

# DOE-ID NEPA CX DETERMINATION

## Idaho National Laboratory

### SECTION A. Project Title: Radiation Chemistry Research Gamma Irradiator Projects at EIL and FASB

### SECTION B. Project Description and Purpose:

#### Summary:

Idaho National Laboratory (INL) operates two self-contained gamma irradiators—an MDS Nordion GammaCell 220E instrument in the Fuels and Applied Sciences Building (FASB) at MFC and a Foss Therapy Services, Inc. (FTS) Model 812 in the Energy Innovations Laboratory (EIL) at the Research and Education Campus (REC). INL uses the gamma irradiators to study the interaction of gamma irradiation with materials and to quantify the effects of gamma radiolysis on those materials. This Environmental Compliance Permit (ECP) addresses projects at the INL Center for Radiation Chemistry Research using the gamma irradiators and describes the hazards and recommended tools associated with this work.

While INL irradiates stable and radioactive materials using the instrument in FASB, INL prohibits projects from irradiating radiological material at the Center for Radiation Chemistry Research at EIL. This ECP ONLY covers projects using non-radiological (stable) materials at either facility.

Techniques/processes/experiments follow three distinct steps discussed in further detail below:

#### Chemical Preparation:

Personnel use a number of sample handling techniques. Chemical preparations may be solid (e.g., an aluminum coupon), liquid (e.g., aqueous nitric acid), gaseous (e.g., acetylene), or mixtures or suspensions of these three states.

Solid systems may require additional preparation, e.g., washing, polishing, sanding, etching, etc., prior to investigation.

Projects investigate aqueous and non-aqueous liquid solutions. Typically, activities involve dissolving a solid chemical reagent in a solvent to yield a liquid mixture. Chemicals used may be classified using one or more of the following descriptions:

- non-hazardous
- hazardous
- flammable
- combustible
- irritant
- water reactive
- carcinogenic
- pyrophoric

Handling concentrated and dilute mineral acids and bases is the primary liquid system hazard. Supporting activities for solution preparation include using balances, pH meters, conductivity meters, automatic titrators, vortexers, hot plates with stirrers, constant-temperature circulating baths, and filtration equipment. Standard solutions may be prepared for acids (by dilution from concentrated acid), bases (by dilution from concentrated base), and metal and non-metal salts. Experimental solutions are typically prepared in batches up to 1 L.

Gaseous systems and systems for which controlling the gaseous environment is important (e.g., exclusion of oxygen) will be prepared using either a Schlenk line or environmental glovebag or glovebox. For example, Personnel use a custom-built Schlenk line to prepare flame-sealed glass ampules filled with mixed gases (e.g., 75 % helium, 25 % air, and 50 % relative humidity) and thread Pyrex ampules with or without sample materials to Schlenk line ports to close-off a controlled atmosphere. The ampules are subsequently flushed and filled with a gaseous atmosphere, the humidity of which is controlled by adding water, followed by freeze-thawing with liquid nitrogen, then filled with the required atmosphere. Finally, the ampules are flame-sealed to prevent loss of radiolytically generated gases, ingress of unwanted gases, and the egress of desired gases. When inert gas flow is required for chemical preparation, pressure is limited to <5 psi in glass vessels, with the line kept open to a trap, bubbler, or vacuum line.

INL has designed a test loop system to evaluate the effects of gamma radiolysis and acid hydrolysis solvents. Since solvent extraction processes must exhibit high radiolytic and hydrolytic stability, this test loop is not limited to any one solvent system but is applicable to all systems of interest. Projects may also involve static irradiations. For static irradiations personnel place a container (typically a glass vial for liquids or a metal cylinder for gases) holding the test sample (solid, liquid, or gas) in the sample chamber for irradiation. For test loop irradiations, the test sample circulates through a 'test loop' in the sample chamber. The test loop allows for the irradiation with controlled cover gases.

Evaluating the effects of radiolysis and hydrolysis on a particular solvent extraction flowsheet involve re-circulating an aqueous or organic dispersion through the solvent irradiation loop to achieve the desired absorbed gamma dose then passing the irradiated organic solvent through the scrub, strip, wash, etc., sections of the flowsheet. The re-conditioned organic solvent is then dispersed with a fresh aqueous solution and subjected to another cycle in the solvent irradiation loop. This process is repeated until a desired total absorbed dose is achieved.

#### Free Radical Production and Consumption / Reagent Degradation:

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Test samples for irradiation experiments are prepared in INL facilities at MFC or REC and transferred to FASB or EIL. Samples for static irradiation experiments include metal nitrate salts in acidic solutions and complexants dissolved in organic solvents. Acid use includes nitric acid, hydrochloric acid, phosphoric acid, and sulfuric acid. The organic solvent is typically dodecane, but other non-flammable organics, i.e., Isopar L or a similar technical grade solvent, are used.

### **Instrumental Analyses / Product Separation and Identification:**

Following irradiation, sample analysis determines composition and identifies products of radiolytic degradation. Typical analysis methods include the following:

- gas chromatography
- liquid chromatography
- mass spectrometry
- electrospray ionization mass spectrometry
- UV-visible-NIR spectroscopy
- IR/Raman spectroscopy
- NMR spectrometry.

## **SECTION C. Environmental Aspects or Potential Sources of Impact:**

### **Air Emissions**

Project activities have the potential to generate chemical emissions from the gas chromatograph. Because INL performs evaluations on a small number of samples, emissions are expected to be minimal.

### **Discharging to Surface-, Storm-, or Ground Water**

N/A

### **Disturbing Cultural or Biological Resources**

FASB is over 50 years old. However, no changes will be made to the structure or the aesthetics of the building.

### **Generating and Managing Waste**

The proposed action generates industrial and municipal waste. Municipal waste may consist of common lab waste including packaging materials (cardboard, wood, paper, etc.), wipes, samples, and other materials.

Wastes related to using the gamma irradiators is predominately PPE. All irradiated and non-irradiated materials are returned to the project for final disposition and disposal.

### **Releasing Contaminants**

Laboratory personnel would maintain chemical inventories to verify compliance with applicable codes, standards, and regulations.

### **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.

**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)-

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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, Item B3.6, "Small-scale research and development, laboratory operations, and pilot projects"

**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."

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

Approved by Jason Anderson, DOE-ID NEPA Compliance Officer on: 03/17/2021