Shri Vithalrao Joshi Charities Trust's
B. K. L. WALAWALKAR RURAL MEDICAL COLLEGE
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BKL Walawalkar Hospital, Diagnostic and Research Centre

Radioactive Materials Disposal at Radiotherapy Facility

Department of Radiation Oncology

The Radiotherapy machines are used to treat cancer by delivering radiation to a specific part of the body:

External beam radiotherapy (EBRT) and Internal Beam Radiotherapy (IBRT)

1. EBRT Linear accelerator (LINAC)

Make: Varian Medical Systems

Model: Halcyon

Source: High energy X-rays (6 MV FFF)

2. EBRT Telecobalt

Make: Panacea Medical Systems

Model: Bhabhatron-II

Source: Cobalt-60 Radioactive Material

3.IBRT Brachytherapy

Make: Nucletron

Model: Microselectron.

Source: Iridium- 192 Radioactive Material

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Commitment to radiation safety and environmental protection

a) The ultimate disposal of radiotherapy sources is carried out in a manner approved by the Competent Authority AERB.

b) Ensuring safe disposal of disused radioactive sources and other decayed sources at an authorised waste management facility or return it to the country of origin with prior approval of the Competent Authority; action for the safe disposal of such sources are being initiated without any delay.

AERB Regulatory Compliance

Reference to specific AERB regulations and guidelines followed

1. SAFE TRANSPORT OF RADIOACTIVE MATERIAL

   AERB SAFETY CODE NO: AERB/NRF-TS/SC-1 (Rev.1)

2. SECURITY OF RADIOACTIVE MATERIAL DURING TRANSPORT

   AERB SAFETY GUIDE NO. AERB/NRF-TS/SG-10

Radioactive Waste Categorization

A (1) Description of the sources and their use and security level For Co-60 (EBRT)

Source(s) possess by the facility	: Cobalt-60
Physical form of the source(s)	: Doubly encapsulated sealed source
Number of source(s)	: single source
Category of Radioactive Sources	: Category-1
Type of Use	: Teletherapy
Security level	: Level- A

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B (2) Description of the sources and their use and security level For Ir-192 (IBRT)

Source(s) possess by the facility	: Ir-192
Physical form of the source(s)	: Encapsulated sealed source capsule
Number of source(s)	: Single source
Category of Radioactive Sources	: Category - 2
Type of Use	: Brachytherapy
Security level	: Level- B

Transportation Procedures and Safety Measures for Radioactive Waste

Transportation Procedures

The transportation of radioactive waste is a highly regulated activity that requires strict adherence to safety standards to protect public health and the environment. Here are some key procedures:

Packaging:

Radioactive waste must be packaged in robust containers designed to withstand the rigors of transportation, including vibration, shock, and temperature extremes.

The packaging must be certified by the appropriate regulatory authority.

The waste must be securely fixed within the container to prevent movement during transit.

Labeling:

Each package must be clearly labeled with radiation symbols and specific hazard information.

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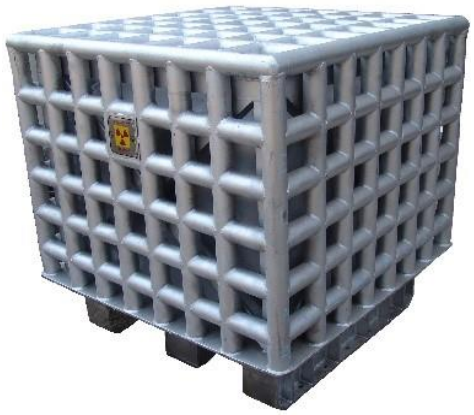
Labels must indicate the type and quantity of radioactive material, as well as any special handling requirements.

Documentation:

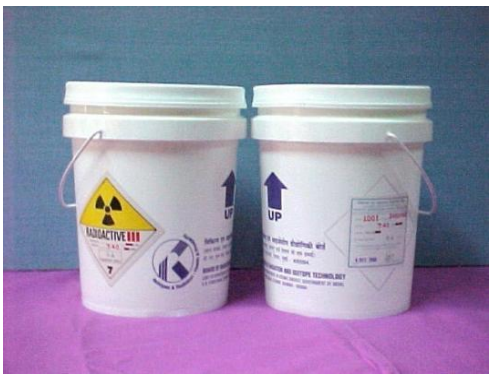
Detailed documentation is required for each shipment, including:

- Shipper and receiver information
- Description of the radioactive material
- Packaging specifications
- Routing information
- Emergency contact information

Cobalt-60 Transport Container



HDR Iridium source container



Vehicle Selection:

Vehicles used for transporting radioactive waste must be specifically designed for this purpose and meet stringent safety standards.

They should be equipped with radiation detection and monitoring devices.

Routing and Scheduling:

The transportation route should be carefully planned to minimize the risk of accidents and exposure to the public.

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The shipment should be scheduled to avoid peak traffic hours and other potential hazards.

Safety Measures

Driver Training:

Drivers transporting radioactive waste must undergo specialized training to understand the risks involved and to know how to respond to emergencies.

Security:

Adequate security measures must be in place to prevent theft or unauthorized access to the radioactive material.

This may include GPS tracking and other security measures.

Emergency Response:

A comprehensive emergency response plan should be in place to handle accidents or incidents during transportation.

This plan should include procedures for containment, evacuation, and decontamination.

Regulatory Compliance:

All transportation activities must comply with national and international regulations governing the transport of radioactive materials.

Regular inspections and audits should be conducted to ensure compliance.

By following these procedures and safety measures, it is possible to transport radioactive waste safely and securely, minimizing the risk of accidents and protecting public health and the environment.

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INSTRUCTIONS TO THE CARRIER

1. The package should be transported by the most direct route.

2. Intermediate off-loading and reloading of the package should be avoided wherever possible.

3. Package should be handled carefully. Suitable mechanical means should be deployed for handling packages weighing more than 30 kg.

4. Persons should not be allowed to sit on the package or spend more time than the necessary time in the vicinity of the package.

5. The package should not be transported along with other dangerous good such as explosives and inflammables.

6. The package should not be transported/stored together with photosensitive films/plates.

7. The package should be kept segregated from spaces occupied by passengers and public.

8. If several packages containing radioactive material are to be transported, then the total number of packages loaded in a single vehicle should be so restricted that the sum of the transport indexes of the packages does not exceed 50, except in case of exclusive use.

Further the total number of packages stacked in a storage area should be so limited that in a given stack the above limit of 50 of the sum of transport indexes is not exceeded and such stacks containing radioactive consignments are separated by at least 6 meters.

9. If the shipment is under exclusive use i.e. the entire conveyance is for the proposed transport of radioactive material then (a) there should not be any intermediate loading and unloading operations of other goods. (b) Nothing other than the intended radioactive material along with its accessories should be carried in this vehicle.

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10. At the destination, it should be ensured that the package is delivered to the consignee to whom it is indeed addressed.

11. One copy of the TREMCARD should be carried in the vehicle carrying the radioactive cargo. If the package(s) get(s) involved in an accident or get(s) damaged during transport, the instructions specified in the TREMCARD should be implemented.

12. If the package is not claimed by the consignee at the destination, it should not be auctioned or otherwise disposed of. The matter should be brought to the notice of the consignor and Head, RSD, AERB, Niyamak Bhavan, Anushaktinagar, Mumbai – 400094 and such measures as recommended in this regard by Head, RSD, AERB, Mumbai,should be duly implemented.

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What is radioactive waste from a nuclear medicine department?

Solid waste in the form of syringes, needles, cotton swabs, vials, contaminated gloves and absorbent materials containing traces of radioactivity (radionuclide or radiopharmaceuticals) is called radioactive waste. Clothing, utensils & body fluids of patients administered with high doses of radioisotopes like I-131 constitute the solid radioactive waste material.

In contrast to other nuclear applications, the use of radionuclides in nuclear medicine department requires mostly one radionuclide per procedure. Radionuclides used in these procedures are mostly short lived i.e. there half life ranges from few hours to few days as compared to the radionuclides used in a nuclear reactor. Hence, waste generated in such a department is managed by delay & decay method.

Waste management right from point of generation.

Segregation of waste is an essential component of radioactive waste management. Waste is segregated at the point of origin itself according to its characteristics and classification. While segregating wastes, characteristics such as half-life, physical and chemical form, metallic and non-metallic forms, dispersible and non-dispersible forms and combustible and non-combustible forms are considered. It is taken care of that nonradioactive waste does not get mixed or collected along with radioactive waste. Further to reduce the volume, the radioactive waste of relatively short half-life is collected separately. If the waste contains chemically toxic or carcinogenic substances, which are incompatible for release to the environment, they are segregated and collected separately and is managed with appropriate procedures.

Solid radioactive waste:

Solid waste in the form of syringes, needles, cotton swabs, vials, contaminated gloves and absorbent materials containing traces of radioactivity contribute to generation of solid waste in a nuclear medicine department. The waste is segregated according to the colour code (red, yellow, blue, black) at the point of generation. This waste is stored at the site (NM department) for physical decay as these radionuclides are short lived and contain tracer quantities of radioactivity. Storage of this waste is done in areas specially reserved for this called as 'radioactive waste storage room' in designated "decay drums". Typically, the waste is kept for decay until 10 half lives of that particular radionuclide which ensures that levels of radioactivity reduce to background levels.

Once the decay period is completed, the waste is monitored to measure the radiation levels & it is ensured that they have fallen to background levels. After ensuring this, the waste can be treated as non-radioactive waste and can be further handed over for normal disposal.

Liquid radioactive waste:

Radioactive liquid waste in a nuclear medicine department consists of body fluids of the patients. This is generally generated from active toilets in the nuclear medicine department. This waste is

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connected directly through leak proof pipelines to delay tanks specially constructed for the purpose. The liquid waste from the tanks should be released to environment only after storage for decay.

Special consideration is always be given to the management of contaminated sharp objects, such as needles and syringes, scalpel blades, blood lancets, glass ampoules, etc. These items are commonly referred as “sharps”. These are stored separately with appropriate containment and marking.

Other types of radioactive waste:

Apart from above mentioned wastes, other types of waste include spent 99Mo- 99mTc generator, spent radioactive phantoms, etc.

Spent 99Mo- 99mTc generator are those which do not provide sufficient yield and concentration of 99mTc radionuclide for procedure purposes. These spent generators contain small amounts of radioactive Molybdenum 99. These spent generators are returned back to the manufacturer or vendor for their disposal after allowing it to decay for 10 half-lives of 99Mo i.e. 660 hours.

Radioactive phantoms are used for the purpose of QA & QC of the PET-CT & SPECT machines. These phantoms contain radionuclides which are long lived (half-life ranging from 270 days to 2-3 years). Gradually these phantoms decay and can no longer be used for calibration of the cameras and need replacement. In such cases, these phantoms are sent back to original manufacturers for proper disposal.