GTS DURATEK
RADIOLOGICAL ENGINEERING AND FIELD SERVICES

FINAL REPORT

FOR

UNIVERSITY OF MISSOURI ALPHA LABORATORY

July 1998
Revision 0

Prepared By: _____ 7/17/98
Roy Banning
Radiological Engineer
Date

Reviewed By: _____ 7/20/98
Robert E. Hornbeck
Senior Radiological Engineer
Date

Approved By: _____ 7-20-98
Harvey F. Story
Director
Radiological Engineering and
Decommissioning Services
Date

Prepared By:

GTS Duratek
Radiological Engineering & Field Services
628 Gallaher Road
Kingston, TN 37763

TABLE OF CONTENTS

1.0 INTRODUCTION

In February of 1998, GTS Duratek was awarded a contract to remove three glove boxes, some equipment and ventilation ducts from the Alpha Laboratory located at the University of Missouri-Columbia Research Reactor Facility (MURR). All generated waste and glove boxes were packaged for shipment to GTS Duratek's Bear Facility for processing or reuse. All equipment, which was located outside of the glove boxes, was surveyed for release and turned over to MURR facility personnel for disposition. The Alpha Laboratory was decontaminated to pre-job levels, as necessary, and a post decontamination room surveys performed to validate decontamination effectiveness. The post decontamination fixed contamination survey indicated one spot of Alpha contamination (109 dpm/100cm^2). The loose surface contamination survey conducted of the area indicated no activity above established levels for the project. A resurvey of this area was performed during the month of July 1998. No activity of concern was noted during this survey.

2.0 BACKGROUND

The Alpha Laboratory was placed into service in 1990 at the University of Missouri in Columbia, Missouri. In 1995, the laboratory was renovated and was a fully equipped, functional actinide facility. Pyropartitioning was selected as one option for separating transuranic metals from fission products. The Alpha Laboratory was designed to conduct pyropartitioning chemistry experiments. The end result of these experiments was to provide the scientific and process data necessary to validate the pyropartitioning concept. The results of these experiments was applied in the design of a pilot plant to test the separation process.

The laboratory used three glove boxes, an Argon Glove Box, an Air Glove Box and an Inductively Couple Plasma-Mass Spectrometer (ICP-MS) Glove Box. These glove boxes provided primary containment of actinide metals during experimentation. They were designed to ASTM standards for plutonium fuel processing. They operated at a nominal 0.5 inches of water column with respect to the laboratory.

The Alpha Laboratory provided containment of the radioactive materials in the Reactor Center Building. The laboratory operates at a nominal negative 0.5 inches of water column with respect to the building. The HVAC air supply is double HEPA filtered entering the laboratory.

This arrangement provides for three levels of monitored confinement of alpha emitters. The building is under negative pressure with respect to the atmosphere, the laboratory is under negative pressure with respect to the building and the glove boxes were under negative pressure with respect to the laboratory.

Argon Glove Box

The Argon Glove Box is constructed of stainless steel, has double side windows with two glove ports per window, an overhead lighting window and a volume of about one cubic meter. This glove box with the inert Argon atmosphere used redox chemistry which uses molten salts (lithium chloride/potassium chloride eutectic salt) and liquid metals (cadmium and bismuth) as solvents for the heavy metal chlorides and reduced metals respectively. Oxidation-reduction chemistry and electrochemical methods were used to obtain thermodynamic data and to evaluate the separation factors for the transuranic metals from the fission product metals. This glove box had a thermal well in the floor of the box. This well is about 10 cm in diameter and extends about 45 cm below the glove box floor.

Air Glove Box

The Air Glove Box is made of aluminum with double side windows, two glove ports per window, an overhead lighting window and a volume of about one cubic meter. This glove box has connecting ports to both the Argon Glove Box and the ICP-MS Glove Box. There is a bag-out port in one end. The preparation of aqueous samples for chemical analysis was performed in this glove box. Samples of solid salt and metal from experiments in the Argon Glove Box were dissolved in water and nitric acid. It is aliquots of these solutions that were diluted and analyzed using an ICP-MS located in the ICP-MS Glove Box. The residual liquids from the ICP-MS and the sample preparation mixtures were collected in the Air Glove Box. Solid Sodium Hydroxide was added to make the solution basic and the solutions were evaporated to collect a solid residue. This solid residue contained mixed waste from the project. The Air Glove Box was expected to be the most contaminated since the aqueous chemistry is the "dirtiest" step in the test sequence. The Air Glove Box had been exposed to the same list of materials as the Argon Glove Box plus the acid fumes from the aqueous solution. The humid atmosphere, containing acid fumes, caused surface corrosion in the Air Glove Box.

ICP-MS Glove Box

The ICP-MS Glove Box is constructed of stainless steel with double sided windows, a window on one end and a overhead lighting windows. It has fourteen glove ports and a volume of about two cubic meters. Samples were brought in and waste removed through to the Air Glove Box through the stainless steel connecting chamber. This glove box was used for sample preparation and contains the sample delivery system, an interface panel for instrument utilities and instrument lines for a FISONS ICP-MS instrument. This glove box had been exposed to the same materials as the other glove boxes, but only in dilute solutions. It was expected to be the cleanest of the three boxes since careful housekeeping is required to protect the quality of the analytical work.

The primary sources of contamination are the radioactive isotopes americium, neptunium, plutonium and uranium. MURR facility personnel performed the Hazardous waste testing necessary to determine that the glove boxes were radioactively contaminated only. Facility personnel removed most of the equipment from all glove boxes. The ICP-MS glove box had the most equipment left to be removed during this project. This equipment was to large to remove through the bag-out ports. A portion of the work with this project was to remove the end window, after the glove box was decontaminated, and remove the rest of this equipment from this glove box.

3.0 PRE-JOB PREPARATIONS

3.1 Work Plan and Procedure

A site specific work plan was generated by GTS Duratek to support on-site activities necessary for the preparation of the survey, removal and packaging of the glove boxes, ventilation ducts and room equipment. A copy of this work plan is included in Appendix D.

In conjunction to the aforementioned work plan, a glove box procedure, MURR-RAM-101, *Glove Box Removal of Materials*, was developed to be utilized by on-site personnel.

3.2 License Agreement and Respiratory Protection Program

GTS Duratek received Nuclear Regulatory Commission (NRC) approval to use GTS Duratek's Respiratory Protection Program during this project. GTS Duratek also received NRC approval to allow GTS Duratek to perform the work associated with this project under GTS Duratek's D&D license (R-73018-E00) under the NRC's Reciprocity Agreement for NRC member states.

4.0 ON-SITE WORK

4.1 Equipment Removal from Laboratory

Laboratory equipment consisted of instrumentation cabinets, file cabinets and a tool cabinet. Due to the size and difficulty of surveying instrument lines and detectors, all lines and detectors that were located in the instrument cabinets and glove boxes were considered contaminated. All piping and tubing was removed and disposed as radioactive waste. All equipment that was surveyed and was not determined contaminated, was released to the MURR facility staff for disposition. This equipment was surveyed with a large area wipe and direct frisked for both Alpha and Beta contamination. If the equipment was contaminated, it was disposed in the B-25 boxes.

Some waste consolidation was performed for the facility. This waste consolidation consisted of transferring the contents of nine 55 gallon drums into a B-25 box. Additionally an old ICP-MS glove box was also added to the B-25 box.

4.2 Glove Box Decontamination

All glove boxes were characterized by direct frisk for Alpha contamination and smears for both Alpha and Beta loose surface contamination, prior to the beginning of decontamination. The initial contamination level in the glove boxes are listed in the following table.

Table 4.2
Glove Box Characterization Survey

Glove Box	Alpha contamination loose surface	Beta Contamination loose surface	Alpha contamination fixed
Argon	5,000,000 dpm	100 mRad/hr	500,000 cpm
Air	5,000,000 dpm	64 mRad/hr	500,000 cpm
ICP-MS	2,000,000 dpm	220,000 dpm	300,000

All glove boxes were kept on negative HEPA ventilation during the characterization surveys, decontamination and post decontamination surveys. As the waste from decontamination was generated, it was transferred out of the glove boxes by double bagging, surveying and placed in a B-25 box for disposal. "Scrubby Bubbles", a commercial bathroom cleaner was used as the decontamination solution. Stiff scratchy pads/brushes and wipes were also used in the decontamination process. This decontamination process include spraying down the inside of the glove box with the decontamination solution, then using the stiff pads and brushes to clean the inside surfaces of the glove boxes. The most contaminated areas of the glove boxes were the floor surfaces and the HEPA discharge area. The contamination levels were to be reduced to below the A^2 value for Am^{241} (about 70 mCi of total contamination) for shipment as LSA. The inside of the glove boxes were surveyed between decontamination efforts. An additional decontamination technique that was used was to leave a layer of decontamination solution on the inside box surfaces overnight and removed the next morning. The final survey of each glove box was performed by MURR Health Physics Technicians.

The Argon glove box was the first glove box to be decontaminated. A total of four decontamination efforts were used for this glove box. The final survey showed loose surface Alpha contamination levels to 510K dpm/100 cm^2 maximum and direct Alpha contamination levels to 500K cpm maximum.

The Air glove box was the next glove box to be decontaminated. Because this glove box was the most contaminated, a total of five decontamination efforts was used. The final surveys for Alpha contamination indicated this glove box to be contaminated to 12K dpm/100cm^2 maximum loose surface contamination and 50K cpm maximum direct contamination. The decontamination of this glove box was more effective because a layer of solution was left on this glove box over the weekend and was wiped up Monday morning.

The ICP-MS glove box was the least contaminated, so the decon effort consisted of a single wipe down and a survey. The contamination levels were reduced to the lowest possible level, because the end window and side windows had to be removed for the glove box for shipment. The final survey on this glove box indicated that the maximum loose surface Alpha contamination was 3700 dpm/100cm^2 and a maximum of 5K cpm fixed Alpha contamination.

4.3 Equipment Removal from Glove Box

Any waste generated by the decontamination efforts was removed from the glove boxes as needed during the decontamination. The few pieces of equipment in the ICP-MS glove box was to large to be removed through the bag-out ports. This equipment was analytical equipment used during the experiments. Most of the equipment was waste that was bagged inside of the glove box and was removed through the end window of the glove box. The FISONS ICP-MS instrument was contaminated and was not disposed as waste. MURR personnel wanted this piece of equipment, so it was surveyed, double bagged and released to MURR personnel for disposition. All equipment was surveyed, bagged and removed through the end window. The end window on this glove box was replaced with a 5/8" thick piece of plexiglass for shipment. When equipment was removed from the glove box floors, plates of sheet metal was fabricated to cover any holes in the glove box floor. This plate was installed using 3M spray glue and tape. In addition, the holes from the connecting tubes between each glove box was covered with Herclulite and taped.

The thermal well was removed from the bottom of the Argon glove box prior to the glove box being placed in the shipping container. The thermal well was double bagged and placed in a B-25 box as waste.

4.4 Glove Box Packaging

All glove boxes were placed in wooden shipping containers for shipment. These wooden containers were constructed from 3/4" thick, 4' x 8' pieces of plywood using screws and glue. All joints were sealed with silicone sealant inside and outside to prevent any leakage of radioactive contamination during transit.

After the glove boxes were decontaminated and the final survey completed, the glove boxes were disconnected from each other and was disconnected from ventilation. The external surfaces of the glove boxes were surveyed for loose surface contamination, wiped down as necessary and rolled outside of the laboratory to be weighed and packaged in the wooden shipping containers.

4.5 Ventilation

There were two ventilation systems in the laboratory. One ventilation system was the HEPA ventilation for the glove boxes and the second system was the ventilation system for the room.

The HEPA ventilation system piping was removed with the exception of the welded piping penetrations through the room ceiling, the HEPA filter housings and the filter housing exhaust lines. All piping removed was disposed as radioactive waste. The piping penetrations, the HEPA filter housings and the filter housing exhaust piping was wiped down and surveyed for free release. Both loose surface and fixed contamination surveys were performed.

The room ventilation was surveyed by cutting holes in the ventilation ducts. Both loose surface contamination and fixed contamination surveys were performed on this ducting. In addition the prefilters and the first HEPA filter downstream on the room ventilation line was removed, surveyed and disposed as waste. No contamination was found in the lines or on the HEPA filters surveyed. After the surveys were completed the holes in the ventilation ducts were repaired with pieces of sheet metal and duct tape.

4.6 Performance of Final Survey

The work area had been previously gridded by the technicians that had performed the initial characterization survey. These 1 meter square grids were left in place and utilized for the final survey. A 100 % scan of each grid on the floor and walls (2 meters high) for both Beta and Alpha contamination was performed using the Ludlum Model 2350 with the 43-68 gas flow detector. At the area of each highest reading, a measurement was recorded for both Alpha and Beta contamination. A 30 point survey on the ceiling was performed with the same detectors that were used for the floor and wall survey. Additionally, the six ventilation duct openings through the ceiling were also surveyed.

One Alpha measurement in grid #39 was 109 dpm/100 cm^2. This area was wiped down during the survey. This area was resurveyed at a later date and no activity above estalished limits was noted during this survey. There were some Beta readings that were higher than the average, these readings were attributed to Reactor operations because the readings were located on the south wall of the laboratory. The results of the surveys for the Alpha Laboratory can be located in Appendix F, Alpha Laboratory Final Survey Results.

5.0 CONCLUSION

The laboratory equipment, glove boxes and ventilation ducts were surveyed, removed and packaged with few problems. The waste was packaged for shipment to GTS Duratek's Bear Creek Facility for processing or use. Mr. Hoyle Dake, GTS Duratek Engineer, has expressed an interest to use the glove boxes at the Bear Creek Facility for some experiments that are to be conducted there. Bear Creek will dispose of the glove boxes after the completion of these experiments.

The only problem encountered was that there was more equipment than expected in the ICP-MS glove box. This was alleviated because there was less equipment to be surveyed in the laboratory. The facility health physics staff had surveyed and removed some of the clean equipment from the laboratory prior to the commencement of the project.

The laboratory ventilation ducting was surveyed in place and left for future use.

6.0 APPENDICES

6.1 Appendix A, Schedules and Daily Logs

6.2 Appendix B, NRC Notifications

6.3 Appendix C, Radiation/Hazardous Work Permit

6.4 Appendix D, Work Plan

6.5 Appendix E, Daily Safety Meetings

6.6 Appendix F, Alpha Laboratory Survey Results

Available Upon Request - Click here to email a request

Significant information from pages 1-7. Entire document not scanned.