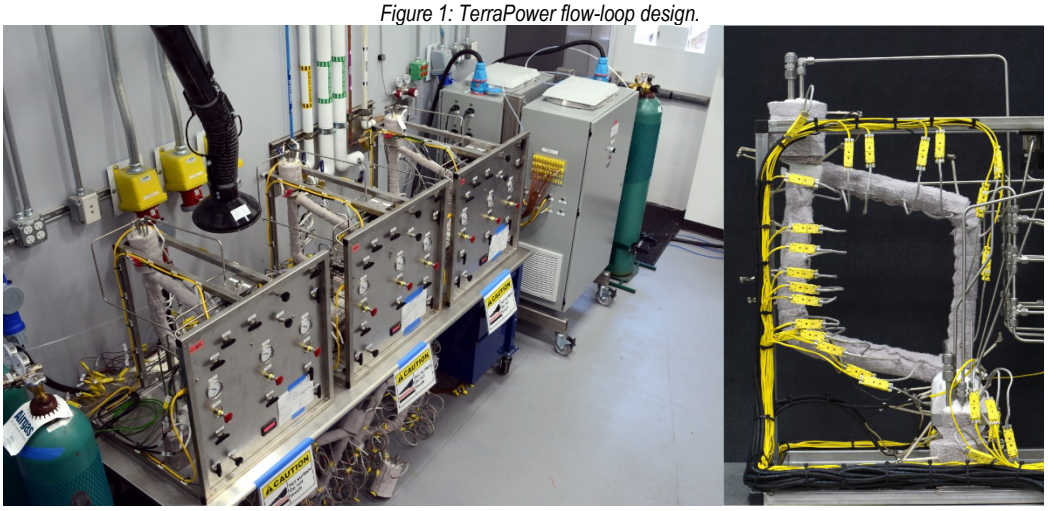
Molten chloride fast reactor (MCFR) technology presents a potential low-cost reactor that can operate safely in high-temperature regimes. The MCFR design is a type of molten salt reactor (MSR). TerraPower synthesizes and purifies molten chloride salt to support various MCFR technology experiments to assess corrosion rates on various structural materials. TerraPower has operated more than 40 flow-loops using coolant salt (NaCl-MgCl2) and uranium bearing salt to generate materials data. To improve the technical readiness level for the MCFR, TerraPower needs to operate a plutonium salt flow loop and evaluate material performance following flow loop operation.

TerraPower proposes to send to Idaho National Laboratory (INL) a flow-loop, which will be filled with about 400g of eutectic $PuCl_3$-NaCl, requiring about 200g Pu as the starting material. INL synthesizes the eutectic salt in the Fuel Manufacturing Facility (FMF) at the Materials and Fuels Complex (MFC). During the first step of synthesizing the eutectic salt, INL hydrides the plutonium metal using the Advanced Fuel Cycle Initiative (AFCI) Sintering Furnace. The next step transfers the plutonium hydride to a new jeweler furnace that will be installed in the AFCI Glovebox where the hydride is reacted with NaCl in a simple chlorination process.

INL proposes to install the loop at window 10 in the Fuel Conditioning Facility (FCF) and load the loop with salt, flush and pressurize the system, and operate the loop at temperatures between 600 - 740°C for at least 2,000 hours to quantify corrosion rates. INL will then drain and section the loop for imaging and analysis at the Irradiated Materials Characterization Laboratory (IMCL) to quantify surface corrosion. The rabbit transfer system at MFC ships corrosion samples generated at FCF to the Hot Fuels Examination Facility (HFEF) for sample preparation then from HFEF to IMCL for characterization.

Under the proposed action, TerraPower supplies and ships the flow-loop and associated control systems to INL where INL will modify the flow-loop and control system for remote operation in FCF. The loop as designed measures about 2.5 ft x 2.5ft x 2.5 ft (see Figure 1).

Figure 1: TerraPower flow-loop design.



The major tasks associated with the proposed action are broken down as follows and many of the task running concurrently:

<u>$PuCl_3$-NaCl SALT SYNTHESIS AT FMF</u>

- Prepare experimental plan
- Author new Laboratory Instruction (LI) for salt synthesis in the AFCI Glovebox
- Obtain Unreviewed Safety Question (USQ) approval and authorization to proceed from FMF
- Procure new furnace internals, i.e. crucibles
- Perform synthesis operations in FMF
- Take salt samples
- Ship samples to the MFC Analytical Laboratory for analysis
- Obtain analytical results to verify salt synthesis purity.

<u>PLUTONIUM CHLORIDE SHIPMENT FROM FMF TO FCF</u>

- Revise LST-390 “Fuel Conditioning Facility (MFC-765) Criticality Control List” for receipt of the 6M drum at FCF.
- Revise SD-30.1.3 “FCF Fissionable Material User Rules.”
- Revise FCF-OI-1302 “Material Control and Accountability.”

- Author new OI (procedure) for 6M drum receipt at FCF.
- Complete FRM-381 "Radiological Material Transfer Form."
- Complete FRM-790 "Transfer of HC-3 or Greater Quantity of Hazardous Material in Non-DOT-Certified Packaging."
- Complete an Engineering Calculation and Analysis Report (ECAR).
- Perform USQ (nuclear safety screening) for each form change.
- Load plutonium payload into the 6M drum at FMF. $PuCl_3$ is packaged in a small Improved Gavin Can (IGC) and overpacked with a crimp seal quart can or a paint lid quart can.
- Transfer 6M drum payload from FMF to FCF.
- Receive payload at FCF and transfer container into FCF main cell.

INSTALLING AND OPERATING THE TERRAPOWER FLOW LOOP

- Engineering documentation (EJ process)
- Complete electrical engineering design
- Generate electrical drawings
- Fabricate out-of-cell and in-cell-cables for interfacing with hot cell feedthroughs
- Modify the flow loop to allow remote control of the system
- Assemble and test the flow loop (Phase 1 testing)
- Write Phase 2 Equipment Qualification Procedure (EQP) for performing remote qualification testing
- Complete Phase 2 qualification in remote mockup facility
- Write Phase 3 EQP (procedure) for performing in-cell final qualification
- Write ECAR for lifting attachments for hoisting the equipment into the FCF hot cell
- Perform USQ
- Write new procedure for operating the flow loop in the hot cell
- Develop training documentation for FCF operators
- Load flow loop with salt
- Operate flow loop
- Terminate flow loop run
- Disassemble flow loop
- Cut samples from flow loop for analysis
- Ship samples to HFEF containment box for sample preparation
- Complete FRM-381 "Radiological Material Transfer Form"
- Complete FRM-15031 "Radiological Control/Containment Determination"
- Complete FRM-1563 "IMCL Sample Request Form"
- Complete FRM-1483 "Approval Form: Radioactive Material Receipts into IMCL"
- Transfer samples to IMCL
- Perform energy dispersive x-ray spectroscopy (EDS)/ scanning electron microscopy (SEM) at IMCL
- Complete FRM-434.40 "MFC Analytical Laboratory Analysis Request Form"
- Complete FRM-381 "Radiological Material Transfer Form"
- Transfer samples to AL
- Characterize salt at AL.

WASTE MANAGEMENT

- Cut remaining flow loop into small pieces
- Remove salt from loop tubing
- Place salt in closed-metal container storage for future research activities
- Disposition flow loop as remote-handled mixed low-level waste (all FCF hot cell waste is assumed Cd–contaminated).

Nearly all plutonium at MFC was supplied by defense programs. MFC involvement with defense-related programs and materials has been continuous since the earliest days of operation. MFC facilities that are qualified for plutonium handling, including FMF and HFEF, are contaminated with transuranics from these programs.

Waste associated with project activities is eligible for disposal at the Waste Isolation Pilot Plant (WIPP). National Environmental Policy Act (NEPA) coverage for the transportation and disposal of waste to WIPP are found in the *Final Waste Management Programmatic Environmental Impact Statement [WM PEIS]* (DOE/EIS-0200-F, May 1997) and *Waste Isolation Plant Disposal Phase Supplemental EIS* (SEIS-II) (DOE/EIS-0026-S-2, Sept. 1997), respectively. The 1990 ROD also stated that a more detailed analysis of the impacts of processing and handling transuranic (TRU) waste at the generator-storage facilities would be conducted. The Department has analyzed TRU waste management activities in the *Final Waste Management Programmatic Environmental Impact Statement* (WM PEIS) (DOE/EIS-200-F, May 1997). The WM PEIS analyzes environmental impacts at the potential locations of treatment and storage sites

for TRU waste; SEIS-II addresses impacts associated with alternative treatment methods, the disposal of TRU waste at WIPP and alternatives to that disposal, and the transportation to WIPP.

There is the potential to generate low level waste (LLW). The environmental impacts of transferring LLW from the INL Site to the Nevada National Security Site were analyzed in the 2014 *Final Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada* (DOE/EIS-0426) and DOE's *Waste Management Programmatic EIS* (DOE/EIS-200). The fourth Record of Decision (ROD) (65 FR 10061, February 25, 2000) for DOE's *Waste Management Programmatic EIS* established the Nevada National Security Site as one of two regional LLW and MLLW disposal sites.

Onsite disposal of RH-LLW was analyzed in the *Final Environmental Assessment for the Replacement Capability for Disposal of Remote-Handled Low-Level Radioactive Waste Generated at the Department of Energy's Idaho Site* (DOE/EA-1793, 2011).

SECTION C. Environmental Aspects or Potential Sources of Impact:

Air Emissions

Operations involving the TerraPower flow loop at FCF could result in increased radioactive air emissions from the hot cell to the FCF suspect exhaust ventilation system. The FCF suspect exhaust system is equipped with filtration and monitoring systems to prevent releasing these materials into the atmosphere. The proposed action may require an Air Permitting Applicability Determination (APAD) to determine if the PTC will need to be revised.

Disturbing Cultural or Biological Resources

The facilities at MFC have not been reviewed for eligibility to the National Register of Historic Places (NRHP); therefore, a cultural review is required.

Generating and Managing Waste

The proposed action will generate remote-handled mixed low-level waste and mixed TRU waste after operation of the flow loop. INL estimates the proposed action will generate about 0.5 ft^3 of TRU waste. Project personnel would work with WGS to properly package and transport regulated, hazardous or radioactive material or waste according to laboratory procedures.

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Releasing Contaminants

Chemicals will be used and will be submitted to chemical inventory lists with associated Safety Data Sheets (SDSs) for approval prior to use. The Facility Chemical Coordinator will enter these chemicals into the INL Chemical Management Database. All chemicals will be managed in accordance with laboratory procedures. When dispositioning surplus chemicals, project personnel must contact the facility Chemical Coordinator for disposition instructions.

Although not anticipated, there is a potential for spills when using chemicals or fueling equipment. In the event of a spill, notify facility environmental staff. If environmental staff cannot be contacted, report the release to the Spill Notification Team (208-241-6400). Clean up the spill and turn over spill cleanup materials to WGS.

Using, Reusing, and Conserving Natural Resources

All applicable waste will be diverted from disposal in the landfill when possible. Project personnel will use every opportunity to recycle, reuse, and recover materials and divert waste from the landfill when possible. The project will practice sustainable acquisition, as appropriate and practicable, by procuring construction materials that are energy efficient, water efficient, are bio-based in content, environmentally preferable, non-ozone depleting have recycled content and are non-toxic or less-toxic alternatives. New equipment will meet either the Energy Star or SNAP requirements as appropriate (see http://www.sftool.gov/GreenProcurement/ProductCategory/14).

SECTION D. Determine Recommended Level of Environmental Review, Identify Reference(s), and State Justification: Identify the applicable categorical exclusion from 10 Code of Federal Regulation (CFR) 1021, Appendix B, give the appropriate justification, and the approval date.

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, or similar requirements of Department of Energy (DOE) or Executive Orders; (2) require siting and construction or major expansion of waste storage, disposal, recovery, or treatment or facilities; (3) disturb hazardous substances, pollutants, contaminants, or Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)-excluded petroleum and natural gas products that pre-exist in the environment such that there would be uncontrolled or unpermitted releases; (4) have the potential to cause significant impacts on environmentally sensitive resources (see 10 CFR 1021). In addition, no extraordinary circumstances related to the proposal exist that would affect the significance of the action. In addition, the action is not "connected" to other action actions (40 CFR 1508.25(a)(1) and is not related to other actions with individually insignificant but cumulatively significant impacts (40 CFR 1608.27(b)(7)).

References: 10 CFR 1021, Appendix B to subpart D, items B3.6, "Small-scale research and development, laboratory operations, and pilot projects"

Final Environmental Impact Statement for the Waste Isolation Pilot Plant (DOE/EIS-0026, October 1980) and *Final Supplement Environmental Impact Statement for the Waste Isolation Pilot Plant* (SEIS-I) (DOE/EIS-0026-FS, January 1990)

Final Waste Management Programmatic Environmental Impact Statement [WM PEIS] (DOE/EIS-0200-F, May 1997) and *Waste Isolation Plant Disposal Phase Supplemental EIS* (SEIS-II) (DOE/EIS-0026-S-2, September 1997)

Final Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada (DOE/EIS-0426, December 2014)

Final Environmental Assessment for the Replacement Capability for Disposal of Remote-Handled Low-Level Radioactive Waste Generated at the Department of Energy's Idaho Site (DOE/EA-1793, 2011).

Justification: The proposed R&D activities are consistent with CX 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); 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 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 deployment."

NEPA coverage for the transportation and disposal of waste to WIPP are found *in Final Waste Management Programmatic Environmental Impact Statement [WM PEIS]* (DOE/EIS-0200-F, May 1997) and *Waste Isolation Plant Disposal Phase Supplemental EIS (SEIS-II)* (DOE/EIS-0026-S-2, Sept. 1997), respectively. The 1990 ROD also stated that a more detailed analysis of the impacts of processing and handling TRU waste at the generator-storage facilities would be conducted. The Department has analyzed TRU waste management activities in the *Final Waste Management Programmatic Environmental Impact Statement (WM PEIS)* (DOE /EIS-200-F, May 1997). The WM PEIS analyzes environmental impacts at the potential locations of treatment and storage sites for TRU waste; SEIS-II addresses impacts associated with alternative treatment methods, the disposal of TRU waste at WIPP and alternatives to that disposal, and the transportation to WIPP.

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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: 03/10/2020