DOE-ID NEPA CX DETERMINATION
Idaho National Laboratory

CX Posting No.: DOE-ID-INL-20-065

SECTION A. Project Title: HFDA Head Plate for the Dross Chlorination Experiment

SECTION B. Project Description and Purpose:

The Hot Fuels Dissolution Apparatus (HFDA) located within the hot cell of the Hot Fuels Examination Facility (HFEF) requires the headplate to be modified for the Dross Chlorination Equipment (DCE). The existing head assembly to the HFDA is regarded as inadequate for stirring the crucible contents for the DCE. The existing head-assembly has two ports that accommodate rotation and can be used to rotate electrodes or salt stirrers. The ports are off-set from center, which need a center stirrer (or scraper) that will move the solid materials on the bottom of the crucible. The new headplate will allow for constant, low speed stirring of particulate at the bottom of a heated crucible. In addition, it will have ports for inserting electrodes, feed material, sampling devices, and sensors into the salt bath, see diagrams below.

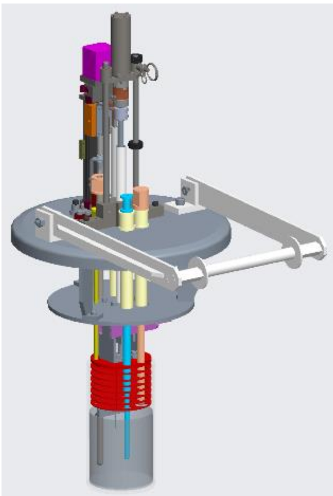
The purpose of the DCE is to chemically chlorinate dross materials that are generated during casting operations in the cathode processor and casting furnace in the Fuel Conditioning Facility. Also, the DCE may be applicable for oxidized sodium-bonded fuels. During the DCE, the crucible will be loaded with LiCl-KCl eutectic salt at temperatures between 500 to 700°C. The dross is essentially a solid powder composed of oxidized and non-oxidized metals, mostly uranium and zirconium. The dross powder and chlorinating chemicals (e.g., Zr metal and $FeCl_2$ or $NiCl_2$) will be incrementally added to the salt. Adequate stirring of the salt and solids is essential. Electrochemical measurements (e.g., cyclic voltammograms) will be taken of the salt during chlorination and salt samples will be collected. When chlorination is complete, the crucible will be transferred to a distillation furnace to distill the salt away from the remaining solids. The resulting salt and solids will be sampled for characterization. The end goal is to chlorinate the dross to put it in a chloride form for eventual waste disposal.

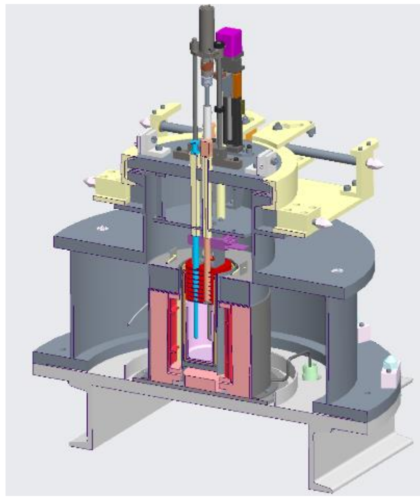
The following HFDA head plate modifications will need to be designed:

- Feed port for solids, powders, etc.
- Center stirrer port with a blade/paddle/scraper that extends to the bottom of the crucible, rotates at low rpm (e.g., 1 to 5 rpm), and covers a significant portion of the inside-diameter of the crucible.
- Thermocouple port.
- Sampling port. The feed port and the sampling port may be the same port.
- Working electrode port. The working electrode is a 1-mm-diameter wire (e.g., tungsten) that is electrically isolated from the system. The working electrode is connected to the potentiostat for taking electrochemical measurements.
- Working electrode position movement. The working electrode must move up-and-down to allow adjustment of the wetted surface area of the electrode with the salt. This is needed as an adjustment parameter for the electrochemical measurements.
- Counter electrode port. The counter electrode supports the opposing half-cell reactions occurring at the working electrode. The surface area of the counter electrode must be many times greater than the working electrode. The metal crucible containing the salt can function as the counter electrode. Or a dedicated electrode can function as the counter electrode. The counter electrode is connected to the potentiostat for taking electrochemical measurements.
- Reference electrode port. The reference electrode is the Ag/AgCl-type. The reference electrode is made from a 7/16-inch diameter mullite tube submerged in the salt. There is an existing standard design for this reference electrode. The reference electrode is connected to the potentiostat for taking electrochemical measurements.
- For electrochemical measurements, the working, counter, and reference electrodes need to be in the salt at the same time. This is the standard “three electrode arrangement” for electrochemical measurements.
- Metal crucible. All metal components in contact with the salt will likely be fabricated from ASME 387 steel (same as the Mk-IV ER) or equivalent steel. The crucible must be able to fit within the HFDA or the standard HFDA lidded outer crucible. Crucible must have remote handling hardware if not using the standard HFDA crucible.
- New internal components for the JFCS distillation furnace. These are needed as not to cross-contaminate salts between the DCE and the JFCS.
- Any electrical connections for hardware such as motors, linear slides, or other atypical electrical hardware will use any appropriate available goggins box or feedthrough with sufficient voltage and amperage ratings.
- All controls for additional electrical hardware (motor, linear slide, etc.) will be built or purchased as needed. If needed, the HFDA control cabinet may be used to control additional electronics as appropriate.
- The new headplate must fit onto the old HFDA furnace.

- The headplate design will be overall remotely operable as appropriate for HFEF operators as needed. This includes manipulation by master/slave manipulators, the EM crane, and the hot cell crane.

- The furnace must be able to accommodate and heat a salt bath (or other in-crucible materials/hardware) to a temperature of 700°C.





SECTION C. Environmental Aspects or Potential Sources of Impact:

Air Emissions

The modification of the headplate for the HFDA and operation of the HFDA in HFEF is not a modification in accordance with Idaho Administrative Procedures Act (IDAPA) 58.01.01.201 and 40 Code of Federal Regulation (CFR) 61 Subpart H. Air emissions are anticipated to be minor, and all radionuclide release data associated with this experiment will be recorded as part of the HFEF continuous stack monitor.

In 2018, the effective dose equivalent to the offsite maximally exposed individual (MEI) from all operations at the INL Site was calculated as 1.02 E-02 mrem/yr, which is 0.10% of the 10-mrem/yr federal standard and was calculated using all sources that emitted radionuclides to the environment from the INL site. The additional increment in emissions from the proposed action would not significantly change the total site-wide MEI dose. Therefore, the emissions are bounded by the analysis in the Sodium Bonded Fuel EIS, which estimated the annual cumulative doses to the maximally exposed worker, offsite maximally exposed individual (MEI), and the collective population from DOE's decision to implement the preferred alternative (DOE/EIS0306). The potential air emissions and human health impacts associated with the proposed action are bounded by the impacts presented in the Sodium Bonded Fuel EIS.

Discharging to Surface-, Storm-, or Ground Water

N/A

Disturbing Cultural or Biological Resources

HFEF is eligible for listing on the National Register of Historic Places (NRHP), and all project activities associated with the building must undergo cultural resource review (CRR).

Generating and Managing Waste

When wastes are generated, how they are disposed can adversely affect the environment. Managing wastes appropriately and responsibly and implementing recycling or reuse practices, where feasible, during project activities can reduce the potential impact on the environment.

Total project waste volume from the design, development and research performed associated with the DCE is projected to be less than 1 m^3. Non-radioactive wastes generated would include common trash, scrap metal, and possibly small amounts of hazardous waste (e.g., electronic circuit boards, solvent contaminated wipes) from the development of the headplate.

Other expected waste streams that may be generated during DCE activities in HFEF hot cell include:

Salt and solid samples that are delivered to the Analytical Laboratory (AL) for radiochemical analysis would become waste when the material has been accumulated to the point where it can be removed from HFEF in a waste can, has been terminated from safeguards and transitioned to waste management. This waste would be managed as typical AL remote-handled waste. Expected waste form is RH-TRU.

LiCl-KCL salts would be maintained at HFEF as in-process material used for ongoing research work. When determined no longer needed expected waste form is RH-TRU.

The distilled metals or solids from the distillation furnace will be put into a chloride form for eventual waste disposal. Expected waste form is RH-TRU.

Expected waste in the form of RH TRU (mentioned above) will eventually be dispositioned off-site to the Waste Isolation Pilot Plant (WIPP). The RH TRU waste is defense related since it is from the dross generated at FCF.

Releasing Contaminants

When chemicals are used during the project there is the potential for spills that could impact the environment (air, water, soil).

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. 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 materials will be reused and recycled where economically practicable. All applicable waste will be diverted from disposal in the landfill where conditions allow.

Project description indicates materials will need to be purchased or used that require sourcing materials from the environment. Being conscientious about the types of materials used could reduce the impact to our natural resources.

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)

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 Waste Isolation Pilot Plant (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 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.

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: 08/24/2020