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HEALTH PHYSICS AND SAFETY GUIDELINES FOR THE DOSAR FACILITY

G.D. Kerr

J. W. Poston

E. M. Robinson

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ORNL-TM-1981

Contract No. W-7405-eng-26

Health Physics Division

H.C. 300; MN 65

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G. D. Kerr, J. W. Poston, and E. M. Robinson

Dosimetry and Applications Research (DOSAR) facility
From ORNL 4113

SEPTEMBER 1967

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee
operated by
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HEALTH PHYSICS AND SAFETY GUIDELINES FOR THE DOSAR FACILITY

G. D. Kerr, J. W. Poston, and E. M. Robinson

INTRODUCTION

It is the health physics and safety policies of the DOSAR Facility to conduct all activities with the lowest reasonable risk of personnel injury or property loss and perform all work and maintain the working environment in accordance with Laboratory health physics and safety regulations.

Staff members and visitors are required to practice the guidelines of this report. They are urged also to give due considerations to safety at all times. The Facility supervisor, reactor supervisor, accelerator supervisor, and Facility health physicist are always available for discussions of the more detailed problems concerning experiments including safety aspects. More detail on specific problems in radiation protection and safety procedures is given in the Oak Ridge National Laboratory's Health Physics Manual and Safety Manual.

I. GENERAL

Each person must have a security badge or meter containing dosimetric devices in order to gain admittance to the DOSAR Facility. Visitors must obtain security meters at the East Portal of the main Oak Ridge National Laboratory complex. It is required that security meters issued to visitors be signed by a staff member on the reverse side if the visitor enters a radiation zone. Meters issued to visitors for more than one day must be left at the Guard Station to the DOSAR area overnight. Visitors may obtain their security meters each morning from the guard at the Facility by presenting him with suitable identification.

In addition, each person entering the area is given a numbered "DOSAR-MUSTER" badge which should be worn on the clip of the security badge at all times. These badges are used to account for personnel in the area during reactor operations and emergencies. "Muster" badges must be returned to the guard each time a person leaves the DOSAR area.

All persons are required to wear a pair of pocket ionization chamber meters when working with radioactive sources or working in the reactor or accelerator buildings. These are located in a tray near the front entrance of Building 7710, the laboratory and reactor control building. Envelopes are provided in the tray for used meters. The envelopes should be signed (name, affiliation, and date), pocket meters placed in the envelopes, and the envelopes containing the pocket meters placed in the tray. A rack located above the tray is for the use of staff members only, and pocket meters should not be removed from it or deposited in it by other persons.

Personnel radiation monitors (audible) and pocket electroscopes are provided in the HPRR and DLEA control rooms for the convenience of persons who wish to monitor their own dose rates or doses, respectively. It is suggested that at least one member in each group that enters Building 7709, the HPRR building, or Building 7712, the DLEA building, wear a personnel radiation monitor to indicate unexpected changes in a radiation field.

In addition, radiation survey meters to measure fast neutron, thermal neutron, and gamma-ray dose rates are available in Room 111. The gamma-ray survey instruments can be used also to estimate the dose rate from small beta-particle sources.¹ Monitoring services will be provided by the Facility health physicist on request of persons who lack familiarity with the proper usage of these instruments.

II. PERSONNEL CONTROL AT THE DOSAR FACILITY

A. Health Physics Research Reactor

The radiation field produced by the reactor makes it necessary to control access to the DOSAR area during reactor operation. Two areas of control are provided at the Facility: an Exclusion Area, surrounded by a fence of a 1000-ft radius around the reactor building, and a Controlled Area, surrounded by a fence with a minimum radius of 3000 ft. In particular, no one is allowed inside the Exclusion Area during any type of operation. Before any reactor operation, a "muster badge" check is requested by the reactor operator, and horns in the area sound for three minutes. Reactor scram switches, which prevent reactor operation, are located inside and outside the reactor building and on the main gate to

the area. The badge check, operation announcements, warning horns, lights, and the use of these switches insure the safety of all personnel before reactor start-up.

A "muster badge" check is completed as follows. All personnel are asked, by a public address announcement, to report for a badge check. This is done through an intercommunication system located in each room of the Facility or by contact with the operator in the control room. If there is any difficulty, a staff member will be glad to assist you. Briefly, the "call-in" button on the speaker is pushed to alert the operator. In a short while, the operator will respond, "Go ahead." Place the switch in the "normal" position and call the muster badge numbers, three at a time. The operator will acknowledge each time three numbers are called. Proceed in this manner until all badges are reported and acknowledged by the reactor operator.

The dose rate in the area between the 1000-ft fence and the 3000-ft fence will vary several orders of magnitude depending upon the type of reactor operation. Therefore, at the time that the operator calls for the badge check, the type of reactor operation and any restrictions will be announced, viz, one of the following:

1. Low power operation, no entry or exit restrictions (outside the 1000-ft fence), or
2. High power operation, remain in the building until further notice, or
3. Burst operation, remain in the building until further notice.

Immediately after the announcement of condition (2) or (3), a red sign over every outside door will be illuminated which states DO NOT EXIT WITHOUT APPROVAL OF REACTOR OPERATOR and an air horn sounds in short blasts for three minutes. This horn can only be heard outside the building and is a warning to anyone who may be outside the shielded control building. In addition, a rope barrier is placed across the main exit of the control building.

Upon reactor shutdown, the warning lights will be turned off, and an announcement will be made that "the reactor is shut down until further

notice." Reactor shutdown from a low power condition is not normally announced except to experimenters directly interested in the operation.

For safety reasons, access to the reactor building is restricted, and visitors will be permitted access to the building only when escorted by a DOSAR staff member. Private vehicles are not permitted inside the inner area fence. Only Government vehicles will be allowed in this area. Transportation will be provided by members of the staff. Removal of equipment from this area should conform to the guidelines presented in the section on "Transfer of Radioactive Materials and Equipment."

In the event a nuclear accident should occur, there will be a general announcement over the public-address system. Instructions will be given as to the proper procedures to follow at this time. NO building evacuation alarm will be given for a nuclear emergency.

In the event of fire in the control building, the fire alarm will sound. This is the ONLY audible alarm located in the control building. The staff members have assigned duties and will carry them out immediately. All unassigned staff members and visitors will assemble outside the front door of the control building. This may be accomplished through the nearest available exit. There are exits at both ends of the control building and through the experiment preparation room. Please note the nearest exit should its use be necessary. At this time a badge check will be held to assure that all personnel are present.

B. The DOSAR Low-Energy Accelerator

The DOSAR Low-Energy Accelerator (DLEA) is located across the street from the laboratory building in Building 7712. Control of the accelerator is accomplished in a shielded trailer located a short distance from the building. The unit is a Texas Nuclear Model 9999 which has been modified to make it capable of delivering a 1-ma beam at 200-kv accelerating potential.

Access to the accelerator building is restricted by the DOSAR staff, and visitors are not permitted in the building unless accompanied by a staff member.

Several personnel safety warning devices are located in and around the accelerator building. The area is surrounded by a chain fence posted

with radiation warning signs. During operation a yellow rope barrier is used to close the entrance to this area. A rotating red light located on top of the building and another red light over the door indicate that the accelerator is on. Inside the building, lights and signs are provided to indicate "High Voltage On" and "Beam On." An automatic-resetting neutron monitor equipped with a rotating blue warning light is also installed in the building (alarm point set at ~ 10 mrem/hr).

Before the accelerator is operated, a PA announcement is made stating the restrictions which apply to the area. All accelerator shutdowns are similarly announced. At this time a green light over the entrance door is turned on.

Equipment which has been connected into the accelerator vacuum must be placed inside two layers of plastic bags and left in the accelerator building until it has been checked and cleared by the Facility health physicist. Removal of other equipment from the building should conform to the guidelines laid down in the section on "Transfer of Radioactive Materials and Equipment."

III. HANDLING OF RADIOACTIVE MATERIALS

A. Encapsulated Radioactive Sources

Sources available for routine use at the DOSAR Facility are shown in Table 1.

Laboratory policies require that areas be posted with warning signs where the dose-equivalent rate exceeds 3 mrem/hr.² Radiation signs on yellow stanchions are provided for this purpose in Room 111. The dose-equivalent rate and source description should be written on these signs with a grease pencil in the manner of the following example:

3 mrem/hr @ 2 meters
²⁴¹Am-B Neutron Source

If the source is not under direct supervision of a person at all times during its use, the area around the source where dose-equivalent rates are greater than 3 mrem/hr should be enclosed with a yellow rope barrier. Rope can be obtained for this purpose in Room 111.

Table 1. Calibration Sources at the DOSAR Facility

<u>Source Material</u>	<u>Source Designation</u>	<u>Source Output</u>	<u>Dose-Equivalent Rate at 1 Meter</u>
^{60}Co	"Little Blue"	8.11 mr/hr $\pm 3\%$ @ 1 meter by NBS on 5/6/60	7 mrem/hr (5/6/60)
^{60}Co	"Big Blue"	104 mr/hr $\pm 3\%$ @ 1 meter by NBS on 4/20/65	90 mrem/hr (4/20/65)
$^{239}\text{Pu-Be}$	M698	1.86×10^6 N/S $\pm 2\%$ by NBS on 12/12/63	3 mrem/hr
$^{239}\text{Pu-Be}$	MRC-274	6.82×10^6 N/S from long-counter comparison with BMS- certified sources	12 mrem/hr
$^{241}\text{Am-Be}$	MRC-110	1.27×10^7 N/S $\pm 2\%$ by NBS on 5/16/66	22 mrem/hr
$^{241}\text{Am-B}$	3000-AM- 114	5.55×10^6 N/S from long-counter comparison with NBS- certified sources	9 mrem/hr

If a rope barrier to control exposure to a source is not practical, areas can be used where access is controlled by other methods, such as the HPRR building or DLEA radiation zone. Radiation signs should be posted near the source in all cases.

Sources should be removed from the storage cage in Room 114 only after steps necessary for limiting exposures to other persons have been taken. Visitors must have the approval of the Facility health physicist unless they are working with a staff member. Name of user and place of use should be recorded on source inventory list located on the storage cage.

Any possible damage to the source during its use should be reported immediately to the Facility health physicist.

Name of user should be removed from inventory list when source is returned to the storage cage.

B. Unencapsulated Radioactive Materials

Visitors must obtain permission from the Facility health physicist to work with unencapsulated radioactive materials. Both staff members and visitors are required to monitor their work continuously. Portable alpha-particle, beta-particle, and gamma-ray survey meters are provided for this purpose in Room 111.

Counting systems employing a scintillation detector for alpha particles, a G-M end window detector for beta particles, and a 2π gas-flow detector for evaluating smears are available in Room 111. In addition, a 7.5×7.5 cm scintillation crystal located in Room 112 is available for evaluation of gamma-ray activity on smears.

Facility tolerances for unidentified surface contamination are:

<u>Type of Activity</u>	<u>Transferable</u>	<u>Direct Reading</u>
α particle	30 dpm/100 cm ²	300 dpm/100 cm ²
β particle and γ ray	200 dpm/100 cm ²	0.05 mrad/hr
Tritium	2000 dpm/100 cm ²	-----

Work with radioactive material at the Facility is limited to those quantities which can be handled safely in a chemical hood or bench top³ (Type C or D Laboratory). Appropriate modifying factors,³ depending on operations to be performed with the material, should be applied which can either increase or decrease the degree of hazard in handling radioisotopes. All work should be carried out on blotter paper.

The Facility health physicist should be notified when work with the radioactive material has been completed so that the area and equipment can be cleared for further use. Contaminated waste should be doubly sealed in plastic bags and deposited in one of the YELLOW waste cans located on the loading dock of the control building.

All radioactive material to be stored at the Facility must be surveyed and identified with a magenta and yellow Radiation Hazard tag.

IV. TRANSFER OF RADIOACTIVE MATERIALS AND EQUIPMENT

A. Interarea Transfer

All items used in the HPRR or DLEA buildings should be returned to the loading dock of the control building and be surveyed before they are brought into the control building. All items used in both buildings should be surveyed for alpha- and beta-particle contamination, although this has never been a problem at either of the buildings. In addition, equipment used in the DLEA should be surveyed for tritium contamination.

If the activity on the items exceeds Facility tolerances,* they should be doubly sealed inside of two plastic bags and identified with a yellow and magenta Radiation Hazard tag.

One problem associated with the use of experimental equipment in both buildings is neutron-induced radioactivity; so that a preliminary survey should be made with field instruments to determine the level of neutron activation in irradiated equipment.

Staff members can complete their own radiation and contamination surveys on equipment and can assist visitors in surveying equipment.

Any contamination of equipment of significant neutron-induced radioactivity (external dose rate >3 mrem/hr) should be reported to the Facility health physicist.

*See Section III. B.

Interarea transfer of radioactive materials are required to be conducted in a manner that will prevent the release and spread of radioactive contamination and minimize personnel radiation exposures.

B. Interlaboratory Transfer

All materials or equipment that involve a shift in supervisory responsibilities must be identified by a properly executed tag of the following type: Material Transfer Clearance, Radiation Hazard-Material Transfer, or Contamination Hazard-Special Handling.

Equipment and tools for reissue are given a Health Physics Material Transfer Clearance if the levels of contamination are less than the following recommended maximum contamination:⁴

<u>Type of Activity</u>	<u>Transferable</u>	<u>Direct Reading</u>
α particle	30 dpm/100 cm ²	300 dpm/100 cm ²
β particle and γ ray	200 dpm/100 cm ²	0.05 mrad/hr
Tritium	2000 dpm/100 cm ²	-----

All transfers of radioactive materials must be identified by a Radiation Hazard-Material Transfer tag properly executed by the shipper and Facility health physicist. Laboratory regulations require all radioactive materials to be adequately shielded and reliably contained while in transit. Secondary containment is required for transfer of liquids, gases, or finely divided solids. On completion of the transfer, the perforated section of the Radiation Hazard tag marked "Transfer" should be removed.

Contaminated equipment being transferred should be contained in a manner that will prevent the release and spread of radioactive contamination. It should be identified by a properly executed Contamination Hazard-Special Handling tag if it is being transferred to the Decontamination Facility. Otherwise, the contaminated equipment should be identified by a Radiation Hazard-Materials Transfer tag.

Equipment in which the external dose due to neutron-induced radioactivity is greater than 0.05 mrad/hr will be treated as radioactive materials and will require a Radiation Hazard Materials Transfer tag for removal from the DOSAR area.

C. Off-site Transfer

In brief, radioactive materials must be packaged, labeled, marked, and certified in accord with Interstate Commerce Commission, Federal Aviation, U. S. Postal, or other applicable regulations.

Before shipment or removal of radioactive or fissile materials in any form (including instrument testing sources, equipment with measurable neutron-induced radioactivity, etc.) from the Laboratory, the Isotopes Division Sales Department should be contacted to determine the proper procedure for handling or transfer of material.⁵

Shipment of radioactive materials can be made from the Oak Ridge National Laboratory only after an appropriate form has been completed (AEC Form-375 if shipment is to a federal agency or AEC Form-391 if shipment is to other organizations). Thus, a visitor should bring the appropriate completed form to avoid delays in shipment of radioactive materials or equipment in which the neutron-induced radioactivity during an experiment will be significant.

V. OTHER SAFETY GUIDELINES

Some safety guidelines⁶ established for the Oak Ridge National Laboratory with which all staff members and visitors at the Facility should be aware are listed below.

Several laboratories, shops, and the DLEA building of the DOSAR Facility have been designated as areas in which eye protection is necessary. These areas are posted with the standard sign:

"SAFETY GLASSES MUST BE WORN IN THIS AREA"

Safety glasses are provided for visitors near the entrances to all these areas. In addition, goggles are required for work with machine tools and chemicals.

Electronics equipment having voltages in excess of 50 volts must be protected from accidental human contact by means of an enclosure, and the

enclosure must be grounded. In addition, power supplies must be labeled DANGER HIGH VOLTAGE and the main switch to the power supply must be clearly identified. All terminals, cables, or exposed electrical contacts on power supplies must be provided with means to prevent accidental human contact.

Gas cylinders must be used in an upright position and adequately fastened or chained to prevent them from falling. Regulators or automatic reducing valves must be used only for the gas for which they are intended. If toxic or flammable gases are being used, an appropriate warning should be posted in a conspicuous manner. In the event of a leak or suspected leak of toxic or flammable gases, a fire alarm should be sounded and the building evacuated immediately.

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- ⁴Health Physics Manual, Oak Ridge National Laboratory.
- ⁵Standard Procedures Manual, Oak Ridge National Laboratory.
- ⁶Safety Manual, Oak Ridge National Laboratory.

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