

DOE-ID NEPA CX DETERMINATION

Idaho National Laboratory

SECTION A. Project Title: Impact of Ionizing Radiation on Reverse Osmosis Membrane Transport Properties

SECTION B. Project Description and Purpose:

The US Army Combat Capabilities Development Command (CCDC) Ground Vehicle Systems Center (GVSC) is a research and development facility for advanced technology in ground systems. One aspect of GVSC's work is development of mobile water treatment systems that provide potable water to deployed US military forces. Reverse osmosis (RO) is the primary purification technology used in these systems. These systems are prone to exposure to extreme variations in feedstock water quality due to biological, chemical, and radiological contaminants.

GVSC is interested in testing the performance of RO membranes and RO-based water treatment systems that are exposed to a variety of contaminants. In particular, GVSC has little information on the effects of ionizing radiation. Based on Idaho National Laboratory's (INL) expertise in testing potable water systems and expertise with radioactive sources and materials, GVSC wishes to engage INL to conduct testing to measure the effects of various contaminants, in particular radiological contaminants, on RO membranes and water purification systems.

The initial phase of the project will focus on reverse osmosis (RO) membrane performance when subjected to irradiation and radiological contamination. The nature of radiological constituents in water will depend on the source. For ^{90}Sr , ^{137}Cs , and most other cationic radionuclides, Army Public Health Center and sponsor testing and analysis indicate that a combination of reverse osmosis and mixed-bed ion exchange resin will achieve the necessary 5-Log₁₀ reduction from a likely challenge concentration of 5,000 $\mu\text{Ci/L}$ gross α/β . However, there is currently no fundamental understanding of the impact of ionizing radiation on polymeric membranes. This research proposes to investigate the effects of ionizing radiation on polymeric membranes' structure, properties, and mass transport. INL will provide subject matter expertise and testing to support the sponsor's project entitled, "The Impact of Ionizing Radiation on Membrane Transport Properties."

GVSC will provide membrane materials, and potentially water system components and/or entire systems, for testing. GVSC will perform baseline testing on the materials before they are sent to the INL.

INL will provide radioactive sources and/or materials for irradiating membranes and associated equipment (e.g., pumps, instrumentation) for setting up testing apparatus. Needed equipment, materials, and consumables will be procured using funds supplied by GVSC.

Initial experiments will be designed to irradiate ~1" diameter RO membrane swatches. These experiments may be as simple as exposing the swatches to a sealed rad source, or they may include circulating water containing a short-lived radionuclide (e.g., Tc-99m, Ga-66) through the swatches. The volume of water could be as much as tens of liters. In the latter case, the swatches, water, and associated equipment will be held in an appropriate rad containment area while the radioactivity recedes. Rad concentrations/intensities will be determined based on INL SME recommendations to achieve the project goals and ALARA guidelines.

Radioactive testing will be conducted at INL's (potentially the rad lab at CFA-625), or a subcontractor's (e.g., Washington State University) facilities. Subcontractor facilities would be required to possess an NRC license. Irradiated membranes and systems supplied by GVSC will be returned to GVSC for subsequent analysis once radiation levels have been verified to be below required thresholds for releasing the material/equipment. In instances where items cannot be released due to lingering radioactivity (i.e., INL RadCon free-release criteria), they will not be returned to GVSC. In instances where items do not meet the free-release criteria due to lingering radioactivity, they will be dispositioned appropriately on-site at INL as low-level waste.

Tasks:

1. Design Experiments - Assist in determining a design of experiments with an initial starting point based on the anticipated maximum challenge level of 5,000 $\mu\text{Ci/L}$ as gross alpha/beta radiation, or 5 $\mu\text{Ci/cm}^3$.
2. Refine Experiments – Determine type of exposure, intensity, and exposure time for design of experiments.
3. Execute experiments - Expose membrane swatches provided by GVSC to ionizing radiation; provide experimental data and analysis to GVSC.

Subsequent work may focus on other aspects of mobile water system performance. For example, the effects of chemical or biological contaminants may be tested. The effects of chemical, biological, and radiological (CBR) constituents on other water treatment components, such as pumps and filters, and on complete water treatment systems, may also be evaluated. Such experiments will be addressed in subsequent environmental reviews.

SECTION C. Environmental Aspects or Potential Sources of Impact:

Air Emissions

In the event a short-lived radionuclide is used, there is a potential for the release of a small amount of radioactive material to be emitted from the facility where the irradiation/contamination occurs. In the event a radioactive release occurs, an APAD will be required. The use of sealed radioactive sources, however, will not result in air emissions.

Discharging to Surface-, Storm-, or Ground Water

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Disturbing Cultural or Biological Resources

In order to satisfy the Section 106 requirements under the National Historic Preservation Act (NHPA), the CRMO has reviewed the proposed activities identified in this EC. If selected for this activity, CF-625 is considered Not Eligible based on year of construction, and is therefore not historic. Documentation of the proposed undertaking will be completed through a Cultural Resource Review Record and retained in the CRMO project files. If an alternate building is selected for these activities, additional review by the CRMO is required.

Generating and Managing Waste

Project activities would also result in the generation of small amounts of industrial waste. Samples (membranes/components) are intended to be returned to GVSC for further testing and analysis. In instances where items cannot be released to due to lingering radioactivity, they will be dispositioned appropriately as radioactive waste.

Small amounts of low-level waste could be generated in the form of personal protective equipment (PPE) and wipes. If a radioactive water solution is used to irradiate the membranes/components then a low-level waste liquid could be generated. It is expected that the solution would decay rapidly, due to the use of short-lived radionuclides to a wastestream that could be free-released.

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

Justification: The research activities in this EC are consistent with 10 CFR 1021 Appendix B to Subpart D Item 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 deployment."

The environmental impacts of transferring LLW from the INL Site to the Nevada National Security Site for disposition 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

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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.

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: 6/18/2020