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**METHODS USED IN THE UNITED STATES HOT LABORATORIES
FOR TRANSFERRING MATERIALS THROUGH GAMMA AND
ALPHA-GAMMA BARRIERS**

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SUMMARY

The importance of suitable procedures for transferring materials through Hot Cell walls cannot be underestimated. To prevent extensive design changes and modifications it is necessary that the methods for introducing and removing materials be well established in the basic design.

With the advent of handling irradiated Pu and other highly toxic radioactive nuclides, it has become increasingly more important that systems be installed which will provide: simplicity of operation, low radiation exposure to personnel and containment of the noxious materials. Frequently it has been necessary to construct new facilities or extensively modify existing cells to cope with problems of containment and transfer when handling these higher specific activity materials.

Many of the procedures used for transferring materials to and from gamma cells may be equally applicable to alpha-gamma facilities. However, to simplify the presentation, the basic subject of transfer methods has been divided into 3 categories: (1) the transfer of non-radioactive materials into gamma and alpha-gamma cells; (2) the introduction and removal of radioactive material through gamma barriers; and (3) the introduction and removal of radioactive materials through alpha-gamma barriers.

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1. The Transfer of "Cold" Materials into Cells

Every facility has some means of introducing tools, waste containers, sample holders, replacement equipment and a host of other "cold" materials into the cells. All faces, including top and bottom, of the cell have been used for this purpose.

A. Transfer Ports

Although it is possible to introduce "cold" equipment by the same method that is used for radioactive materials, it is usually more convenient and economical to provide a simple port for this purpose. Perhaps one of the more often used locations for the type of port shown schematically in Fig. 1 is the operating face. Although this simple device may also be used for removing low level samples from a gamma cell, it can be considered a "one-way" port in an alpha-gamma cell.

Several facilities have converted existing penetrations into pass-through ports by installing a flap device on the cell side and a movable shield on the operating area. An example of this is shown in Fig. 2. Some ports have been installed at an angle thus permitting the item to drop into the cell without the aid of a drawer or push-rod. There are many variations to this type of entry system.

An example of a "lazy susan" arrangement is seen in Fig. 3. This device, used mainly as an inter-cell transfer, could also serve for introducing materials from the operating area.

The use of airlocks in either the horizontal position through the wall shielding or through the roof shield provide a convenient method for introducing materials into alpha-gamma cells.

Bagging techniques using casks or large penetrations through the

wall or roof are frequently used for admitting materials to alpha-gamma cells. The problems are magnified when it becomes necessary to maintain an inert

atmosphere.

The use of a sphincter system, shown in Fig. 4, is a convenient method used at several installations. This does have the disadvantage of accumulating in the box a number of cans which constitute the sphincter valve and the carrier.

II. The Introduction and Removal of Radioactive Material Through Gamma Barriers

Because of the large variety of sizes and shapes of fuel elements and other materials, it is obvious that no one style of transfer port would have universal application. The arrangement and design of cells often dictate the type of transfer operation to be used. In the introduction and removal of "hot" materials again, it is found that use has been made of all faces of the cell.

A. Use of Shielded Casks and Ports

Because of its simplicity of operation and adaptability to almost any cell configuration the cask-port system has widespread use. Although there may be many variations as to size and operation, the basic idea relies on the following: attachment of a shield to a port equipped with a movable plug; the shield has either a retractable bottom or top drawer; the "hot" item is inserted into the cell by means of a push rod through the horizontal faces or floor; or it may be lowered by means of a cable from roof locations.

Essentially the same techniques in reverse apply to the removal of samples and "hot" wastes from the cells.

The use of plastic bagging techniques for both insertion and removal are readily adaptable to this operation.

B. Use of Isolation Areas

In many cases the shields are moved into an isolation area either manually or remotely. The isolation area may consist of: a shielded space behind the cells, a corridor common to a number of cells or a single cell which serves this purpose.

After closing the shield to the isolation area, the contents of the casks are removed and distributed to the various cells by means of remote manipulators, conveyors, pneumatic tubes, transfer drawers, etc. The barriers (usually composed of steel, concrete or lead shielding) between the cells and isolation area are moved remotely by many different methods.

It is in these areas that the high level waste and samples may be properly packaged and shielded.

C. Other Methods

In those hot cell facilities adjacent to reactors employing canals it is not uncommon to have a trench or basin passing below the cell. A hatchway in the floor is used for introducing active materials into the cell. Water transfer tanks below the cell are also used for inter-cell transfers.

Conveyors are used to operate in shielded ducts both below and above cells.

In some cases the casks are placed on movable doors which plug into the cell wall after the normal shield is moved to the side.

Remote controlled vehicles find application in some of the larger cells for transporting the shielding casks and for moving activated materials.

A pneumatic rabbit system is used to transfer active slugs from a canal to a receptacle in the cell.

Shielded labyrinths with remotely controlled conveyors have been used in a few instances.

III. Introduction and Removal of Radioactive Materials Through Alpha-Gamma Barriers

Perhaps one of the most significant advances in hot cell equipment has been that of the transfer equipment for alpha-gamma cells. A great amount of ingenuity by the design engineers is leading towards the development of sophisticated equipment to effect these transfers. It has been found that special packaging techniques were necessary for irradiated Pu because of its pyrophoric

nature, toxicity and self-heating. In general gross quantities of this material should be sealed in metal cans prior to placing in the metal transfer container. This method prevents oxidation and provides a metal to metal contact for the dissipation of heat.

A. Bagging Techniques

The "Berkeley System" of sealing off plastic bags for the removal of hot materials and waste from boxes continues to set the pace for this method of operation.

Variations to this scheme include: horizontal bag-out ports where the sealing operation is carried out after both cell and cask have been shielded with the plastic protruding through a stepped cover on the cask; vertical bag-out systems employing essentially the same techniques as listed above; and the bag-out method in an isolation area where the sealing, bag replacement, etc., are performed remotely.

B. Mechanical Systems

At least four installations employ a mechanical system for introducing and removing materials. The sealed containers are attached to sealed ports on the boxes remotely. The sealing doors or lids are then removed by a variety of actuators to connect the box with the container, see Fig. 5. Some containers are provided with bag-out systems for both low and high level wastes. In Fig. 6 is shown a bag (containing a waste container) attached to the transfer can; a remote sealing method is demonstrated in Fig. 7. Inexpensive disposable containers may also be used on these same systems.

One facility employs a port with sliding seals in a tube to introduce capsules into an inert cell. The seals serve as both a contamination barrier and a means of inerting the tube during transfers.

Since there is an increasing need for handling irradiated alpha emitters in hot cells, much design work is currently in progress to satisfy the requirements peculiar to various installations.

The material presented in this Summary was obtained from the following sources: Proceedings of the Hot Laboratory and Equipment Conferences, Reactor Handbook-Engineering, Nucleonics, and Private Communications. Only those methods used throughout the United States have been presented.

Figure 1

HOT SIDE

~ CELL
WALL ~

COLD SIDE

FLAP
SEAL
DOOR

RECEIVING
TRAY

MOVABLE
SHIELD

PASS THROUGH HOLE

Figure 2

2

LAZY SUSAN PASS THROUGH

Figure 3

Figure 4

Figure 5

Figure 6

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Figure 7

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