SAFETY ANALYSIS OF ISOTOPES ALPHA HANDLING FACILITY

H. G. Hunter, R.W. Schaich, and J. A. Setaro

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H. G. Hunter, R. W. Schaich, and J. A. Setaro

ABSTRACT

A critical review of the hazards associated with operation of the Isotopes Alpha Handling Facility is presented. The physical facilities, operations, and operating procedures for the plant are described. Analyses were made of the operational hazards and it is shown that the primary and secondary containment features of the facility are adequate to contain the radioactive contamination to the confines of the facility.

INTRODUCTION

The Isotopes Alpha Handling Facility (AHF) will be used for studying the physical and chemical characteristics of transuranium elements, fabrication of alpha- and neutron-emitting targets and sources, and fabrication of beta and low-energy gamma sources. The cells are arranged to provide for segregation of operations so that different experiments can be performed in separate cells with a minimum of interference. This segregation is accomplished by vacuum airlocks between the cells.

DESCRIPTION OF FACILITY

Building

The AHF is housed in Building 3038, which is located on the southwest corner of Isotope Circle in the Radioisotope Area (Fig. 1). Its relation to nearby facilities in terms of distance and quantities of radioactivity normally handled is listed in Table 1; also included is the number of people occupying nearby facilities.

Building 3038 is a masonry structure with a total floor area of 7200 ft$^2$ and a total free-space volume of 87,000 ft$^3$. The building has a pneumatic fire alarm system which is continuously monitored by the ORNL Fire Department. The AHF portion of the building consists of a total floor area of 1000 ft$^2$ and a free-space volume of 12,000 ft$^3$. The rest of the building contains the Radioisotope Packing and Shipping Facility, an analytical laboratory to the east of the AHF, a development laboratory north of the AHF, and the main Health Physics office for the Isotopes Area (Fig. 2). All entries to the AHF have airlocks for lift-truck and
Fig. 1. Plan of Radioisotope Area Showing Building 3038 Location and Evacuation Route.

Table 1. Activity Inventories and Occupancy of Nearby Facilities

<table>
<thead>
<tr>
<th>Building Number</th>
<th>Facility</th>
<th>Distance and Direction from Building 3038</th>
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<th>Type of Activity</th>
<th>Occupancy, number of weeks</th>
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</table>

^aAdditional scientific and maintenance personnel may temporarily occupy the building.
Fig. 2. Radioisotopes Laboratory
personnel access. The AHF is designed so that if there were a release of gaseous, solid, or liquid waste the activity would be confined within the building. Emergency power is not required for this facility. The AHF consists of five shielded manipulator cells, which are discussed below.

**Cells**

The five manipulator cells comprising the AHF are surrounded by steel tanks filled with water for shielding purposes. The tanks on the operating side of the cells contain 3 ft of water for viewing and shielding. Each cell is separated from its adjacent cell by a partition tank containing 1 ft of water. The shielding tanks are bolted together to form the basic cell arrangement and a stainless steel liner is installed in each cell to seal all access to the cells. Figure 3 is a cut-away view of the AHF cell bank. All penetrations to the cell are welded at the liner, and the cells are connected in series with a vacuum airlock system.

Extended-reach Model G manipulators are inserted through holes in the front face of the cell. The slave sections of the manipulators are covered with urethane manipulator boots sealed to the cell liner. An additional plastic boot and wiper seals around the tapes in the manipulator barrels provide a secondary containment for the manipulator penetration. The removal of manipulators for normal maintenance is controlled.
by the Alpha Handling Facility Manipulator Removal Procedure (Appendix A). A sealed hatch on top of the cell liner can be opened or the front shielding tank can be drained and the window removed from the cell liner under controlled conditions to provide personnel access, which is controlled by the Alpha Handling Facility Cell Entry Procedure (Appendix B). Table 2 lists the various services available for in-cell operations.

Table 2. Alpha Handling Facility In-Cell Services

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<td>5</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

The cells can be operated using an atmosphere of plant air or argon (Fig. 4) depending on the type of operation needed for the experiment. The cells are operated on a balance of cell atmosphere leaving the cell via the off-gas system and the air or argon entering the cell through the atmosphere control system.

The atmosphere control system operates under preset conditions and automatically responds to changes in cell pressure to either add more gas to the cell (in case the cell goes to a higher negative pressure) or reduce the amount of gas going to the cell (in case a cell begins to go positive).

The system is designed to be fail safe so that the cells cannot be pressurized. This is accomplished by a system of photohelic gages which control the flow of plant air or argon through solenoid valves. In the case of electrical power failure, the cells will go to the maximum negative pressure available on the AHF off-gas header (~4.0 in. H2O). A vacuum breaker in the off-gas header will automatically open to the operating area if the negative pressure exceeds 4.0 in. H2O.

The airlocks between the cells can be evacuated and backfilled with inert gas if necessary.

**Equipment**

Since the AHF cells will be used for a variety of research and development work, each experimenter will be responsible for obtaining and installing his own equipment. The experimenter's equipment, as well as his operating procedures, will be reviewed by the Isotopes Division Chemical Hazards Committee in advance to ensure safe operations.

Lift trucks, manipulators, safety showers, emergency lanterns, etc., are on the Plant and Equipment programmed maintenance list and are inspected regularly by the Inspection Engineering Group.
Fig. 4. Alpha Handling Facility – Cell Ventilation Schematic
CONTAINMENT

Building

The AHF is designed so that the cells constitute the primary containment and the building constitutes a secondary containment layer for the protection of the environment. All entries have airlocks for lift-truck and personnel access, and all doors are gasketed to reduce in-leakage to a minimum. The AHF is maintained at a negative pressure of greater than 0.25 in. of water with respect to the outside environment. All air exhausted from the facility is passed through FG-25 roughing filters and testable High Efficiency Particulate Absolute (HEPA) filters located in the Isotopes Area filter house before it is discharged to the 3039 stack. The normal air flow systems are shown in Fig. 5.

![Diagram](image-url)

Fig. 5. Alpha Handling Facility Air Flow.

The containment system is checked daily to assure that the facility is meeting the containment criteria of greater than 0.25 in. of water negative pressure with respect to the outside environment.

Cells

The containment of activity in the cells is accomplished by stainless steel liners, penetrated by service lines and conduits. The makeup air for the cells is supplied from the plant air system in order to keep the cells as clean and dry as possible. The effluent air passes through HEPA in-cell filters that are not routinely tested and then through two sets of HEPA filters that are tested routinely by the Inspection Engineering Group.
The manipulators are doubly sealed: a primary seal afforded by the urethane boot and a secondary seal formed by the wipers inserted in the manipulator barrel.

OPERATIONS

The AHF will provide needed space for the Isotopes Target Program, the Curium Isotopic Power Program, the Beta Radiation Source Development Program, and the radioisotope shipping activities required to meet customer demand for transuranic elements. All of these programs are expanding in the amount of work involving alpha-neutron emitting isotopes and in the quantities of such materials that will be handled. Thus the cell operations will be varied and will be scheduled on a priority basis to meet the AEC program demands. Some typical operations that are proposed for the facility are discussed.

Electrodeposited sources of $^{252}$Cf will be prepared for subsequent use as self-transfer sources for producing thin targets and sources for studying fission fragments. It is anticipated that up to 1-mg quantities of $^{252}$Cf will be employed in fabricating these sources.

One of the five cells will contain electrodeposition equipment which can contain 100- to 200-µg quantities of $^{252}$Cf and an apparatus for self-transfer of $^{252}$Cf to thin substrate foils from a mother source. A vacuum evaporation system (oil-diffusion pumped) with a glass or stainless steel vacuum chamber will be used to evaporate the $^{252}$Cf and to overcoat sources prepared by self-transfer or electrodeposition.

Another cell is expected to be used for encapsulation of neutron-emitting isotopes such as $^{252}$Cf, $^{242}$Cm, $^{244}$Cm, and $^{238}$Pu. Encapsulation will be performed by TIG welding of stainless steel or other metal capsules into which weighed quantities of dry or liquid materials will be placed; therefore, the cell will be fitted with a rotary, x-y drive welding table and an appropriate TIG torch that can be moved vertically and horizontally. Drive mechanisms on the welding apparatus will be motorized for remote control outside the cell.

The maximum quantities of any one radioisotope ($^{252}$Cf, $^{242}$Cm, $^{244}$Cm, $^{241}$Am, $^{243}$Am, and $^{238}$Pu) that is anticipated to be used in a single cell and in all cells are listed in Table 3. Quantities of other radioisotopes will be limited by the shielding and the permissible radiation dose to personnel.

Experimental work with gram quantities of $^{244}$Cm and other radioisotopes will be done on a scheduled basis in the other cells. Experiments involving thermal conductivity measurements, solubility, and compatibility of materials will be

<table>
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<tr>
<th>Radioisotope</th>
<th>Maximum Single Cell Inventory</th>
<th>Maximum Facility Inventory</th>
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<tbody>
<tr>
<td>Californium-252</td>
<td>0.100</td>
<td>0.500</td>
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<tr>
<td>Curium-242</td>
<td>10</td>
<td>50</td>
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<tr>
<td>Curium-244</td>
<td>1000</td>
<td>5000</td>
</tr>
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<td>Plutonium-238</td>
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<td>5000</td>
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<tr>
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<td>5000</td>
</tr>
<tr>
<td>Americium-243</td>
<td>1000</td>
<td>5000</td>
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<tr>
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<td>5</td>
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designed and installed in the appropriate cell. Similar experiments have been safely operated in Buildings 3028 and 3047 for several years.

WASTE DISPOSAL

Three types of waste result from operations in the AHF: liquid, gaseous, and solid. The sources from which these wastes derive and the means of disposing of them are described below.

Liquid Waste

The liquid wastes in the AHF consist of process waste from cells, solutions from building floor drains, and storm sewer waste.

The solution from building floor drains is negligible; therefore the only source of contamination to the system would be solutions used to decontaminate the operating area floor. This waste is continuously monitored by the ORNL Waste Monitoring System. The storm sewer waste consists of all roof drainage and condensate from the building heating system; these are nonradioactive. The only possible contamination in this system, therefore, would come from an outside source which settled on the building roof. All cell wastes are sent to tank WC-2 on the ORNL Tank Farm via the cell floor drains. The normal volume of waste should be less than 50 gal/day and the normal activity (primarily alpha) level should be less than 20 mCi/gal. The WC-2 transfer system is contained for alpha waste handling and the tank is vented to off-gas through two testable HEPA filters. This waste is continuously monitored by the ORNL Waste Monitoring System.

Gaseous Waste

Gaseous wastes normally originate during cell operations and exhaust to the ORNL off-gas system. The AHF is kept at a negative pressure of greater than 0.25 in. of water by means of a duct from the cell ventilation system. All air passing through this system goes through a testable HEPA filter in the AHF and then through FG-25 roughing filters and testable HEPA filters in the Isotopes Area filter house before discharge to the 3039 stack. The cell atmosphere is triply filtered through HEPA filters. The primary (in-cell) filter is changed routinely with manipulators and is not routinely tested after initial installation. The other two sets of HEPA filters, however, are routinely tested by the Inspection Engineering Group. All HEPA filters must meet a DOP test of greater than 99.95% efficiency for particles greater than 0.3 micron.

Solid Waste

According to the Isotopes Division Solid Waste Handling Procedure (Appendix C), all alpha solid waste is considered as high-level waste. All materials are washed and removed from the cell bank (usually at Cell 3) by standard bagging techniques. The material is triply contained and checked before being transported to the Solid Waste Handling Facility.
The AHF cells were designed for inert atmosphere operations with an oxygen content of less than 100 ppm. The cell liners, electrical penetrations, services, etc., are sealed with vacuum-type fittings to prevent the in-leakage of air. If a pressure or vacuum of >10 in. of water is accidentally created within the cell liner, the cell window will fracture and break the primary containment barrier of the cell. To prevent this type of accident, a photohelic cell will control the cell atmosphere to -1.0 in. H₂O pressure. If the cell exceeds -2.0 in. H₂O pressure, the photohelic cell will energize an alarm circuit and increase the flow of air or argon to the cell to maintain the -1.0 in. H₂O pressure. The inlet gas system is orificed to restrict the inlet flow to <10 cfm and is controlled by the photohelic cell when the pressure reaches -0.5 in. H₂O. The discharge to the off-gas system is manually valved to an equivalent flow.

All equipment installed in the cells requiring additional gas flow will be safeguarded by reducing stations and orifices to prevent an over-pressure situation. If a vacuum system is attached to the cell, the discharge capacity of the system will be limited to <5 cfm. The cell atmosphere control system is designed to automatically meet this flow condition and hold the cell at -1.0 in. H₂O pressure. Inlet gas flow indicators are mounted on each cell and pressure drop readings on the in-cell HEPA filters will be recorded on a daily basis to determine the proper gas flow to each cell.

The control system is designed to be fail safe in case of electrical power failure in the Isotopes Area or at the ORNL off-gas system. The measurement of the high-temperature (up to 2300°C) chemical and physical properties of radioisotope power source materials are typical of a category of operations which may from time to time be carried out in the AHF cells. The measurements can include surface tension, viscosity, emissivity, heat capacity, compatibility, vapor pressure, melting point, thermal conductivity, and helium release. All of the above measurements require the attainment and maintenance of high temperatures.

A failure of the cooling water to a furnace which is operating at a power level of several kilowatts could result in a heat load in excess of the dissipation capabilities of the hot cell. The cooling water outlet is equipped with a flow detector which will open a switch in the event of a reduction in flow of the cooling water. The switch deenergizes a breaker which removes power from the furnace power supply and opens the normally closed cooling water valve. The pressure in the hot zone of the furnace is monitored by a pressure-sensitive switch which in the event of a water leak into the hot zone of the furnace would perform the same functions as the flow switch.

Hydrogen will be used as a reducing agent in some experiments. The explosive limits of hydrogen at atmospheric pressure and room temperature in oxygen is 4.65 to 93.9% and in air 4.00 to 74.2%. An analyzed mixture of 4% hydrogen-96% inert gas will be used as an absolute preventive of an explosive mixture.
The encapsulation of radioisotopes in stainless steel or other suitable metal containers will be performed by welding samples in appropriate containers. Since this is performed under a blanket of inert gas (argon or helium) the arc itself is essentially inert except that it is a source of high temperature. During welding (especially of massive materials) chill blocks will be used to avoid large temperature increases within the cell and no solvents will be permitted within the cell during such operations. Since argon or helium purges are employed through the torch head, the possibility of increasing cell operating pressure exists, but this problem is overcome by employing a maximum pressure photohelic control which will provide additional cell exhaust capability through use of hot off-gas facilities.

In the vacuum evaporation condensation of thin films consisting of alpha- and neutron-emitting isotopes, it is conceivable that some material may be exhausted through the pumps and into the cell ventilation or hot off-gas systems. Past experience with such evaporation in Building 3028 has shown such occurrences to be nearly impossible because of the scrubbing action of the oil vaporization pump and the oil-containing rotary pump. The possibility of plugging absolute filters in the cell facility with oil vapors originating from the vacuum pumps will be eliminated by the installation of de-misters in the exhaust headers from the pumps. These devices will also assure further protection from the possibility of exhausting radioactive material from the pumps.

Cooling water used in the evaporation devices and welding devices in the cells will be from a closed recirculation system including a chiller. As a result no radioactivity will reach the process drain system; when the monitored activity in the chilled water system reaches a preset level, the entire system will be drained and flushed through the hot-liquid waste disposal system.

PERSONNEL PROTECTION

The personnel protection program at the AHF is implemented through operating safeguards, radiation and contamination detection devices, training of personnel preventive maintenance, and a continuing interest in maintaining a high safety standard.

The chemical safety practices specified in Section 1.4 of the ORNL Safety Manual are followed and special regulations that are applicable to certain jobs are posted.

Two emergency cabinets are maintained in the building for protection of personnel, one in the shipping area and the other in the west airlock. These emergency cabinets are stocked with coveralls, gas masks, shoe covers, gloves, flashlights, and rope. All employees know the location of these cabinets and their contents.

The cells are designed to limit the beta-gamma-neutron dose to personnel to <1 mrem/hr. The exposure from normal operations will not exceed 100 mrem/week. The greatest amount of exposure will come from decontamination work.
Radiation and contamination detection devices are located throughout the building (see Fig. 6). Monitrons (1 beta-gamma and 3 neutron) are located at strategic points in the building for the detection of beta-gamma-neutron radiation, and all monitors are connected to a central alarm and panelboard system located in the Health Physics Office. Monitors are also equipped with local alarms to notify personnel of hazardous conditions. All monitron units are checked daily for operability.

One alpha constant-air monitor and one beta constant-air monitor are located in the operating area (Fig. 6). These instruments are equipped with local and central alarms and are checked for operability daily.

Portable alpha counters, GM survey meters, cutie pies, and neutron instruments are available for use in the building, and all operating personnel will be trained in the use of these instruments.

An alpha survey meter is located adjacent to the normal exits of the operating area; all personnel are required to check themselves for contamination before leaving the building. Instruments are also available for checking beta and gamma contamination on the outer garments. Figure 6 shows the location of these instruments.

Radiation detection equipment is located in the Health Physics Office in Building 3038 - an alpha smear counter, a beta-gamma smear counter, high-level radiation probes, portable air samplers, Hi-Vol air samplers, cutie pies, neutron and alpha survey meters, and GM survey meters. All operating personnel are trained in the use of this equipment. Failure to use the radiation detection instruments under specified conditions is grounds for disciplinary action. All instruments are on the Instrumentation and Controls Division programmed maintenance list and are checked and calibrated on a regular basis.

TRAINING PROGRAM

Although there is no formal training (i.e., classrooms, lectures, etc.) of the technicians at the AHF, all of them are thoroughly familiar with the standard operating procedures of the Division regarding safety, contamination control, radiation exposure, and manipulator cell operation. In addition, all personnel are thoroughly trained in the use of radiation instruments, and a record of their training is kept. A copy of the Health Physics Training Card is shown in Fig. 7.

People who normally work in the AHF are members of the Isotopes Area Emergency Squad and are given training in fire prevention and first aid. A copy of the Area Emergency Procedure is given in Appendix D.
Fig. 6. Alpha Handling Facility Radiation and Detection Devices.
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<td>Hand &amp; Foot Counter</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smear Counters</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The above named operator has been instructed in the operation and use of the Health Physics instruments listed above. He is qualified to use these instruments as necessary in the performance of his work.

Fig. 7. Health Physics Training Card.
APPENDIX A

Alpha Handling Facility

Manipulator Removal

A. Preparation

NOTE: Supervision will schedule shutdown of the cell and determine when the manipulator arm is to be pulled.

1. Cover the floor in front of the cell with blotter paper.
2. Cover adjacent panelboards, cabinets, and the cell face with brown wrapping paper.
3. Position CAAM near the operating area.
4. Establish zone and control areas.
5. Provide the following protective clothing and equipment:
   a. Plastic suits (3)
   b. Vests (3)
   c. Air lines (connected to air supply)
   d. Surgeon's gloves
   e. Shoe covers
   f. Assault masks
   g. Dosimeters (zeroed)
   h. Cutie pie (10 R/hr), neutron meters, alpha survey meters, and GM survey meter

NOTE: Supervision will place "Entrance Requirement" signs at all entrances to the manipulator area and will specify gas mask, "C" clothing, and shoe covers.

6. Turn air conditioner OFF

B. Removal of Manipulator Arm

Removal of the manipulator arm will be done by members of P and E Division. The operation will have Health Physics coverage. All personnel inside the roped-off area will be in plastic suits. Others in the manipulator area will wear assault masks.

The arm is removed in a plastic pull bag and sealed. All manipulators removed from the AHF cells will be triply bagged and transported in a closed truck to the manipulator maintenance area (Building 3047) where they will be bagged into the alpha glove box. Decontamination and repair of the manipulators will be done at the manipulator maintenance area and the manipulators will then be returned to AHF.

C. Insertion of Repaired Manipulator

The repaired manipulator is inserted into the manipulator port and boot by P and E personnel. The preparations outlined in "A" apply. After insertion of the manipulator, Health Physics will check the area for contamination and the area will be cleaned if necessary.

Supervision will remove "Entrance Requirement" signs at all entrances.
Cell Entry Procedure

A. Preparation

1. Entry into the AHF cells is made only with the permission of supervision.
2. Supervision will determine if entry is to be made from the top hatch of the cell or by way of the front viewing window.
3. Before entry all unnecessary equipment will be removed from the cell. The cell will be remotely decontaminated to a smear level of less than 500,000 dpm alpha.
4. If entry is to be made via the front viewing window, the water must be drained from the front tank. Health Physics will take radiation readings during this operation and will check radiation levels at adjoining cells to ensure that other tanks are not being accidentally drained. After draining, the front tank is removed. (NOTE: Cell containment is still intact at this point.)
5. A plastic tent is erected over the entrance to the cell. This is true for top entry as well as front entry.
6. Obtain RWP clothing required: coveralls, plastic airline suit, surgeon's gloves (2 pair), plastic boots (2 pair), and necessary Health Physics equipment.
7. Air condition blowers are OFF.

B. Entry

1. The cell entry plate is removed inside the tent and properly contained.
2. Entry will be observed at all times by personnel outside the cell.
3. Personnel entering the cell will have portable radiation instruments with them and will check for changes in radiation background as they perform their work.
4. Personnel will work at a normal speed. Trying to work at faster than normal speed is a departure from safe work habits.

C. Departure

1. When the employee reaches a designated area the observer will wash the contamination from the plastic suit with a water spray.
2. The employee will then enter a Contamination Zone and be assisted in the safe removal of his plastic suit.
3. The employee will then be surveyed by designated personnel and his exposure recorded on the RWP.
D. Placing Cell Back in Service

After completion of in-cell work, the cell will be placed in operation by the following procedure:

1. The cell plate is replaced on the cell.
2. Health Physics checks for contamination inside the tent. The tent area is cleaned before removal.
3. Remove the plastic tent.
4. Health Physics checks the area for contamination and the area is cleaned if necessary.
5. In the case of front entry, the front tank is replaced and re-filled with water.
APPENDIX C

ISOTOPES DIVISION SOLID WASTE HANDLING PROCEDURE

J. H. Gillette

Date Issued
April 1, 1968

Oak Ridge National Laboratory
operated by
Union Carbide Corporation
for the
U. S. Atomic Energy Commission
FOREWORD

This procedure presents standard techniques for the safe handling of waste generated in the Isotopes Division. All members of the Division should become well acquainted with it to eliminate unusual difficulties and incidents.
ISOTOPES DIVISION SOLID WASTE HANDLING PROCEDURE

1. INTRODUCTION

Solid radioactive waste from the Isotopes Division may consist of contaminated bottles, swabs, paper, glassware, laboratory equipment, or any other solid materials used within hot cells, hoods, or glove boxes. These materials may be contaminated with alpha, beta, and gamma activities with beta-gamma radiation readings from 1 mr/hr to greater than 10 r/hr at the surface of the primary package. No liquids are to be intermixed with solid waste but channeled through the appropriate liquid disposal system. This procedure is established to assure the safe handling and disposal of these materials and supplement procedure number 5.1 in the ORNL Health Physics Manual.

2. DEFINITIONS

**Low Level Waste** - Those materials which read less than 6 mr/hr beta-gamma at the surface of the primary package.

**Intermediate Level Waste** - Those materials which read from 6 mr/hr to 200 mr/hr beta-gamma at the surface of the primary package.

**High Level Waste** - All alpha contaminated material.

All process equipment and other highly contaminated material from hot cells, shielded barricades, or glove boxes.

All material with a radiation reading greater than 200 mr/hr.
3. LOW LEVEL WASTE HANDLING PROCEDURE
(Less than 6 mr/hr)

Containers

Each building in the Isotopes Division which handles radioactive materials will be supplied with disposal cans (Fig. 3.1) properly labeled for contaminated materials. The disposal can will be supplied with a double layer of plastic bags to guard against possible rupture of the plastic by sharp objects or poor seals formed on the seams (seals should be examined). Low level waste may be disposed of in these containers.

Procedure for Disposal Units Within Defined Limits

When the disposal unit is filled, the chemical operator or technician responsible for waste removal will carefully seal the plastic bag with tape or a heat sealing device. The sealed package is to be properly tagged with a radiation reading and the individual's name. All plastic bags containing low level material will be placed in an appropriate container and delivered, by assigned personnel, to the nearest yellow dumpster (Fig. 3.2) for removal to the burial ground. Clean plastic bags will be installed in all disposal cans and Health Physics will check all cans once per day for radiation and contamination levels above those approved by the Health Physics Manual.

Procedure for Disposal Units Exceeding Defined Limits

If a container reads greater than 6 mr/hr, see procedure for handling intermediate or high level waste.

Contamination waste disposal cans are not to be used for high level waste materials. Any disposal can reading greater than 200 mr/hr will be reported immediately to supervision and handled as high level waste.
Procedure for Washable Items

Additional disposal cans appropriately labeled for gloves, shoe covers, etc., will be available for those buildings requiring this service. They will be handled under the same rules that apply to low level waste with the exception that all washable items reading less than 20 mr/hr beta-gamma and 25,000 disintegrations per minute alpha will be sent to the laundry. All materials above these levels of contamination must go to the burial ground as waste.

4. INTERMEDIATE LEVEL WASTE HANDLING PROCEDURE

(6 mr/hr to 200 mr/hr)

Containers

Materials in the intermediate level of contamination must be handled very carefully to prevent the spread of contamination during all handling operations from the originating area to the burial ground. Materials in this range should be placed in cans or boxes purchased from Stores. Inexpensive cans (Fig. 4.1) are available in 1-, 2-, 10-, and 20-gallon capacities at Building 3036. These may be used as primary and/or secondary containment shells for contaminated waste.

Procedure for Disposal Units Within Defined Limits

After the can is full and the lid sealed, it should be smeared. If it does not smear more than 10 mr/hr, it may be placed in a plastic bag, sealed and transported to the yellow dumpster. If the can smears greater than 10 mr/hr, it must be placed in another solid container and sealed. The surface of the outer container must be smear clean in order to control the spread of contamination at the burial ground.
Procedure for Disposal Units Exceeding Defined Limits

Contaminated waste in this range should be removed from the building as soon as possible to reduce the exposure to personnel. If a can is above the specified limits, it should be placed in a garbage can, sealed, and tagged. A special hot truck should be requested to remove the package. (See procedure for disposal of high level waste.)

5. HIGH LEVEL WASTE HANDLING PROCEDURE

(Greater than 200 mr/hr, all alpha)

Containers

High level waste originating from hot cell or glove box operations in the Isotopes Division must be handled with extreme care to prevent exposure to personnel and the spread of high level contamination within the Laboratory. Table 5.1 lists the containers used for disposing of these materials by the Isotopes Division and the characteristics of these containers.

Table 5.1. High Level Waste Carrier Data

<table>
<thead>
<tr>
<th>Type</th>
<th>Cavity volume, gal</th>
<th>Shielding, in. of lead</th>
<th>Weight, lb</th>
<th>Normal building location</th>
<th>Figure No.</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>FPDL Bottom Discharge</td>
<td>1.0</td>
<td>4</td>
<td>1000</td>
<td>FPDL</td>
<td>5.1</td>
<td>11</td>
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<tr>
<td>RDL Bottom Discharge</td>
<td>1.0</td>
<td>4</td>
<td>1500</td>
<td>3047</td>
<td>5.2</td>
<td>12</td>
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<td>Cobalt Garden</td>
<td>0.1</td>
<td>8</td>
<td>1800</td>
<td>3029</td>
<td>5.3</td>
<td>13</td>
</tr>
<tr>
<td>Iodine-131 Ring</td>
<td>0.1</td>
<td>9</td>
<td>3600</td>
<td>3028</td>
<td>5.4</td>
<td>14</td>
</tr>
<tr>
<td>SRO</td>
<td>2.0</td>
<td>3.5</td>
<td>2000</td>
<td>3047</td>
<td>5.5</td>
<td>15</td>
</tr>
<tr>
<td>3036</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead Dumpster</td>
<td>100</td>
<td>1</td>
<td>7500</td>
<td>Burial Ground</td>
<td>5.6</td>
<td>16</td>
</tr>
<tr>
<td>Stainless Steel Dumpster</td>
<td>20</td>
<td>4</td>
<td>8500</td>
<td>FPDL</td>
<td>5.7</td>
<td>17</td>
</tr>
<tr>
<td>Curium Waste</td>
<td>6</td>
<td>1</td>
<td>900</td>
<td>3028</td>
<td>5.8</td>
<td>18</td>
</tr>
<tr>
<td>Cobalt Transfer</td>
<td>0.1</td>
<td>8</td>
<td>3300</td>
<td>3029</td>
<td>5.9</td>
<td>19</td>
</tr>
<tr>
<td>Pierce Waste Carrier</td>
<td>11</td>
<td>8</td>
<td>10,000</td>
<td>3047</td>
<td>6.0</td>
<td>20</td>
</tr>
<tr>
<td>FPDL Top Loader</td>
<td>2.0</td>
<td>4</td>
<td>2000</td>
<td>FPDL</td>
<td>6.1</td>
<td>21</td>
</tr>
<tr>
<td>SLFP Carrier</td>
<td>1.0</td>
<td>4</td>
<td>1500</td>
<td>SLFP</td>
<td>6.2</td>
<td>22</td>
</tr>
</tbody>
</table>
Procedure

To remove high level waste from a hot cell, barricade, or glove box, the radioactive material should be reduced to the smallest size possible and then loaded into a suitable lard can, garbage can, or plastic pail to form the initial containment layer. The container should be sealed in plastic and transferred to one of the carriers previously listed. If a shielded dumpster is used (Fig. 5.6 and Fig. 5.7), it should be placed in the cell or immediately adjacent to the cell for loading with manipulators or long tongs. After the dumpster is loaded and cleaned to shipping tolerances, it should be tagged and immediately removed from the area.

Bottom discharge carriers cannot handle cans sealed in plastic bags. Thus, waste materials should be bagged in plastic and placed in a can or plastic pail; the can or pail should be sealed and finally washed free of all loose contamination before being loaded into the carrier. This procedure will reduce the possibility of contamination at the burial ground and aid in the decontamination of the waste carrier.

Material placed in lead shielded dumpsters must smear less than 100 mr/hr on the outer surface of the package, and the burial ground personnel must be notified as to its contents. If a carrier cannot be removed to the burial ground immediately, it should be properly tagged and roped off to prevent exposure to personnel.

High level waste material should not be removed from a cell until a proper shielding device is ready to receive the package. Garbage cans with improvised shielding may be used with the supervisor's approval, provided prior arrangements for removal have been made with burial ground personnel. The burial ground supervisor will determine if the hot truck or a shielded dumpster is required for removing the cans.
Additional Precautions for Handling High Level Wastes

1. Wash and drain all equipment before removal.

2. Place all glassware and sharp objects in lard cans or garbage cans. This should apply to all levels of waste.

3. All radioactivity used for heat sources should be segregated from all burnable materials and placed in suitable steel containers for immediate disposal.

4. All alpha materials should be triply contained. If heat is no problem, one layer of containment must be a sealed can or cardboard box. The other two layers may be sealed plastic.
Fig. 3.1. Contaminated Waste Disposal Containers
Fig. 3.2. Yellow Dumpster for Low and Intermediate Solid Waste Disposal
Fig. 4.1. Waste Disposal Cans
Fig. 5.1. FPDL Bottom Discharge Waste Carrier
Fig. 5.2. RDL Bottom Discharge Waste Carrier
Fig. 5.3. Cobalt Garden Transfer Carrier
Fig. 5.4. Iodine-131 Ring Carrier
Fig. 5.5.  SRO Carrier
Fig. 5.6. One Inch Lead Dumpster
Fig. 5.7. Stainless Steel Dumpster
Fig. 5.9. Cobalt Transfer Carrier
Fig. 6.0. Pierce Waste Carrier
Fig. 6.1. FPDL Top Loader
Fig. 6.2. SLFP Carrier
APPENDIX D

RADIOISOTOPE AREA EMERGENCY AND EVACUATION PROCEDURE
RADIOISOTOPE AREA

EMERGENCY

AND

EVACUATION PROCEDURE

January 1970

EFFECTIVE DATE

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee
operated by
UNION CARBIDE CORPORATION
for the
U.S. ATOMIC ENERGY COMMISSION
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January 1970

1. RESPONSIBILITIES OF ALL EMPLOYEES

One of the most critical factors in combating emergencies is the ability of the person discovering an emergency to act immediately, with knowledge of what to do, where to get help, and how to get it fast. Any employee can become that person.

Be thoroughly familiar with:

- The responsibilities of a person discovering an emergency (see Sec 2).
- Location and use of fire-fighting and other emergency equipment in the immediate area.
- Plans and assembly points for local and Laboratory-wide evacuations.
- Local and Laboratory-wide alarms and signals (radiation monitoring, fire, evacuation, etc.).
- Names of local emergency personnel in the immediate area.

In an emergency, follow directions of local emergency squad personnel and/or instructions over the public address system.

When instructed to evacuate by alarm or voice:
- Shut down equipment if possible.
- Leave the building or immediate area quickly.
Proceed to the local assembly point.
Stay there until otherwise instructed.

2. RESPONSIBILITIES OF PERSON DISCOVERING AN EMERGENCY

Take immediate and appropriate action to protect personnel, prevent property damage, and bring the emergency under control. This applies to fire, radiation, explosion, personal injury, or any other emergency, and can be accomplished by one or more of the following methods:

- Control the emergency singlehanded if possible.
- Telephone 3-6358 (Emergency Control Center) for help.
- Pull the nearest fire alarm box.
- Call the local emergency supervisor or warden on the Emergency Page System.
- Call a local emergency squad member or anyone near.
- If necessary, evacuate the area by an announcement on the Emergency Page System.
- Meet and orient the emergency service unit or units.

When a call is received by the Emergency Control Center at 3-6358, the dispatcher immediately notifies the Laboratory Shift Supervisor and dispatches the
emergency service units needed (Fire, Guard, Ambulance, Radiation Survey, electrician, chemical operator, etc.).

3. RESPONSIBILITIES OF LOCAL EMERGENCY PERSONNEL

A local emergency squad consists of a local emergency supervisor, wardens, searchers, and other squad members. The responsibilities of each are outlined below.

3.1 Local Emergency Supervisor

Organize and train the local emergency squad and plan for its use in handling the various types of anticipated emergencies; ensure that the local plans are consistent with the overall Laboratory plans. Maintain emergency equipment and evacuation plans.

In the event of a local emergency, direct his squad and ensure that:
Personnel have been evacuated from the affected area.
The Emergency Control Center has been notified.
Emergency service units are met, briefed on the situation, and directed to the scene.
Equipment and processes are shut down as necessary for safety.

The safety of the assembly point has been checked and moved if necessary.

The Laboratory Emergency Director is kept advised of the status of the emergency and of any needed assistance.

Additional manpower is secured if needed.

In the event of a Laboratory-wide emergency, comply with the instructions of the Laboratory Emergency Director, which may include:

Evacuating the area by an announcement on the Emergency Page System.

Accounting for all employees in his area after an evacuation.

Shutting down of process and building equipment.

Assembling his local emergency squad and dispatching it as directed.

3.2 Local Emergency Squad

Control or localize any emergency.

Direct employees from the emergency area to the local assembly point.

Prevent reentry.
Have employees monitored for radioactivity, if need is indicated, before dismissing them.

Direct employees to other assembly points as instructed over the public address system.

3.3 Searchers

Search all areas of building to make sure all employees have evacuated and report to the Local Emergency Supervisor.

Assist the Local Emergency Squad.

3.4 Other Squad Members

Notify or summon assistance from the proper emergency service unit.

Meet and orient the emergency service unit when it arrives.

Make necessary operational changes.

Combat the emergency as required.

Provide rescue service and first aid if required.
4. EMERGENCY SIGNALS AND PROCEDURES

4.1 Radioisotope Area Evacuation Signal

The signal for evacuation of the area is a verbal announcement over the ORNL public address speakers located in the Radioisotope Area buildings and 3026-C building. Fourteen phones located at strategic points in the areas under the jurisdiction of the Isotopes Division are equipped with an emergency page button. The emergency page system is activated by punching the red page button and manually holding the "Push to Page" button in the down position. A verbal announcement to evacuate the area is repeated three times.

When the evacuation announcement is received, the Radioisotope Area personnel will evacuate to the grass plot east of Building 3036. They will wait there for instructions from the "Local Emergency Supervisor" or the "Laboratory Emergency Director" who is the Laboratory Shift Supervisor on duty at the time.

4.2 Radioisotope Area Emergency Squad Signal

The signal for summoning the "Radioisotope Area Emergency Squad" is a verbal announcement over the Radioisotope Area emergency page system. Personnel requiring emergency assistance will activate the
signal by punching the red "Page" button and then manually holding the "Push to Page" button in the down position. A verbal announcement that an emergency exists in a specific location will be repeated three times, slowly and distinctly, to ensure that all emergency personnel have received the message.

The Emergency Squad, the local Emergency Supervisor, and Health Physics personnel will assemble at the announced location and take whatever action is required to handle the emergency.

4.3 Laboratory Evacuation Signal

The Laboratory evacuation signal is a siren-like wail over the ORNL public address system. All radioisotope personnel will follow evacuation routes and assemble in the grassed area east of Building 3036. Further instructions will be given on the public address system.

5. PERSONNEL ASSIGNMENTS

5.1 Radioisotope Area Emergency Squad

The following personnel are assigned to the Radioisotope Area Emergency Squad and will be trained by the Local Emergency Supervisor to handle emergency situations according to Secs 3.2 and 3.4.
Local Emergency Supervisor  
Alternate Emergency Supervisor  
Squad Members  
R. W. Schaich  
J. A. Setaro  
E. H. Acree  
H. Bailey  
E. B. Cagle  
F. L. Herron  
F. Huber  
H. G. Hunter  
B. P. Phillips  
E. E. Pierce  
J. E. Ratledge  
R. E. Keny  
A. J. Smith  
W. G. Tatum  

5.2 Radioisotope Area Searchers  

The following personnel are assigned as "Searchers" for their respective buildings and will be trained by the Local Emergency Supervisor to handle the duties listed in Sec 3.3.

<table>
<thead>
<tr>
<th>Building</th>
<th>Searchers</th>
<th>Alternate</th>
</tr>
</thead>
<tbody>
<tr>
<td>3037 — Second Floor</td>
<td>J. E. Ratledge</td>
<td>H. C. Austin</td>
</tr>
<tr>
<td>3037 — First Floor</td>
<td>T. S. Mackey</td>
<td>E. L. Maples</td>
</tr>
<tr>
<td></td>
<td>Anne Caylor</td>
<td>Donna Watkins</td>
</tr>
<tr>
<td>3038 — Shipping, AHF, R. C. Osborne and Cold Lab</td>
<td>J. B. Walker</td>
<td></td>
</tr>
</tbody>
</table>
6. EMERGENCY EQUIPMENT

6.1 Local Assembly Point

The Local Emergency Supervisor or a designated emergency squad member will inventory and maintain an emergency supply cabinet at the local assembly point (southeast corner 3036 building). This cabinet will contain gas masks, plastic boots, coveralls, airline suits with portable air supply, rubber and cotton gloves, emergency lanterns, rope, and any other item required for emergency problems.
6.2 Process Buildings

Individual building emergency cabinets will be supplied and maintained for quick access during a local emergency. They will contain three gas masks and one complete change of protective clothing.

6.3 Hazardous Areas

A system of permanent posts with cow chains attached will be maintained at strategic locations in the Radioisotope Area to facilitate the isolation of hazardous areas.

7. EVACUATION ROUTES

The evacuation routes are shown on appropriate signs which are posted in strategic locations in the area.

All visitors will be evacuated in the same manner as regular personnel.
DISTRIBUTION

1-8. T. A. Arehart
9. P. S. Baker
10. F. R. Bruce
11. T. A. Butler
12. F. N. Case
13. J. H. Gillette
14-17. H. G. Hunter
18. Lynda Kern
19. C. V. Ketron
20. E. H. Kobisk
21. E. Lamb
22. E. E. Pierce
23. R. A. Robinson
24. A. F. Rupp
25. R. W. Schaich
26. J. A. Setaro
27-31. Laboratory Records
32. Laboratory Records - RC
33-34. Central Research Library
35. Document Reference Section
36-50. DTIE, AEC
51. Laboratory and University, ORO
52. ORNL Patent Office