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सचिव

Dr. N. A. Kazmi
Secretary

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ज्ञान-विज्ञान विमुक्तये

By Speed Post

D.O. No. F.10-1/2010 (CPP-II)

4 January, 2011
7 JAN 2011

Dear Sir / Madam,

UGC has prepared guidelines for universities and colleges for procurement, storage, usage and disposal of radioactive and other hazardous materials/chemicals. Awareness of and adherence to these guidelines is of utmost importance, particularly in view of the recent accident of disposal of Cobalt-60 isotope by the University of Delhi in a casual manner causing death of one person and illness to many others.

A copy of the guidelines, which were approved by the Commission in its meeting held on 27th September, 2010, is enclosed.

It may please be noted that compliance of these guidelines is mandatory without exception. Action taken in the matter may please be intimated to UGC at the earliest.

With regards,

Yours sincerely,

(N. A. Kazmi)

Enc: As above

(i). All Vice Chancellors
State Universities/Deemed to be Universities
Central Universities/Private Universities
(List of 506 Universities is attached)

(ii) The Secretary (Higher Education) All States and Union Territories (list attached)

Copy to:

1. The Secretary, Government of India, Ministry of Human Resource Development, Department of Higher Education, Shastri Bhawan, New Delhi 110001.
2. AS-I/AS-II/FA/JS(CU)/JS(DU)/DS(SU)/DS (NRCB)/All ROs UGC
3. The Publication Officer (WS) UGC, New Delhi for posting on UGC website

(V.K. Jaiswal)
Deputy Secretary

UGC Guidelines for Universities, Research Institutes and Colleges for Procurement, Storage, Usage and Disposal of Radioactive and other Hazardous Materials / Chemicals

INTRODUCTION

Radioisotopes and many hazardous chemical substances are routinely used for scientific research by universities and other institutes. There are set protocols for handling/storage and disposal of these substances by regulatory authorities at International level and Atomic Energy Regulatory Board (AERB) at National level. The medical use of radioactive substances and X-rays for diagnosis and treatment is extensive and is fairly well established. However, in Universities and other institutes of higher education and research, the awareness and adherence to regulations seems to be lacking, as has been observed in the recent incident of disposal of Co-60 isotope in a very casual manner causing one death and grave injuries to some common people. Activities concerning hazardous materials/chemicals are regulated by "Hazardous Waste Management and Handling Rules 1989" of Ministry of Environment and Forests.

In view of the seriousness of the issue, the University Grants Commission has constituted an Expert Committee vide order No. D.O. No. F.10-1/2010(CPP-II) to frame guidelines for universities, research institutes and colleges for procurement, storage, usage, and disposal of radioactive and other hazardous materials / chemicals. The Committee studied the various provisions of the existing regulations like the Atomic Energy Act, 1962, the AERB Regulations, the Hazardous Wastes (Management and Handling) Rules 1989 of the Ministry of Environment and Forests, GoI, etc.

After detailed and comprehensive discussions, the Committee framed the following Guidelines on the usage of radioactive and other hazardous material/chemicals by universities/institutions.

GUIDELINES

A. Administrative Mechanism

All the radiation related activities in laboratories have to be carried out by designated Radiation Staff under the supervision of a Radiation Safety Officer (RSO), who can be a faculty with experience in radiation field and get designated as RSO by AERB on the recommendation of the Institution.

Other responsible persons may be designated as Supervisors who can be lab in-charge and actual users who use radioisotopes/hazardous materials/chemicals for research or routine experiments.

Responsibilities of RSO

1. Responsible for procurement/storage/disposal of all radioisotopes used in the campus as per the regulation laid down by AERB.
2. Co-ordination with national authority (AERB) for licensing, guidance, reporting etc.
3. Supervise overall use of radioisotopes
4. Suspend activities deemed unsafe
5. Prepare and disseminate information about radiation safety to all users
6. Train new radiation workers
7. Supervise personnel monitoring services, and maintains records of personnel exposures
8. Ensure that radiation safety guideline and requirements are followed in all laboratories using radioisotopes
9. Investigate unusual incidents or violation involving radioactive material, supervise remedial action and keep the report
10. Supervise & coordinate waste disposal programme as per regulation and keep the proper record
11. Maintain inventory of radioisotopes in all departments
12. Supervise regular contamination and area surveys of facilities where radioisotopes are used

Responsibilities of Supervisor

1. Plan each experiment to ensure that proper safety procedures are employed
2. Instruct all students & employees of safety procedures & monitor their compliance
3. Provide appropriate radiation protection equipments
4. Ensure that only authorized work is done with radioisotopes
5. Notify the RSO, in writing, about the new employees/students who need to work with radioactive material.
6. Ensure that new workers complete the department safety programme
7. Designate an area for appropriate storage of radioisotopes and radioactive waste material
8. Post areas with appropriate radiation symbols/ warnings
9. Maintain inventories, receipts, and use and disposal record of radioactive material.

GKRath

10. Ensure that the areas containing radioactive material are locked after working hours.

Responsibilities of User

1. Each person working with radioactive material should be familiar with the radiation safety manual of the laboratory.
2. They should keep personnel exposures as low as reasonably achievable (ALARA)
3. Wear appropriate safety equipment such as gloves, lab coat, safety glasses etc.
4. Use protective barrier or shield whenever required
5. Always use fume hood when working with volatile radioisotopes
6. Never pipette by mouth. Use appropriate mechanical devices for transferring liquid
7. Do not smoke, drink, eat, store food or apply cosmetic in the lab
8. Wash hands thoroughly after use of radioisotope
9. Always wear personnel monitoring badges like Thermo Luminescent Devices(TLD)
10. Check lab's survey- meters periodically to keep in working order
11. Label radioactive storage containers with following – Radioisotope type, activity, date, user name, symbol etc
12. Keep working area clean, remove unnecessary material
13. Report any unusual incident to supervisor / RSO

B. PROCUREMENT and USAGE of RADIOISOTOPES

Introduction:

Activities concerning establishment and utilization of radiation facilities by using radioactive sources are to be carried out in India in accordance with the provisions of the Atomic Energy Act, 1962, Atomic Energy (Radiation Protection) Rules, 2004 and Atomic Energy (Safe Disposal of Radioactive Waste) Rules, 1987 and various notifications issued there under for implementation of an effective radiation protection programme by ensuring radiation safety of members of the public and occupational workers as well as protection of environment. Atomic Energy Regulatory Board (AERB) India is empowered to exercise the regulatory and safety functions relevant to various practices and Chairman, AERB is the Competent Authority. Any practice involving radiation source requires specific licence in the form of registration. Such registration is issued on the basis of detailed safety assessment during various stages and activities like site selection, design, construction, commissioning, operation, decommissioning and disposal of radioactive sources.

1. Procurement of Sealed radioisotopes

1.1 General

Sealed radioisotopes in different quantities are used in various research applications such as agriculture, industry, biomedical, biological sciences, physical & chemical sciences, education and training. Sealed sources are used either in shielded containers (e.g. gamma irradiation chamber) or in open depending on the activity content.

1.2 Procurement and Registration

The applicant needs to submit an application to AERB to obtain consent for procurement of sealed sources. This also requires submission of details indicating the layout of the site of handling and storage facility for the sources, wherever necessary. These are to be approved by AERB. The sealed source should be type approved or in case of low activity sources it should at least meet the relevant standard prescribed by AERB. Also, the device containing the sealed source(s) should be type approved by AERB. Pre-requisites for procurement of sources include the following:

- Intent of use
- Approval of the design of sources and equipments as per the standards
- Availability of safe and secure source storage facility
- Approval of installation to use the radioactive materials
- Availability of radiation (area and personnel) monitoring
- Availability of qualified and trained man power such as Radiological Safety Officer (RSO) which should commensurate with the degree of potential hazard
- Availability of emergency response plans
- Commitment from prospective users to return spent sources to original supplier

AERB may inspect the sealed source installation site or source storage facility prior to issuance of NOC for procurement of the sources. Based on the review of the application for procurement and information obtained from inspection, if any, AERB may issue the NOC for procurement of radioactive sealed sources. On the procurement of sealed source(s), and after its installation but before its use the applicant should submit the application for registration of sealed sadiation source(s).
The Consentee is required to submit to AERB periodic status report after procurement of sealed radioactive sources. Also, the Consentee shall not transfer the sealed source(s), without the permission of AERB.

Any unusual occurrence or loss of radioactive source or devices with source therein should be promptly reported, within 24 hours, to the AERB and this should be followed by a detailed report.

2. Procurement of Unsealed radioisotopes

2.1. General

Unsealed radioisotopes in small quantities are used as tracers in various research applications such as in agriculture, industry, biomedical, biological sciences, and also in teaching. Normally, a few kBq of radioactive sources like ^{3}H, ^{14}C, ^{32}P, ^{35}S, ^{125}I, etc. are used as tracers in such applications. These sources are generally handled in small quantities as per the requirements and are locally used up. Safe handling of such sources is important to prevent spread of contamination.

2.2 Procurement and Registration

The AERB assesses the application for the use of unsealed sources in the research application, along with the layout plan of the laboratory. Pre-requisites for procurement of sources include the following:

- Intent of use
- Approval of the design of the sources and equipments as per the standards
- Availability of safe and secure source storage facility and temporary provisions for storing radioactive wastes
- Approval of installation to use the radioactive materials
- Availability of Radiation (area and personnel) monitoring
- Availability of qualified and trained man power such as Radiological Safety Officer (RSO) which should commensurate with the degree of potential hazard
- Availability of facilities for decontamination,
- Availability of Emergency Response Plans
- Commitment from prospective users to return spent sources (if any) to original supplier

AERB may inspect the unsealed source installation and source storage facility prior to issuance of NOC for procurement of the sources. Based on the review of the application for procurement and information obtained from inspection, if any, AERB issues the NOC for procurement of radioactive unsealed sources. On the procurement of sources(s), and before its use, the applicant should submit the application for registration of unsealed radiation sources used in research and other applications.

The Consentee is required to submit to AERB periodic status report after procurement of unsealed radioactive sources. The Consentee shall not transfer the source(s), without the permission of AERB.

Any unusual occurrence or loss of radioactive source or devices with source therein should be promptly reported, within 24 hours, to the AERB and this should be followed by a detailed report.

2.3 Additional requirements for laboratory irradiators, X-Ray generators and neutron sources:

1. The design of the room designated for installation of laboratory irradiators, X-Ray generators and neutron sources shall be approved by AERB.
2. Appropriate radiation monitors shall be in place and shall be periodically calibrated.
3. The radiation field in the room shall be prominently displayed along with the radiation symbol.

depends upon the intensity of the radiation field. Higher the field strength, lesser is the size of the detector. Contamination monitoring is carried out by a window type GM detector or a pancake type detector. For contamination check caused due to alpha emitting nuclides either a solid state detector or a scintillation detector (ZnS(Ag)) is used. For personal exposure monitoring, the systems used include TLD, DRD (Direct Reading Dosimeter) or Electronic Personnel Dosimeter. The table A (enclosed as Annexure 5) gives the types of detecting systems needed for different radiations.

It is mandatory to get calibrated all the radiation monitors at a regular interval from an authorized agency (currently it is once in two years as per AERB) and register for personal dosimetry service with a national Agency like PMS/RP&AD, BARC or any other agency authorized by AERB. Such Agency will not only provide the TLD badges, but will also provide read out services and will maintain the dose records.

D. DISPOSAL OF RADIOISOTOPES

1.0 Conditions and procedures for disposal of Radioactive waste by Institutions handling small quantities of Radioisotopes.

Institutions such as universities, colleges, hospitals attached to universities and tracer research laboratories handling small quantities of radioisotopes of short effective half life shall after obtaining the authorization undertake disposal of radioactive waste, in accordance with the following procedures:

1.1 Disposal of Radioactive waste by release into sanitary sewerage system – An authorized person may discharge radioactive waste into a sanitary sewerage system, provided:-

a. The waste is readily soluble or dispersible in water.

b. The maximum quantity of radioactive material released in the sanitary sewerage system is less than the quantity prescribed in **Table.1 (Annx 1)** and is not in excess of the quantity which, if diluted by the average daily quantity of sewerage released into the sewerage system by the authorized institution, will result in an average monthly concentration equal to the limits:-

   i. As specified in Table.1

   ii. As specified by AERB on a case by case basis for radio nuclides, not listed in Table.1.

c. The gross quantity of radioactive material released into the sewerage system by the institution does not exceed 37 GBq per year.

d. When more than one radio nuclide is present in the liquid waste, the sum of the ratios of the individual quantities of each of the radioisotopes present and their respective maximum quantities allowed as per Table.1, does not exceed unity;

e. Periodic maintenance and monitoring of the path-ways of the liquid effluents shall ensure that the appropriate disposal limits are not exceeded.

f. A log book is maintained in the attached **Form.III (Annx 3)** recording the identity and quantity of each radioisotope disposed, its time of disposal, the name of the person who has supervised the waste disposal and the data on radiation surveillance.

2.2 **Disposal of Solid Radioactive Waste---** A person authorized (by University only) may dispose of solid radioactive waste by burial into pits, specially contained, provided:

a. The pit is located in an isolated site owned by the University.
b. The site is duly fenced off to prevent unauthorized entry.
c. The site is duly approved by AERB for disposal of radioactive waste.
d. The total activity of the wastes disposed in the pit does not exceed
   i. the limits specified in **Table.2 (Annex 2)** ; or
   ii. the limit specified by AERB on a case by case basis; for radio nuclides not listed in Table.2
e. When more than one radionuclides is present in the solid waste, the sum of the ratios of the individual quantities of each of the radioisotopes present and their respective maximum quantities allowed as per Table.2, does not exceed unity;
f. The depth of pit is so chosen that the wastes have a top layer of compact earth of minimum 120 cm. thickness when the pit head is closed.
g. Successive pits are separated by a distance of 180 cm.
h. A closed pit is not opened for reuse till 10 half lives, of the longest lived radioisotope disposed in that pit, have elapsed.
i. The material excavated from a closed pit is released for normal disposal, under the supervision of the authorized person and after due assessment of the balance activity before reusing the pit as laid down in (i).
j. Periodic monitoring of the pit and its environment shall be done to ensure that the operational limits on radioactive contamination are not exceeded;
k. A log book is maintained in attached Form.III recording identity and quantity of each radioisotope disposal description of water, time of disposal, name of the person who has supervised the disposal operations and the data on radiation surveillance.

2.3 **Incineration of Radioactive Waste ----** A person authorized by University may incinerate the radioactive wastes, including incineration of radioactive animal carcasses, provided AERB is duly satisfied that----

a. The design of the incinerator is suitable for the intended operations and provides for retention of solid and liquid combustion/scrubbing by products and for controlled discharge of liquid and gaseous effluents;

b. The incineration operations will not result in air borne radioactive contamination in excess of the operational limits prescribed under Radiation Protection Rules , 1971 for unrestricted areas:

c. The solid and liquid radioactive wastes arising from incineration operations shall be duly collected and disposed off as prescribed above.

d. Adequate environmental surveillance, including air monitoring where necessary, shall be provided to ensure that the limits are not exceeded.

e. The incineration operations are undertaken under direct supervision of the radiological safety officer;

f. Up-to-date records are maintained, in attached Form.III of the incineration operations indicating the names of radio nuclides and their amount finally disposed in gaseous, liquid and solid form, the details of such disposals, names of the persons involved in these operations and the date of radiation surveillance.

2.4 Annual records, in respect of the disposal operations, shall be submitted to AERB in form IV (**Annexure 4)**

2.5 Other conditions ---- The authorized person shall abide by ----

(i) Such orders as may be issued by notifications, by AERB modifying the concentrations prescribed in Table.1 or the quantities prescribed in Table 1 & 2(**Annexures 1 & 2)**

(ii) Any other safety measures stipulated by AERB (form III and IV are attached as **Annexure 3 & 4)**

E. EMERGENCY PROCEDURES

EMERGENCY PREPAREDNESS FOR INSTITUTIONS HANDLING SEALED/UNSEALED SOURCES AND GAMMA CHAMBER

Laboratory based activities involving radioactive materials or chemicals may have potential of developing emergency situations. These emergencies can be either radiological in nature (as described below) or may result into fire or explosion while working with chemicals / flammable gases.

1. Emergency scenario: Damage to the container with radiation source due to accidents like fire and explosion.

- Fight fire from a safe distance
- After extinguishing fire, assess the condition of the sealed source container
- In case of damage to the sealed source container, measure the radiation level and record the observations
- If the measured levels are in excess of the prescribed limits, put appropriate

shielding material sheets on the container to reduce the radiation levels in the surrounding area

- Transfer the container into an exclusive storage room and arrange for adequate security
- Inform Head, RSD, AERB, Niyamak Bhavan, Anushaktinagar, Mumbai 400 094 and the supplier of the sealed source about the damage
- Act as advised by Head, RSD, AERB for safe return of the sealed source container to the source supplier if required

3. Emergency scenario: Contamination of personnel while handling unsealed source

- Wash the contaminated part of the body with warm water and mild soap
- A soft brush may help, but ensure that the skin does not get damaged
- Wash for a few minutes and then dry the area
- Repeat washing if necessary, provided there is no indication of damage
- Ascertain with monitor about decontamination
- If the contaminated part of the body has small open wounds, cuts, or punctures, or other injuries, the wound should be washed immediately
- The washing should be carried out in sink in radioisotope lab in a contamination free area
- Ensure the decontamination with wipe test
- Medical aid may be called to remove contamination that persists even after washing.
- Contaminated clothing, hand gloves, etc. should be removed and collected as radioactive waste in polythene bags

4. Emergency scenario: Contamination of equipment while handling unsealed source

- Decontamination should be done as soon as possible to prevent drying and fixation
- Glassware can be cleaned with chromic acid solution or comparable alternative
- For other equipment, a 2% solution of isoclean in water is a good general cleaning fluid. Please remember liquid soaking solution should be monitored by liquid scintillation counting or gamma well counting before disposal

4. Emergency scenario: Disposal of the radiation source container in an unauthorized manner

- Inform the department of the institution that handles scrapping of material
- Inform the security department
- Contact all the possible scrap dealers and inform about container and source by showing pictures

- Survey all the nearby scrap dealers' premises
- Lodge police Complaint

To respond to such emergencies effectively, it is recommended to have University Safety Committee (USC) at University level. It shall be headed by a senior faculty member authorized by the University. The member secretary of the committee shall be either RSO, wherever applicable, or a person authorized by the University for the safety and the security of the radioactive materials. The other members shall be

1. Medical Officer
2. Fire Officer
3. Communication Officer &
4. Security Officer

The committee shall also oversee the safety in handling radioactive material as well as chemicals. Its mandate shall also include discussion and clearances of any new experiment planned either by faculty or students involving hazardous materials / procedures.

E. Handling of Hazardous Chemicals and do's and do not's during an emergency in a chemical lab.-

1.0 **Introduction:** Chemical laboratories in universities, also handle many hazardous chemicals though in smaller quantities. From academic point of view, chemicals are broadly classified into organic chemicals and inorganic chemicals. As far as chemical safety is concerned chemicals are classified based on their dominant hazardous properties. The widely accepted classification is given below:

- Flammable chemicals
- Explosive chemicals
- Gases under pressure
- Oxidizing agents
- Water-sensitive chemicals
- Health hazard causing chemicals (Toxic chemicals)

Many of these chemicals can be hazardous to health and can also cause fires and explosions. The ill effects on health and hazards of fire and explosion can be controlled by a careful study of the hazardous properties of the chemicals. Identifying chemical hazards is the first step towards chemical safety. The useful source that gives details on hazardous properties and safety measures to be adopted is the Material Safety Data Sheet (MSDS). By instituting proper control measures and explaining in detail to students the consequences of violating safety rules and procedures the occurrence of incidents in the chemical labs of the Universities can be avoided or minimized.

1.1 The following measures in storing, usage and disposal of chemicals and responding to emergency shall be implemented.

1. Perform regular inventory inspections of chemicals
2. Make sure all chemicals and reagents are labelled
3. Know the storage, handling, and disposal requirements for each chemical used. Consult the Material Safety Data Sheet (MSDS) for disposal information and always follow appropriate chemical disposal regulations
4. Chemicals like picric acid and many peroxides are sensitive to shock or impact. These chemicals on exposure to shock, impact or heat may release sudden energy in the form of heat or an explosion. Spillage should not be allowed. Such chemicals should be guarded against rough handling
5. Make sure students are wearing the appropriate personal protective equipment (i.e., chemical splash goggles, laboratory aprons or coats, and gloves)
6. Enforce all safety rules and procedures at all times
7. Never leave students unsupervised in the laboratory. Never allow unauthorized visitors to enter the laboratory
8. Never allow students to take chemicals out of the laboratory without authorization
9. Never permit smoking, food, beverages, or gum in the laboratory
10. Use a hot water bath to heat flammable liquids. Never heat directly with a flame
11. Add concentrated acid to water slowly. Never add water to a concentrated acid
12. Use the laboratory fume hood, when there is a possibility of release of toxic chemical vapours, dust, or gases. When using a fume hood, the sash opening should be kept at a minimum to protect the user and to ensure efficient operation of the hood. Keep your head and body outside of the fume hood face. Chemicals and equipment should be placed at least six inches within the hood to ensure proper air flow
13. When transporting chemicals (especially 250 mL or more), place the immediate container in a secondary container or bucket (rubber, metal or plastic) designed to be carried and large enough to hold the entire contents of the chemical

14. General Guidelines for Storage of Chemicals
    - Store acids in a dedicated acid cabinet. Nitric acid should be stored alone unless the cabinet provides a separate compartment for nitric acid storage
    - Store highly toxic chemicals in a dedicated, lockable poison cabinet that has been labelled with a highly visible sign
    - Store volatile and odoriferous chemicals in a ventilated cabinet
    - Store flammables in an approved flammable liquid storage cabinet
    - Store water sensitive chemicals in a water-tight cabinet in a cool and dry location segregated from all other chemicals in the laboratory. Potassium

and sodium metal and metal hydrides are examples; hydrogen is produced with sufficient heat to ignite with explosive violence

- Do not place heavy materials, liquid chemicals, and large containers on high shelves
- Do not store chemicals on tops of cabinets
- Do not store chemicals on the floor, even temporarily
- Do not store items on bench tops and in laboratory chemical hoods, except when in use
- Do not store chemicals on shelves above eye level
- Do not store chemicals with food and drink
- Do not store chemicals in personal staff refrigerators, even temporarily
- Do not expose stored chemicals to direct heat or sunlight, or highly variable temperatures

15. Compressed gases can be hazardous because each cylinder contains large amounts of energy and may also have high flammability and toxicity potential Gases such as acetylene, ammonia, chlorine, hydrogen, nitrogen, oxygen, sulphur dioxide, etc. come under this category. Recommendations for storage, maintenance, and handling of compressed gas cylinders:

- Make sure the contents of the compressed gas cylinder are clearly stenciled or stamped on the cylinder or on a durable label
- Never use cylinders with missing or unreadable labels
- Check all cylinders for damage before use
- Be familiar with the properties and hazards of the gas in the cylinder before using
- Wear appropriate protective eyewear when handling or using compressed gases
- Use the proper regulator for each gas cylinder
- Do not tamper with or attempt to repair a gas cylinder regulator
- Never lubricate, modify, or force cylinder valves
- Open valves slowly using only wrenches or tools provided by the cylinder supplier directing the cylinder opening away from people
- Check for leaks around the valve using a soap solution
- Close valves and relieve pressure on cylinder regulators when cylinders are not in use
- Label empty cylinders "EMPTY" and date the tag; treat it in the same manner that you would if it were full
- Always attach valve safety caps when storing or moving cylinders

- Transport cylinders with an approved cart with a safety chain; never move or roll gas cylinders by hand
- Securely attach all gas cylinders (empty or full) to a wall or laboratory bench with a clamp or chain, or secure in a metal base in an upright position
- Store cylinders by gas type, separating oxidizing gases from flammable gases by either 20 feet or a 30-minute firewall that is 5 feet high
- Store gas cylinders in cool, dry, well-ventilated areas away from incompatible materials and ignition sources
- Store empty cylinders separately from full cylinders

16. Measures to respond to a chemical emergency:

- Educate students on the location and use of all safety and emergency equipment prior to laboratory activity
- Identify safety procedures to follow in the event of an emergency/accident
- Provide students with verbal and written safety procedures to follow in the event of an emergency/accident
- Know the location of and how to use the cut-off switches and valves for the water, gas, and electricity in the laboratory
- Know the location of and how to use all safety and emergency equipment (i.e., safety shower, eyewash, first-aid kit, fire blanket, fire extinguishers and mercury spill kits)
- Keep a list of emergency phone numbers near the phone
- Conduct appropriate safety and evacuation drills on a regular basis

17. Impact of exposure to chemicals on human beings:

The chemicals may be simple irritants, asphyxiants, poison or they may affect a particular organ in the body. They may affect body metabolism or the entire nervous system. These effects are summarized below:

<u>Respiratory Irritants:</u> Gases like ammonia, sulphur dioxide, formaldehyde, chlorine, bromine, etc. cause local irritation of the upper respiratory tract and, if inhaled more deeply, also of the lower respiratory tract and the lungs. They may also cause irritation of the mucous membranes of eye, nose and throat. Oxides of nitrogen and phosgene can cause serious effects in fairly high concentrations.

Chemical Asphyxiants: Gases like CO_2, N_2, H_2, are simple asphyxiants and cause dilution of oxygen concentration. Other asphyxiants deprive the body cells of oxygen. For example, Haemoglobin of the blood has a preferential affinity towards CO (about 300 times greater than for oxygen), hence, when carbon monoxide is inhaled in high amounts, the blood fails to carry enough oxygen to the tissues.

H_2S: Produces respiratory paralysis.

HCN: Protoplasmic poison; prevents oxygenation of the body cells.

Anaesthetics and Narcotics: The anaesthetic and narcotics act as simple anaesthesia without serious systemic effects, and has a depressant action on the central nervous system governed by their partial pressure in the blood-supply to the brain.

18. Biological/biotechnological laboratories

Commonly used radioisotopes in these laboratories are ^{14}C, ^{32}P, ^{35}S. ^{99}Mo, ^{3H} The analytical instruments which may have radioactive sources in these laboratories include

- Liquid scintillation counter
- Solid scintillation counter
- Radio chromatogram analyser
- Neutron Probes

These labs generate wastes of low level. Indent of instruments and radioactive isotopes shall be routed through a single authority, so that complete inventory can be maintained. Adequate facility for collection and processing of low level radioactive waste must be designed and documented. University Safety Committee will be responsible for implementation of this policy.

(Prof.G.K.Rath) **(Dr.D.D.Deshpande)** **(Dr.D.N.Sharma)**

(Dr.S.A.Hussain) **(Dr.Kanwar Raj)** **(Dr.A.K.Kohli)**

(Dr.S.P.Kale) **(Sh.R.Manoj Kumar)**

Annexure - I

TABLE 1

Disposal limits for sanitary sewerage systems

Radionuclide	Maximum limit on total discharge per day	Average monthly concentration of radioactivity in the discharge
	(MBq)	($MBqM^{-3}$)
H^{3}	92.5	3700
C^{14}	18.5	740
Na^{24}	3.7	222
P^{32}	3.7	18.5
S^{35}	18.5	74
Cl^{36}	0.37	74
Ca^{45}	3.7	10.1
Co^{60}	0.37	37.0
Sr^{89}	0.37	11.1
$Sr^{90}+Y^{90}$	0.037	0.148
$Zr^{95}+Nb^{96}$	3.7	74
$Mo^{99}+Tc^{99m}$	3.7	185
$Ru^{106}+Rh^{106}$	0.37	14.8
Sb^{124}	0.37	25.9
I^{125}	3.7	22.2
I^{131}	3.7	22.2
$Cs^{137}+Ba^{137m}$	0.37	14.8
$Ba^{140}+La^{140}$	0.37	29.6
$Ce^{144}+Pr^{144}$	0.37	11.1
Tm^{170}	3.7	37.0
Ir^{192}	3.7	37.0
Po^{210}	0.037	0.74

Annexure - 2

TABLE 2

Disposal limits for Ground Burial

Radionuclide	Maximum activity in a pit (MBq)
H^{3}	9250
C^{14}	1850
Na^{24}	370
P^{32}	370
S^{35}	1850
Cl^{36}	37
Ca^{45}	370
Co^{60}	37
Kr^{85}	3700
Fe^{59}	370
Sr^{89}	37
$Sr^{90}+Y^{90}$	3.7
$Zr^{94}+Nb^{95}$	370
Mo^{99}	370
$Ru^{106}+Rh^{106}$	37
Sb^{134}	37
I^{125}	37
I^{131}	37
Xe^{131}	37
$Cs^{137}+Ba^{137m}$	37
$Ba^{140}+La^{140}$	37
$Ce^{144}+Pr^{144}$	37
Tm^{170}	370
Ir^{192}	370
Po^{210}	3.7

Annexure 7

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FORM III

[see rule 6 (ii)]

1. Name and address of the Institution :

2. Date of issuance of authorisation and its reference No. :

3. Description of unconditioned radioactive waste :

Principal Radionuclides present and their quantity (Bq)	Physical form with description	Chemical form	Total volume

4. Description of conditioned radioactive waste :

Method of conditioning of radioactive waste	Address of agency which conditioned the waste	Radiation level (dose rate) if any on the surface of the conditioned waste package (unshielded)	Weight & volume of package of each type

5. Details of transportation of radioactive waste :

Name and address of the consignee of the package	Mode of packing of the waste for transportation	Radiation level (dose rate) if any, on the surface of transport package (shielded)	Mode of transportation to site of disposal	Date of transportation

6. Details of disposal of radioactive waste :

Date of disposal	Concentration of radioactive material in the final waste form	Site of disposal (identify the location on the relevant layout drawing for reference)	Method of disposal	Persons involved in disposal

7. Data on periodic radiation surveillance:

Date of measurement	Maximum radiation levels at sites of waste handling				Maximum contamination levels in waste handling areas (accessible points)				Maximum concentration of activity in the influence from the installation going to		Action taken in case of high levels of radiation & contamination
	Storage area	Disposal area	Monitoring area (health physics and change rooms etc.	Any other (specify)	Storage area	Disposal area	Monitoring area (health physics and change rooms etc.)	Any other (specify)	Sewage	Other areas (specify)	

8. Data on environmental surveillance:

Date of measurement	Analysis of ground water			Analysis of soil samples			Analysis of air sampling		Analysis of any other samples (give details)
	location of sampling	depth of sampling	activity content (per ml)	location of sampling	depth of sampling	activity content (per gm)	location of sampling	activity content (per ml)	

Annexure · 4

Form IV
[see rule 6(vi)]

Format for Record of Disposal of Radioactive Waste
(To be submitted to the competent authority)

1. Name and address of the Institution :
2. Details of waste disposal operations :

Sr. No.	Date of issuance of auth-orisation for the disposal of radioactive waste and its reference No.	Description of Radioactive Waste					Radiation dose per hour if any, on the sur-face unshield packages	Mode of transport-ation to the site of disposal shield packages	Site of disposal (attach a sketch showing the location(s) of disposal)	Brief descript-ion of the mode of disposal	Date of diposal	Name and designa-tion of radiation workers involved in waste disposal	Remarks (if any)
		Physical form and contents	Chemical form	Princi-pal radio nuclides present and their quan-tities in each packages (Bq)	Total volume of the radio-active waste disposed with No. of packages	Mode of conditioning and packaging							

3. Details of environmental surveillance :

Date of measure-emnt	Analysis of ground water samples			Analysis of soil samples			Analysis. of air samples		Analysis of any other samples (give details
	Location of sampling	Depth of sampling	Activity content	Location of sampling (per ml)	Depth of sampling	Activity content	Location of sampling (per gm)	Activity content (per ml)	

Name and signature of the
Head of the Installation

Name and signature of the
Supervisor incharge/Head
of the disposal operations

Name and signature of the
Radiological Safety Officer

Annexure 5

Table A- Instruments required for radiation protection purpose during handling radioactive material:

Source	Sealed solid/ Liquid	Activity Level	Personal Monitor	Area Monitor	Contamination	Air activity monitor
Alpha	Loose activity/air borne activity	~µCi	Normally not used.	Normally not used.	a) ZnS(Ag) based Monitor. b) Gas flow type detector	Air sampling on filter papers and counting with (a) ZnS(Ag) (b) Gas flow type (c) thin wall GM detector counting system.
Beta	Sealed solid	~mCi	a) TLD b) DIS dosimeter	Normally not used.	Contamination not expected with sealed sources.	Normally not used.
	Liquid	µCi-mCi	a) TLD b) DIS		a) End window GM based	Air sampling on filter and counting

			dosimeter c) extremity dosimeters		Monitor. b) Flow/sealed type proportional counters	with (a) thin wall GM detector (b) Gas flow Prop. counter (c) thin plastic scintillator types of counting systems.
Gamma	Sealed solid	µCi-mCi	a)DRD (Quartz type) b)TLD c)Silicon detector type	a) Sensitive GM b) Scintillator based monitors	Normally contamination is not expected with sealed sources.	Air sampling on filter and counting with (a) end window GM detector (b) Gas flow Prop. Counter type counting system (c) NaI (Tl)/HPGe spectrometry.
	Sealed solid	~ Ci	a)DRD (Quartz type)	a) Ionization chamber		

			b)TLD c)Silicon detector type d) DIS dosimeter	based b) GM based Monitors. c) Teletector		
Neutron	Sealed solid	~ Ci	a) Neutron film b) SSNTD type dosimeters. c) Bubble detectors.	a) Neutron flux monitor. b) Rem counters c) SSNTD	Normally contamination is not expected with sealed sources.	Area and personal monitors are important.
Accelerator	Microtron	Depending on level of type of radiation (i.e α, β, γ or neutron) and purpose (i.e personnel, area etc) above mentioned monitors can be used.				

(Prof.G.K.Rath) (Dr.D.D.Deshpande) (Dr.D.N.Sharma)

(Dr.S.A.Hussain) (Dr.Kanwar Raj) (Dr.A.K.Kohli) 1/7/2010

(Dr.S.P.Kale) (Sh.R.Manoj Kumar)