University of Nebraska Lincoln

Safe Operating Procedure

(Reviewed 8/14)

SAFETY PROTOCOL: Fe-59

Use of radioactive materials requires a safety protocol be submitted to the UNL Radiation Safety Committee (RSC) for approval. This is a safety protocol. To obtain RSC approval:

- Submit an Authorization for Radioactive Material Use request for approval by the UNL RSC. Contact the UNL Radiation Safety Officer (RSO) for specific instructions.
- Agree to use this safety protocol or submit an alternative and equivalent procedure that you develop to meet your unique needs.

All radiation workers must be at least 18 years of age and have completed required radiation safety training. ***Never handle radioactive material prior to the completion of radiation safety training.***

All research protocols involving the radioactive material must be approved by the RSC.

Physical Data

- Half-life of Fe-59 = 44.6 days.
- Beta particles and gamma-rays are the primary radiation hazard.
- Major beta particle maximum energy and intensity = 466 keV (53%) and 273 keV (45%)
- Major gamma-ray energy and intensity = 1.292 MeV (43%), 1.095 MeV (56%), and 0.192 MeV (3%)
- Maximum beta range in air = 115 cm.
- Half-value layers for shielding gamma-rays = 0.94 cm (lead), 1.59 cm (iron), 4.51 cm (aluminum) and 10.58 cm (water).

Radiation Protection Procedures

1. Special equipment or procedures
   - Use transfer pipettes, spill trays, and absorbent coverings to confine contamination.
   - Volatile chemical forms should be handled in a certified fume hood.
   - Use lab coats, safety glasses, and disposable gloves.
   - Replace gloves as needed.
   - Regularly monitor and promptly decontaminate gloves and work surfaces to maintain contamination and exposures As Low As Reasonably Achievable (ALARA).

- Select gloves appropriate for chemicals handled.
- Do not work over open containers, as practical.

2. Shielding requirements
   - Handle millicurie or larger amounts behind lead shielding.
   - Near an unshielded Fe-59 source, dose rates from beta radiation can be much higher than dose rates due to gamma radiation. Avoid direct eye exposure by always wearing safety glasses, interposing Lucite shields and/or using indirect viewing.
   - Store waste in a shielded area.

3. Surface contamination survey schedule
   - A survey meter should be used to monitor work surfaces after use.
   - A removable contamination (swipe) survey utilizing a smear and appropriate counter must be performed each month in which radioactive material is used (including sewer disposal). The RSC may require a higher contamination survey frequency depending on the amount of material in process.
   - The action limit for cleanup of removable contamination is 1000 dpm/100 cm^2. Any indication above this limit on a swipe survey or above two times background with a survey instrument is considered to be contamination. Any accessible area found to be contaminated above this limit shall be decontaminated.

4. Bioassay requirements
   - None routinely required.

5. Dosimetry
   - Fe-59 can pose an external dose hazard.
   - The lower large intestine is the critical organ of uptake for ingestion of iron compounds. The spleen and the lungs are the critical organs for inhalation of soluble and insoluble iron compounds, respectively. One or two percent of iron uptake is eliminated via urine during the first 24 hours.
   - The annual limit of intake through ingestion is 0.8 mCi.

Waste Disposal

EHS procedures for disposal of hazardous and/or radioactive wastes are to be followed. F-59 waste should be segregated from other radioactive waste. Lead or similar shielding may be needed on waste containers depending upon the amount of waste stored.

Survey Meters

A survey meter is required to work with Fe-59. A thin window Geiger-Mueller tube or a thin window NaI detector is necessary to detect Fe-59.

Personnel Monitoring

Dosimeters are required when any individual will receive or is likely to receive in any period of one year an occupational dose in excess of 10% of the applicable limits. At UNL, all users of Fe-59 are issued whole-body and ring dosimeters.