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United States Government | Department of Energy
Ohio Field Office

memorandum

3776

Fernald Environmental Management Project

DATE: JUN 27 2001

REPLY TO
ATTN OF: FEMP: SATTLER DOE-0687-01

SUBJECT: **DEPARTMENT OF TRANSPORTATION EXEMPTION APPLICATION FOR RAIL SHIPMENTS TO ENVIROCARE OF UTAH FOR DISPOSAL OF QUALIFIED WASTE GENERATED AT THE FERNALD ENVIRONMENTAL MANAGEMENT PROJECT**

TO: Theodore S. Needels, EM-5/CLOV

The Department of Energy, Fernald Environmental Management Project (DOE-FEMP) is seeking an authorization from the United States Department of Transportation (DOT) to transport, in commerce, exclusive use shipments of bulk radioactive Low Specific Activity II (LSA-II) waste material in strong tight packaging (railcars). This authorization is requested in the form of a DOT Exemption. The FEMP has prepared an exemption application to obtain relief from specific regulatory requirements specified in 49 CFR for rail shipments of qualified LSA-II waste to Envirocare of Utah, Inc., for disposal. This exemption is necessary to accommodate the potential for shipping waste material with increased concentrations of Thorium 230 (Th-230). To date, the material shipped to Envirocare has contained Th-230 concentrations well below the LSA-I definition threshold. However, recent field data indicates an upward trend in the Th-230 activity that could result in the waste material that exceeding the A2 value for Th-230, requiring the waste to be defined as LSA-II and requiring IP-2 packaging. The requested exemption will allow shipments of this material in the railcars, which are currently being used. These railcars do not meet the definition of an IP-2 packaging. The exemption application contains the relevant information the DOT requires to facilitate prompt approval.

If you should have any questions or require additional information, please contact John Sattler at (513) 648-3145.

Johnny W. Reising
Associate Director
Remediation Management

Attachment: As Stated

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DEPARTMENT OF TRANSPORTATION EXEMPTION APPLICATION

Date: **06/22/01** **3776**

Shipper: **U.S Department of Energy – Fernald Area Office**

Shipper Contact: **John Sattler, Waste Management Team Leader**

DOE Contractor: **Fluor Fernald Inc.**

Address: **P.O. Box 538705, Cincinnati, OH 45253-8705**

Phone Number: **513/648-3145**

1.0 APPLICANT SUMMARY REQUEST

The U.S. Department of Energy (DOE) seeks an authorization to transport, in commerce, exclusive use, unit train shipments of bulk radioactive LSA-II waste material in strong tight packages (rail cars). The DOE requests exemption from the Code of Federal Regulation (CFR) 49, Parts 173.403, 173.411, 173.427(b), 173.427(f) Table 8, and 173.465.

2.0 HAZARDOUS MATERIAL DESCRIPTION

The process knowledge information provided below will describe, in detail, the material's hazardous characteristics.

2.1 RADIOLOGICAL CHARACTERISTICS

The waste stream primarily consists of unwanted byproduct materials from the processing of uranium-bearing materials (e.g., uranium ores, ore concentrates, and recycled materials) at the DOE's Fernald Environmental Project (FEMP). These uranium-bearing materials underwent dissolution in nitric acid and the resultant solution was subjected to further processing in order to extract the uranium. During this processing, the uranium remained in solution and unwanted solids were precipitated out. This precipitate, identified as *"raffinate"*, was an unusable byproduct; thus, it was neutralized with lime and discarded as waste.

This acid extraction process resulted in an alteration of the normal chemical ratios present in uranium ore and other uranium bearing materials. U-238 is the most abundant isotope of uranium present in the material that underwent processing. As a result of chemical (acid) extraction the uranium was selectively removed and Th-230, being less soluble than uranium, was mainly precipitated out in the raffinate. This resultant concentration of Th-230 is the reason why it is the primary radiological isotope of concern in this waste stream. All other radiological isotopes contained in this waste stream are well below the

LSA-I definition threshold. The exemption application focuses only on the Th-230 constituent because it is the lone isotope that exceeds the A_2 value.

The uranium-bearing materials utilized at the FEMP are depleted. Sampling and analysis results (from gamma spectroscopy, alpha spectroscopy, and ICP-MS uranium enrichment analysis), site scaling factors, and material control and accountability calculations were used to directly determine the waste stream's weighted average concentration. The results show that the waste stream contains depleted uranium with a mean concentration of 0.379 percent U-235 compared to the natural U-235 ratio of 0.71 percent.

The material shipped to date contained Th-230 concentrations well below the LSA-I definition threshold. However, recent field data indicates an upward trend in the Th-230 activity, exceeding the LSA-I definition. Therefore, an evaluation was performed to determine: 1) the average and maximum values of Th-230 present in the waste stream; and 2) the portion of waste material that meets the LSA-II definition and exceeds the A_2 value for Th-230 requiring IP-2 packaging.

The DOE FEMP reviewed the radiological data associated with the waste material. A data set consisting of 316 recent field samples along with 32 historical Remedial Investigation/Feasibility Study (RI/FS) samples was used for this evaluation.

In one package (rail car), the waste's radiological constituent concentrations will exceed the reportable quantity (RQ) listed on 49 CFR, Part 172.101, Appendix A, Table 2. Thus, the waste stream is regulated as a hazardous substance and would be shipped as, "RQ, Radioactive material, low specific activity, n.o.s., 7, UN2912".

2.2 ADDITIONAL CHARACTERISTICS

The waste does not pose any other hazard. The discarded raffinates were often mixed and stored with existing radiologically contaminated soils and fly ash. This waste stream matrix resembles a moist soil/soil-like type material. The possibility of thermal reaction or the emanation of toxic and flammable gases is highly unlikely because the suspended water in the material's matrix does not presently initiate or propagate any hazardous gases. This waste material does not contain flammable or combustible constituents or significant quantities of organic, pyrophoric, or ignitable materials that would initiate a fire nor act as a flame catalyst or ignition source. The material introduces no additional risk hazard, which would require any additional or special assessment.

3.0 PACKAGING

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The DOE purchased 170 gondola-type rail cars to be used at the FEMP for the transportation of wastes in bulk to a permitted commercial disposal facility. These gondola-type rail cars were fabricated to the specifications defined by the Association of American Railroads (AAR) Manual of Standards and Recommended Practices, M1001.

Each rail car is comprised of four components:

- Gondola-Type Rail Car;
- Permanent 60-mil Liner;
- Disposable Poly Liner;
- Detachable Reinforced Fiberglass Cover.

3.1 RAIL CAR SPECIFICATIONS AND FEATURES

Each 2,743 cubic foot, 110-ton, 52.5' gondola-type rail car, which is rated for a 286,000 pound gross rail load, was modified to enable the conveyance to perform as a strong tight package. During manufacturing, the weep holes along with other openings in the standard gondola rail car body were eliminated to remove any pathways that could cause the gondola to leak. Interior surfaces of the gondola-type rail cars are sprayed with a 60-mil polyurethane-sealant coating resulting in a permanent, flexible, impermeable liner. This coating is intended to reduce the potential for leaks that could develop in the floor or walls of the rail car during transport.

A form-fitting, poly, disposable liner, with 9-foot overlapping flaps, is placed inside the rail car's interior prior to loading. The 9-foot flaps are draped over the sides of the rail car to prevent surface contamination during filling activities. The liner flaps are folded over the loaded waste material inside the rail car and secured with pins. The disposable poly liner also eases in the unloading of the waste material and further reduces the risk of contamination at the disposal facility.

The one-piece, reinforced fiberglass rail car covers are designed and manufactured to fit on the gondola-type rail car. Four (4) steel clamp assemblies secure the cover to the rail car during transit.

3.2 RAIL CAR INSPECTIONS AND MAINTENANCE - 3776

One of the potential causes of train accidents is equipment failure. To minimize the probability of a train incident caused by equipment failure, the DOE purchased 170 new, 110-ton, steel, gondola-type cars. New equipment ensures the mechanical condition of each rail car is relatively uniform across the car population and minimizes the possibility for derailments caused by rail cars of unknown mechanical condition. The DOE rail cars have a service life, which extends far beyond the anticipated DOE shipment schedule.

The DOE FEMP implemented a rail car maintenance program, which establishes guidelines and criteria for the inspection and repair of the major components of the rail car (gondola rail car, permanent liner, and fiberglass-reinforced plastic cover). Rail operations personnel at the FEMP conduct these inspections before and after the rail cars are loaded. The rail car structural inspections are performed to requirements specified in 49 CFR, Part 215, Appendix D. The other rail car components are inspected to established DOE FEMP procedures. All rail car repairs meet current engineering specifications. The mandatory inspection results and/or repairs are recorded and kept in a permanent file. The maintenance program ensures rail car system components that fail inspection are taken out of service until specified repairs are completed.

4.0 SHIPPING ASSESSMENT

Over the last several months, the DOE's FEMP shipped over 190,000 tons of Low Level, Radioactive Waste (LLRW) by rail car. The Th-230 concentrations of this LLRW ranged from 1.37% to 96.8% of the LSA-I upper threshold with an average concentration of 27.8%. The DOE FEMP's waste material planned for future shipments is similar to the previous 190,000 tons of waste successfully transported to Envirocare of Utah Inc. (Envirocare) for disposal with the exception of the slightly elevated Th-230 activity.

4.1 FEMP SHIPPING EXPERIENCE

From April of 1999 to December of 2000, the FEMP successfully shipped (32) unit trains (1,803 rail cars) of LLRW to Envirocare for disposal. The (32) shipments represent approximately 20 percent of the DOE FEMP's wastes planned for disposal at Envirocare. The FEMP's current plans are to ship a total of 150-160 unit train shipments (9,000-9,600 rail cars) to Envirocare through 2008.

To date, the DOE's FEMP has a zero accident rating (on-site and off-site) associated with these rail car shipments. There would be no increased risk resulting from the use of this mode of transportation if the exemption is granted. The containment aspects of the rail cars to retain the radioactive contents remain unchanged.

The FEMP currently has an emergency response program, which was in place prior to the first rail shipment. The FEMP also participated in emergency response drills with the CSXT and Union Pacific railroads. The FEMP will continue to provide and maintain emergency response information during transportation in accordance with 49 CFR Part 172.600.

4.2 OTHER CONTRACTOR SHIPPING EXPERIENCE

The DOE is aware of Exemption DOT-E11075 that the DOT issued for the shipment of a similar waste type using comparable strong tight packaging (rail car). Under this exemption, excavated waste soil and soil-like materials containing ore tailings were bulk shipped to Envirocare via rail. This exempted waste stream comprises approximately 1.5 to 2 million cubic yards of radioactively contaminated 11.e(2) byproduct material. The bulk radioactive LSA-II waste material was placed in unlined, gondola-type, rail cars then covered with fiberglass lids. To date, no major on-site or off-site incidents have occurred related to the transportation of this waste stream.

4.3 SAFETY AND RISK EVALUATION

The proposed LSA-II material, which exceeds the A_2 value, would normally be loaded and transported in non-bulk, IP-2 packagings. If the exemption is approved, this material will instead be shipped in exclusive use bulk packagings (rail car) to the off-site commercial disposal facility. Transporting these types of materials by rail has demonstrated to be safer and more efficient than containerized shipment for bulk material of this nature for a number of reasons, including:

- Minimizes material exposure to workers per unit volume of material. The number of rail cars required to transport a given volume of material is much smaller compared to the number of non-bulk, IP-2 packagings required.

- Reduces transport hazards per unit volume of material moved to the disposal facility. Movement by rail has been demonstrated to be safer to the public than movement by truck due to the correspondingly reduced number of trips and miles traveled.

- Unloading material from rail cars at the disposal facility is more highly automated and requires less handling and exposure to the off-loaded material. Container cleaning and re-use is also a safety and logistical problem.

- There are no safety trade-offs due to the utilization of bulk rail transport over containerization for this material. Rail transport is clearly the better method in this instance. The FEMP has shipped LSA-I material by rail car to the disposal facility successfully for nearly two years without incident.

To better prepare for necessary emergency services in the event of a potential off-site rail accident, the DOE performed additional analysis regarding radiological dose consequence of the following two worst-case off-site release scenarios:

1) Calculated the committed effective dose equivalent (CEDE) to a receptor from the release of this waste stream due to a rail accident.

2) Calculated the CEDE to an individual exposed to the release of waste materials from a lidless, moving, gondola-type, rail car as it passes by.

The CEDE is a radiological dose rate calculated in the units of mrem/hr or rem/hr, based on airborne exposure of the modeled receptor to the source material. The calculations for both scenarios utilized the highest isotopic concentrations found in historical characterization analytical data for the modeled source material. Utilizing the highest isotopic concentrations validated the two models as appropriate and representative of the material proposed for exemption, due to the assumptions used. The contents of any rail car will not exceed the maximum radiological activities used in the models.

The calculations for these two scenarios were published in the FEMP document SA-CALC-021 dated 7/2/99. The FEMP Safety Analysis Group performed the calculations to support the modeling. A copy of SA-CALC-021 resides in the FEMP Permanent Operating Record. The results of these modeled scenarios are as follows:

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1) Accidental Rail Car Release

The estimated inhalation dose to an off-site receptor located 30 meters from a spill of up to 10,000 Kilograms of waste material, is less than 1 rem/hr CEDE.

2) Loss of Rail Car Lid While Traveling

An off-site receptor who is 30 meters from a passing, open, gondola-type, rail car carrying waste material at speeds of less than 78 mph would receive less than 30 mrem/hr CEDE.

Both of these events are highly unlikely to occur but serve as the maximum credible off-site events for transporting the material in question. The modeling was performed using the maximum radiological activity from the waste stream proposed for the exemption.

The risk assessment performed for the FEMP off-site rail shipments, like most risk assessments, is by intention very conservative. The actual chance of an accident occurring where one or more rail cars would be overturned and material released into the environment and human exposure occurring is minimal. Accident rates for historical Union Pacific and CSXT rail transport were obtained from the Bureau of National Statistics. Extrapolating this information, 0.53 accidents would be anticipated for the 160 Unit Trains projected for the duration of the project. However, in contrast to most rail facilities the FEMP has relatively new railcars and a newly constructed and tightly controlled rail yard.

Considering all train accidents less than 30% are derailments, resulting in a probability of 0.16 derailments throughout the duration of the project. Of derailments, the probability of the contents of a rail car being released into the environment is an unspecified fraction of this number. The possibility of people being in the proximity of the release and human exposure occurring is even less probable. In the event that a significant release does occur, the exposure to the maximally exposed receptor will be less than 1 rem/hr. The purpose of this modeling was to provide an estimate for the radiological dose received by a reasonable maximum exposed (RME) individual receptor in proximity to material released from a railcar or railcars. This modeling does not, and can not predict the extent of overall damage and impact due to an accident or derailment.

The increase of radioactivity in the material proposed for this exemption request is primarily due to the isotope Th-230. Th-230 is a naturally occurring by-product of processing U-238. When the uranium was chemically extracted from the ore or recycled

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material, thorium 230 remained as the by-product. Because Th-230 is predominantly an alpha emitter, there will be no increase in radiation levels external to the package (railcars). Alpha particles are effectively blocked by something as thin as a sheet of paper, so a steel railcar wall will act as an impenetrable barrier.

5.0 SUMMARY

In summary, the waste stream proposed for this exemption is of a fixed quantity and no additional material of this type is being generated. The overall evaluation for this exemption application is predicated on the current regulations provided in Title 49 CFR. Granting this exemption will allow the DOE's FEMP to transport bulk radioactive LSA-II waste material, which exceeds the A_2 value for Th-230, in the specified strong tight package (rail car).