



Dryden Flight Research Center
P. O. Box 273
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Revision: A

DRYDEN CENTERWIDE PROCEDURE

CODE SH

IONIZING RADIATION SAFETY

Electronically Approved by:
Associate Director

Approved by:
Acting Director, Safety and Mission Assurance

Approved by:
Chief, Safety, Health, and Environmental Office

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1.0 INTRODUCTION

1.1 Purpose

This DCP establishing the minimum procedures and documentation required for safe control of ionizing radiation operations conducted at DFRC and at DFRC controlled sites.

1.2 Applicability

This DCP applies to government and non-government personnel at DFRC, off-site contractors who are under contract to DFRC, and experimenters who utilize DFRC equipment or facilities.

1.3 Scope

This Dryden Centerwide Procedure (DCP) establishes safety policy, defines responsibilities, and prescribes procedures to ensure the protection of people and the environment when projects using ionizing radiation are conducted under DFRC control.

2.0 APPLICABLE DOCUMENTS

2.1 Authority Documents

NPD 8710.2B: NASA Safety and Health Program Policy. This NPD establishes the requirements for the NASA wide safety and health program and is the authority for this DCP.

Title 10 Code of Federal Regulations, Parts 19, 20, 30, 34 & 71: Energy. This CFR is the primary authority for ionizing radiation operations at DFRC.

Title 29 Code of Federal Regulations, Part 1910. 96: Labor. This CFR defines requirements for a safe workplace where radiation sources are being used.

Title 49 Code of Federal Regulations: Transportation. This CFR establishes the requirements for packaging and shipping of radioactive sources.

American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values for Chemical Substances and Physical Agents “TLVs[®]” and Biological Exposure Indices “BEIs[®]”; latest edition. NASA uses TLVs[®] and BEIs[®] as limit values for exposure.

2.2 Guideline Documents

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National Fire Protection Association (NFPA) 801, Standard for Facilities Handling Radioactive Materials. This standard establishes information the local fire department needs in case of fire in a building containing a radiation source.

American National Standards Institute, (ANSI) N43.2; Radiation Safety For X-ray Diffraction and Fluorescence Analysis Equipment. Establishes standards for using x-ray equipment.

California Administrative Code, Title 17 (Public Health), Subchapter 4, California Radiation Control Regulations, and Title 8, Industrial Relations.

3.0 DEFINITIONS

- 3.1 Absorbed dose: the energy imparted by ionizing radiation per unit mass of irradiated material.
- 3.2 Act: the Atomic Energy Act of 1954 as amended.
- 3.3 Activity: the rate of disintegration or decay of radioactive material. The units of activity are the curie (Ci) and the becquerel (Bq).
- 3.4 Adult: An individual 18 or more years of age.
- 3.5 ALARA: “As Low As Is Reasonably Achievable” To make every reasonable effort to maintain exposures to radiation as far below the dose limits as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.
- 3.6 Collective dose: the sum of the individual doses received in a given period of time by a specified population from exposure to a specified source of radiation.
- 3.7 Commission: the Nuclear Regulatory Commission.
- 3.8 Committed dose equivalent (CDE): the dose equivalent to organs or tissues of reference that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.
- 3.9 Committed effective dose equivalent: (CEDE) the sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues.
- 3.10 Controlled area: an area, outside of a restricted area but inside the site boundary, to which access can be limited by the licensee for any reason.

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- 3.11 Declared pregnant woman: a woman who has voluntarily informed the licensee, in writing, of her pregnancy and the estimated date of conception. The declaration remains in effect until the declared pregnant woman withdraws the declaration in writing or is no longer pregnant.
- 3.12 Deep dose equivalent: the dose equivalent at a tissue depth of 1 cm.
- 3.13 Dose or radiation dose: the generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalence or total effective dose equivalent, as defined in 29 CFR 20.1003, Definitions.
- 3.14 Dose equivalent (H_t): the product of the absorbed dose in tissue, quality factor, and all other necessary modifying factors at the location of interest.
- 3.15 Effective dose equivalent (H_E): the sum of the products of the dose equivalent to the organ or tissue and the weighting factors applicable to each of the body organs or tissues that are irradiated.
- 3.16 Exposure: being exposed to ionizing radiation or to radioactive materials.
- 3.17 External dose: the portion of a dose equivalent received from radiation sources outside the body.
- 3.18 Gray: the SI unit of absorbed dose; equivalent to 1 joule per kilogram (100 rad).
- 3.19 Eye dose equivalent: the external exposure of the lens of the eye and is taken as the dose equivalent at a tissue depth of 0.3 centimeter.
- 3.20 Internal dose: the portion of a dose equivalent received from radioactive material taken into the body.
- 3.21 Licensed material: source material, special nuclear material, or by-product material received, possessed, used, transferred or disposed of under a general or specific license issued by the NRC.
- 3.22 Limits or dose limits: the permissible upper bounds of radiation doses.
- 3.23 Monitoring: the measurement of radiation levels, concentrations, surface area concentrations or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses.
- 3.24 Nonstochastic effect: the health effects, the severity of which varies with the dose and for which a threshold is believed to exist.

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- 3.25 NRC: Nuclear Regulatory Commission or its authorized representative.
- 3.26 Occupational dose: the dose received by an individual in the course of employment in which the individual's assigned duties involve exposure to radiation or to radioactive material from licensed and unlicensed sources of radiation, whether in the possession of the licensee or other person. Occupational dose does not include dose received from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released in accordance with §35.75, from voluntary participation in medical research programs, or as a member of the public.
- 3.27 Planned special exposure: an infrequent exposure separate from and in addition to the annual dose limits.
- 3.28 Rad: the unit of absorbed dose. One rad is equal to 100 ergs/grams or 0.01 joule/kilogram.
- 3.29 Radiation: alpha particles, beta particles, gamma rays, x-rays, neutrons, high-speed electrons, high-speed protons, and other particles capable of producing ion.
- 3.30 Rem: the special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rems is equal to the absorbed dose in rads multiplied by the quality factor (1 rem=0.01 sievert).
- 3.31 Restricted area: an area, access to which is limited by the licensee for the purpose of protecting individuals against undue risks from exposure to radiation or radioactive materials.
- 3.32 Sealed source: any byproduct material that is encased in a capsule designed to prevent leakage or escape of the byproduct material.
- 3.33 Shallow-dose equivalent: the external exposure of the skin or an extremity, is taken as the dose equivalent at a tissue depth of 0.007 centimeter averaged over 1 sq. centimeter.
- 3.34 Sievert (Sv): Sievert is equal to the absorbed dose in grays multiplied by the quality factor (1Sv = 100 rems).
- 3.35 Stochastic effects: health effects that occur randomly and for which the probability of the effect occurring, rather than its severity, is assumed to be a linear function of dose without threshold.
- 3.36 Survey: is an evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation. When appropriate, such an evaluation includes a physical survey of the location of radioactive material and measurements or calculations of levels of radiation, or concentrations or quantities of radioactive material present.

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- 3.37 Total Effective Dose Equivalent (TEDE): the sum of deep-dose equivalent and committed effective dose equivalent.
- 3.38 Weighting Factor (Wt): for an organ or tissue is the proportion of the risk of stochastic effects resulting from irradiation of that organ or tissue to the total risk of stochastic effects when the whole body is irradiated uniformly.

4.0 ROLES and RESPONSIBILITIES

4.1 Overview

The chain of responsibility for ensuring that there is a safe work environment at DFRC that follows required safety standards, regulations, codes, and guidelines starts with the Center Director and flows downward through management and supervisors. In addition, each person who works at DFRC must understand that a “condition of employment” is to observe all safety specifications applicable to the task being performed.

4.2 Deputy Center Director

The Deputy Center Director will, with the exception of the Radiation Safety Officer, appoint the members of the Radiation Safety Committee.

4.3 Director, Office of Safety and Mission Assurance

The Director, Office of Safety and Mission Assurance is the official charged with the responsibility for the safety programs at the Center, and will:

- ensure a continuing surveillance of operations utilizing sources of ionizing radiation.
- ensure adequate procedures are in place to provide protection to DFRC personnel, the public, and the environment from sources of ionizing radiation controlled by DFRC.

4.4 Directorates and Single Letter Offices

Directorates and Single Letter Offices are responsible for approving the use of ionizing sources within their jurisdiction.

4.5 Radiation Safety Committee

Members of the Radiation Safety Committee (RSC), with the exception of the Radiation Safety Officer (RSO), will be appointed by the DFRC Deputy Director. The committee will be made up of the RSO, and one member each from Operations Directorate, Projects Directorate, and Office of Safety and Mission Assurance. The committee will be chaired by the RSO who will

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ensure that agendas, meeting minutes, and other communications between committee members are documented and filed. Primary responsibility of the committee is to:

- review and approve DFRC-210, Radiation Project Authorization before the radiation project is put into operation.
- ensure that DFRC is in compliance with the Nuclear Regulatory Commission (NRC) license.
- review past DFRC ionizing radiation activity.
- review and make approval decision on qualifications of Authorized Users (AU) and review DFRC-213, Radiation Experience Record.
- make recommendations to improve the safety of operations of ionizing radiation programs where needed.
- assist the Chief, Safety, Health, and Environmental Office in conducting investigations of accidents or incidents involving radiation operations.
- review ionizing radiation projects semi-annually and as required by the RSO using the appropriate guidelines above. Project renewals will normally be approved during the semi-annual review.

4.6 Safety, Health, and Environmental Office

The Chief, Safety, Health, and Environmental Office is responsible for oversight of the DFRC Radiation Safety Program and will:

- establish and maintain policies for the safe control of ionizing radiation hazards in conformance with applicable regulations and technical guidelines.
- advise DFRC management on matters concerning ionizing radiation safety.
- investigate ionizing radiation accidents and report findings to DFRC management and appropriate regulatory agencies.
- review this DCP annually for necessary revisions.
- appoint the Radiation Safety Officer for DFRC.

4.7 Radiation Safety Officer (RSO)

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The RSO is appointed by the Chief, Safety, Health, and Environmental Office and functions as a link between the user, RSC, and the Chief, Safety, Health, and Environmental Office in matters of radiation safety. The RSO shall have the authority to stop ionizing radiation operations if he/she determines the operation unsafe. In the absence of the RSO, the Chief, Safety, Health and Environmental Office will delegate an alternate or will act as the RSO. The RSO will serve as chairperson of the RSC in addition to the following:

- advise users concerning the storage, handling, and precautionary measures necessary for the safe use of ionizing sources.
- provide the services and equipment for monitoring personnel exposures or dosages such as dosimeters, film badge service, and for measuring ionizing radiation.
- maintain a record of exposure levels on each person working with ionization radiation.
- conduct inspections and surveys necessary to measure the performance of the DFRC Radiation Safety Program and report findings to the RSC and Chief, Safety, Health and Environmental Office.
- serve as the point of contact with AFFTC for ionizing radiation concerns.
- brief the Director of Flight Operations on the hazards of any radioactive sealed source aboard DFRC aircraft to include information to be relayed to the Edwards Fire Department in the event of a crash or landing emergency. (See NFPA 801, Standard for Facilities Handling Radioactive Materials, B-2.5).
- in the event of an accident involving radioactive sealed sources the RSO will instruct the DFRC Emergency Response Team of the hazards involved and recommend measures to control or limit risks to recovery personnel, the public and the environment. When requested by the Chairman of a NASA Accident Investigating Board the RSO will supervise the removal and recovery of radioactive source material.
- ensure that licensed material possessed by DFRC is limited to the types and quantities of byproduct material listed on the license.
- ensure that other radioactive materials brought onto the DFRC site are authorized by the NRC or agreement state under a byproduct material license and that the licensee is authorized to work at the DFRC site under a valid reciprocity agreement.
- ensure the security of radioactive material.

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- ensure that licensed material is transported in accordance with applicable NRC and DOT requirements.
- oversee all activities involving radioactive material, including monitoring and surveys of all areas in which radioactive material is used.
- oversee proper delivery, receipt, and conduct of surveys for all shipments of radioactive material arriving at or leaving DFRC, as well as packaging and labeling of all radioactive material leaving DFRC.
- supervise and coordinate the disposal of radioactive waste.
- oversee the storage of radioactive material not in current use.
- perform or arrange for leak tests on all sealed sources and calibration of survey instruments.
- maintain an inventory of all radioisotopes possessed under the license and limit the quantity to the amounts authorized by the license.
- maintain records required by the regulations.
- perform annual audits of the radiation safety program to ensure that DFRC is complying with all applicable NRC regulations and the terms and conditions of the license.
- ensure that radiation exposures are ALARA.
- ensure that the results of audits, identification of deficiencies, and recommendations for change are documented and provided to management and the RSC for review.
- ensure that prompt corrective action is taken to correct deficiencies.
- ensure that audit results and corrective actions are communicated to all personnel who use licensed material.
- ensure that all incidents, accidents, and personnel exposure to radiation in excess of Part 20 limits are investigated and reported to NRC and other appropriate authorities within the required time limits.
- maintain up-to-date copies of NRC regulations, the license, procedures, and ensure that the license is amended whenever there are changes in licensed activities, responsible

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individuals, or information or commitments provided to NRC during the licensing process.

4.8 Authorized User (AU)

The AU is responsible for the utilization of the source of ionizing radiation. The AU is identified on DFRC-211; Radiation Project Authorization, and is responsible for the following:

- preparation and distribution of an operations plan specifying the manner of handling, use, storage, emergency procedures, and eventual disposition of the ionizing source. In general, the operations plan will describe the actions the AU plans to take to meet the requirements of this DCP. The plan will be reviewed and approved by the RSC. Information provided by the plan will be used to determine if the project falls under NRC licensing requirement.
- implementing the measures in the operation plan and other requirements prescribed by the RSC.
- completing a semi-annual radioisotope inventory using DFRC-215: Radioisotope Inventory Record. A copy of the inventory will be sent to the RSO upon completion.

4.9 Off-site Contractors and Experimenters

Off-site contractors and experimenters are required to provide documented verification that any radioactive material that they intend to bring onto the DFRC site is authorized on a current NRC or agreement state license and that they have obtained a valid reciprocity agreement with the NRC to possess and use that radioactive material in California at DFRC.

4.9.1 Off-Site Contractors

The Contracting Officer (CO), or the Contracting Officers Technical Representative (COTR) will ensure off-site contractors conform to this DCP and supporting documentation.

4.9.2 Experimenters

Experimenters who use radioactive sources at DFRC will conform to the provisions of this DCP. Experimenters will provide a written operation plan for each experiment to the RSO for approval prior to the use of a ionizing source at DFRC.

5.0 PROCEDURES

5.1 Application Procedure

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The prospective AU is required to submit the following DFRC forms or equivalent:

- **DFRC-210: Radiation Project Approval Request.**
This form alerts the RSC that a radiation program coming on line. The RSC reviews and approves DFRC-210.
- **DFRC-211: Radiation Project Authorization.**
The RSC reviews and approves DFRC-211 and specifies any additional approval requirements that need to be addressed. The RSC will also establish the date the project authorization expires. DFRC-211 will include responses to those issues raised before the project may be authorized. This form must be signed by both the Project Manager and the AU. A completed and signed copy will be maintained by the RSO, AU, and Section Chief. The RSO will make recommendations to the RSC, and the Chief, Safety, Health, and Environmental Office based on the findings of the review. The RSO will provide assistance to the AU as necessary.
- **DFRC-213: Radiation Experience Record,** for the AU and each worker.
- **DFRC-214: Receipt of Radiation Regulations.**

5.2 Radiation Safety Officer's Review

The RSO shall review the initial application and evaluate the following factors annually or as necessary:

- qualifications of persons who are working with radiation sources.
- personal exposure history of individual/s (internal and external).
- chemical forms and amounts of the specific radionuclides to be used.
- adequacy of facilities for working with the proposed quantities of isotopes.
- adequacy of the written operating procedures.
- provisions for ensuring the safety of personnel, including the use of hoods and special equipment, methods of monitoring the environment, appropriate dosimeter, and the user's written program.
- radioisotope control records, including inventory, use, storage, and disposal.

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- possibility of contamination.
- the necessity of surveys.
- contamination and radiation control levels.
- posting and labeling of appropriate radiation signs.

5.3 Project Changes and Renewals

The AU may request project changes at anytime. Renewals are normally considered during the Semi-Annual Radiation Safety Program Review conducted by the RSC. The RSO evaluates requests for project changes, makes recommendations to the RSC which then approves or disapproves them.

5.4 Acquisition of Radioisotopes

5.4.1 Purchase Requests

All purchase requests for radioisotopes will be originated by the AU and must be accompanied by an DFRC-212: Application for Radioisotope Procurement. The RSO or designee shall approve the request after confirming that:

- the isotopes are to be used on an approved project.
- the quantity of isotopes does not exceed that approved for the project. A significant increase requires action by the RSC.
- if the users possess a Blanket Purchase Order (BPO) a copy of DFRC- 212 submitted to the RSO prior to any purchase is still required.

5.4.2 Receiving

Incoming radioactive shipments shall be handled expeditiously. Notify the RSO immediately upon receipt of any package labeled, in accordance with DOT requirements, as containing radioactive material. The RSO shall take action to assure that the package external surfaces are monitored to verify that removable contamination levels are less than 2200 dpm/100cm² beta/gamma and 220 dpm/100cm² alpha, if applicable, (see 10 CFR 71.87) and that external radiation levels are as indicated on the shipping papers and label (see 10 CFR 71.47). The monitoring shall be performed as soon as practicable after receipt but not later than 3 hours after the package is received at DFRC during normal working hours

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and not later than 3 hours from the beginning of the next work day if it is received after working hours.

If a package containing radioactive material, even if unlabeled, shows evidence of being crushed, wet, or damaged; precautions should be taken to assure any potential removable contamination is contained and it shall be surveyed promptly in accord with the preceding instructions.

Packages of limited quantities of radioactive materials and excepted articles (see 49 CFR 173.421-428) do not require receipt survey as described in the preceding instructions if they are undamaged and do not require labeling in accordance with DOT requirements.

The RSO shall immediately notify the final delivery carrier and the NRC Regional Office if removable contamination levels on the package exceed the above limits or if external radiation levels exceed those specified in 10 CFR 71.47 or significantly exceed the levels indicated on the shipping papers.

Packages producing external dose rates between 5 and 100 mrem/h at 12" shall be stored only in a posted Radiation Area. Packages producing external dose rates of 100 mrem/h or greater shall immediately be placed in a posted and locked High Radiation Area.

5.4.3 Shipments of Radioisotopes

After the receipt survey of 5.4.2 is complete, the package may be transferred to the AU and moved to an appropriately posted and controlled storage or work area.

5.5 Custody of Radioisotopes

The AU is responsible for the custody of any radioactive material acquired and for the proper accountability, storage, labeling, use, inventory, posting of work and storage areas, and disposal. Records of these transactions must be maintained by the AU with copies provided to the RSO.

5.6 Storage and Inventory of Radioactive Material

5.6.1 Radioactive Material shall only be stored in appropriately posted and controlled rooms, lockers, or cabinets in accordance with the requirements of 10 CFR 20, Subpart I and J.

5.6.2 In conjunction with the semi-annual radioisotope inventory, the AU shall survey the sealed sources and transfer to designated storage, return to supplier, or dispose of as radioisotope waste no longer needed.

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5.6.3 The RSO will assure that an annual review is conducted of the sealed sources in designated storage and determine which may be disposed of.

5.7 Disposal of Radioisotopes

Should licensed radioactive material no longer have any potential future programmatic use or if it is considered radioactive waste, it may only be disposed by transfer to an authorized user, return to the manufacturer, or transfer to a waste disposal facility. Should waste disposal be necessary, specific waste handling, preparation, packaging, and shipment procedures must be developed, approved by the RSC, and implemented in accordance with the requirements of 10 CFR 20, Subpart K, and the guidance of NUREG-1556, vol. 7, Appendix K.

5.8 Transfer and Shipment

5.8.1 Shipments to the Center

Prior to arranging for radioactive material transfer to DFRC, the AU will contact the RSO to assure requirements have been met. DFRC-212: Application for Radioisotope Procurement will be used to meet this requirement, see 5.4, above.

5.8.2 Transfer within the Center

Radioactive materials may not be transferred from one person or project to another without the approval of the RSO. Radionuclides must be packed so they do not present a hazard to DFRC employees or the environment and will be moved under the direction of the RSO.

5.8.3 Shipment from the Center

Shipments of radioactive materials from the Center must be approved by the RSO. This requirement applies to all methods of removal including mailing or hand carrying. Packaging, monitoring and labeling of radioactive materials must be performed under the direct supervision of the RSO or designee and must comply with Department of Transportation regulations contained in 49 CFR. Shipments must be made through the Dryden shipping contractor unless otherwise coordinated with the RSO.

6.0 SAFETY PRECAUTIONS

6.1 General

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Only authorized and trained personnel will be permitted to use radioisotopes or radiation generating devices. Such persons must have read and understand required radiation regulations and signed DFRC-214: Receipt of Radiation Regulations.

6.2 Dosimetry

- All persons working with sources of radiation who are likely to receive in 1 year a dose in excess of 10 percent of the limits of 10 CFR 20.1207 shall participate in a dosimetry program as determined by the RSO. The badges must be processed quarterly and the results made available to the user upon request. The RSO will investigate all cases of exposures in excess of one-third of the permissible annual limits.
- Personnel at DFRC who are occupationally exposed to radiation or radioactive materials shall have their exposures monitored in accordance with the requirements of 20 CFR, Subpart F, to verify compliance with the occupational dose limits of Subpart C. At present, the use of sealed sources is not sufficient to require individual monitoring. No detectable external radiation exposure is expected to result from their use. Should occupational radiation exposure from byproduct radioactive materials be possible in the future, a dosimetry program in support of that activity will be instituted.
- The RSO must be notified immediately if any radiation exposure occurs or is suspected to be above one-third of permissible annual limits. The film badge of the individual concerned must be processed and evaluated at once.

6.3 Posting and Labeling

Warning Signs

Areas containing radioactive materials or radiation hazards shall be posted in accordance with the requirements of 10 CFR 20, Subpart J.

Containers of radioactive material shall be labeled in accordance with the requirements of 10 CFR 20.1904 and 1905.

6.4 Emergencies

6.4.1 Accidents Inside Buildings

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In emergencies, involving radioactive materials, caused by plant operations, (explosives, accidental release of materials, etc.) or by external forces (earthquake, storm, etc.), the following general procedures apply:

- The RSO or other members of the Radiation Safety Committee and the Chief, Safety, Health, and Environmental Office must be notified of the emergency.
- The affected area must be surveyed by a qualified person as soon as possible to assess any radiological hazard.

6.4.2 Transportation Accidents

In the event of an accident or emergency that results in damage to a radioactive source while such materials are being transported on-site, the person/s authorized to use or transport source will:

- notify the RSO or Chief, Safety, Health, and Environment Office as soon as possible and assist in making an initial assessment of potential hazards. If the situation dictates, use the Emergency 911 Telephone Emergency Notification System.
- remain at the scene in a safe area as the responsible person/s until relieved.

7.0 SURVEILLANCE AND REVIEW

7.1 Surveys

The RSO shall make or cause to be made such survey as may be necessary to comply with the regulations of 10 CFR 20 and any specific byproduct material license and are reasonable under the circumstances to evaluate the extent of radiation levels; concentrations or quantities of radioactive material; and the potential radiological hazards that could be present.

7.2 Sealed Source Leak Testing

Sealed source must be tested for leakage or external contamination under the supervision of the RSO at six month intervals or as specified in the NRC license under which they are possessed. If any leak test reveals the presence of more than 0.005 microcurie of contamination, the sources must be repaired, removed from use and decontaminated or disposed.

7.3 Record Reviews

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7.3.1 Semi-annual Records Review

In addition to the records listed below the RSO shall maintain and review records of orders, receipts, inventories, transfers, and disposal of radioactive material semi-annually. These records are in addition to those required to be kept by each AU:

- record of leak tests of all sealed sources.
- reports of periodic radiation surveys.

7.3.2 Annual Program Review

The RSO shall conduct an annual audit of the radiation safety program and the activities of each AU to ensure that DFRC is complying with all NRC regulations and the terms and conditions of the license; the content and implementation of the radiation safety program to achieve occupational doses and doses to members of the public that are ALARA; and required records are maintained.

The RSO and the AU will make an evaluation of safety procedures and the results of the periodic surveys made. The findings of the evaluation will be made available to the RSC which will also review the project. The review is the basis for a renewal of the project authorization by the RSC.

8.0 X-RAY GENERATING EQUIPMENT AND OTHER RADIATION MACHINES

8.1 Approval Requirements

Because byproduct material is not involved, the use of x-ray generating equipment is not subject to Nuclear Regulatory Commission control. However, because radiation is produced which may be harmful to personnel, the RSC will make the operation of these units subject to the overall DFRC radiation safety control program. The RSC reserves the right to approve the operators of these units. Each prospective operator must submit a request to the RSC for approval to operate x-ray generating equipment.

8.2 Types of X-ray Machines

8.2.1 Analytical X-ray Machines

This type of x-ray machine is used to examine the chemical or physical structure of a material by diffraction of an x-ray beam or fluorescence from the material and use

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energies generally less than 100 keV. Specific requirements for analytical x-rays may be found in ANSI N43.2; Radiation Safety for X-ray Diffraction and Fluorescence Analysis Equipment, and protection standards of the Department of Energy, Order 5480.11. (Title 17 instead)

8.2.2 Radiography X-ray Machines

Are used for inspection by producing images on photographic film. This type of x-ray may also be used to deliver radiation dose to a biological or material specimen. When the power level is over 1 MeV the machine is considered an accelerator and must be treated as such.

9.0 FIELD RADIOGRAPHY

9.1 Field Radiography Procedures

The RSO shall ensure that field radiography is accomplished in compliance with the following:

- the RSO will be notified one week prior to any field radiography. This time is needed to evaluate and approve the operation as well as to insure proper notification of DFRC personnel of any restrictions resulting from the operation.
- the radiographer shall have a current safety manual and radioactive material license on file with the RSO. If the radiographer does not possess NRC radioactive material license a reciprocity to work on a federal site will be required.
- fulfillment of the above requirement, the radiographer will be granted approval to perform services at DFRC under the following conditions:
 1. the radiographer and an assistant must be present at all times during the operation.
 2. all work will be performed under the conditions set forth in DFRC-216: Radiation Work Permit.
- the RSO will conduct safety audits of the radiography installation and monitoring procedures. The radiographers will assume primary responsibility in controlling personnel access and exposures to restricted radiographic areas.

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- the RSO or designee shall have the authority to shut down a field operation if he or she believes the safety of the radiographer or ancillary people is in jeopardy.
- based on the radioactive material being used, a barricade will be set up around the radiography operations and the area will be posted Radiation or High Radiation as required by the RSO.
- radiography operations in close proximity to buildings will require caution.

10.0 RADIATION DOSE LIMITS

10.1 Dose Limits:

- The occupational dose limits of 10 CFR 20, Subpart C, shall be complied with. A prospective evaluation has been performed and it has been determined that unmonitored individuals are not likely to receive, in one year, a radiation dose in excess of 10% of the allowable limits in 10 CFR Part 20. No occupational dose is anticipated as a result of the storage and use of licensed radioactive material at DFRC.
- persons working with ionizing radiation will not be exposed to radiation from any source either internally or externally that causes a dose level greater than 5.0 rem per calendar year. If a person is transferred from one radiation program to another the cumulative exposures must be determined.
- the dose equivalent received by any organ or tissue during any calendar year from internal and external sources shall not exceed 50 rem.
- the dose equivalent received by the lens of the eye shall not exceed 15 rem.
- persons may receive larger doses than listed above if the requirements listed in 10 CFR 20.1206 are met.
- If exposure occurs due to an accident or deep dose exposure the amount received must be subtracted from the annual limit.

10.2 Persons Under 18 Years of Age

At DFRC, no person under the age of 18 shall be allowed in any area where exposure to radioactive material or radiation producing devices could occur.

10.3 Pregnant Workers

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10 CFR 20.1208 limits the dose to an embryo/fetus during the entire pregnancy, due to occupational exposure of a declared pregnant woman, to 0.5 rem. The biological effects of ionizing radiation upon the embryo/fetus are summarized in NRC Regulatory Guide 8.13. A pregnant worker or a worker who could become pregnant should consider the information provided in the Regulatory Guide and the specific requirements of the regulations. If that worker elects to declare her pregnancy, DFRC will take action to control that workers occupational exposure to ionizing radiation in accord with the requirements of the regulations.

11.0 TRAINING

General Employee Training is offered to all personnel at DFRC. This training informs personnel that DFRC has a radioactive material license with the NRC and that radiation producing devices and other radioactive materials are used at the site. It details the hazards of these sources; identifies the Notice to Employees, the regulations, the conditions of the license, the DCP and the procedures in use; identifies the locations where documents and postings can be found; instructs employees in the postings in use, labeling and actions required of personnel with regard to postings and labelings.

11.1 Authorized User (AU) Training

Personnel who work under the authority of a Radiation Project Authorization or Radiation Work Permit shall receive training commensurate to the hazard involved. Training will include:

- review of regulations, standards, and guidelines that direct radiation programs.
- structure of the DFRC Radiation Safety Program.
- review of safety requirements.
- other items specific to current or proposed radiation operations at DFRC.

11.2 X-ray Operators and Technicians

Three (3) hours or longer dependent on type of equipment being used.

11.3 Refresher Training

- Technicians ; four (4) hours annually.

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- Authorized Users; one (1) hour annual update of regulations, standards, guidelines, and DFRC policies. May be timed to correspond with annual renewal.
- Authorized Users and Technicians; persons who operate specialized radiation equipment will take advantage of the manufacturer's training programs whenever possible.
- Certificates of training; certificates of training, or copies thereof, will be kept on file by the RSO for three (3) years following termination of the project.
- Contractor and Experimenter Personnel; Persons coming to DFRC from licensed facilities to work under DFRC license and who's training is current and documented are exempt from receiving the initial training. Training from this category of persons will be an orientation of DFRC's general safety requirements and a review of this DCP.

12.0 MANDATORY REPORTS

Reports will be made to the Nuclear Regulatory Commission in accordance with 10 CFR 20, Subpart M-Reports.

12.1 Immediate notification

Notwithstanding any other requirements for notification, each licensee shall immediately report any event involving byproduct, source, or special nuclear material possessed by the licensee that may have caused or threatens to cause any of the following conditions --

(1) An individual to receive --

(i) A total effective dose equivalent of 25 rems (0.25 Sv) or more; or

(ii) A lens dose equivalent of 75 rems (0.75 Sv) or more; or

(iii) A shallow-dose equivalent to the skin or extremities of 250 rads (2.5 Gy) or more; or

(2) The release of radioactive material, inside or outside of a restricted area, so that, had an individual been present for 24 hours, the individual could have received an intake five times the annual limit on intake (the provisions of this paragraph do not apply to locations where personnel are not normally stationed during routine operations, such as hot-cells or process enclosures).

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- (3) A loss of 1 working week or more of the operation of any facilities affected.
- (4) Damage to property in excess of \$200,000.

12.2 Twenty-four hour notification

Each licensee shall, within 24 hours of discovery of the event, report any event involving loss of control of licensed material possessed by the licensee that may have caused, or threatens to cause, any of the following conditions:

- (1) An individual to receive, in a period of 24 hours --
 - (i) A total effective dose equivalent exceeding 5 rems (0.05 Sv); or
 - (ii) A lens dose equivalent exceeding 15 rems (0.15 Sv); or
 - (iii) A shallow-dose equivalent to the skin or extremities exceeding 50 rems (0.5 Sv); or
- (2) The release of radioactive material, inside or outside of a restricted area, so that, had an individual been present for 24 hours, the individual could have received an intake in excess of one occupational annual limit on intake (the provisions of this paragraph do not apply to locations where personnel are not normally stationed during routine operations, such as hot-cells or process enclosures).
- (3) A loss of 1 day or more of the operation of any facilities affected.
- (4) Damage to property in excess of \$2,000.

12.3 Other Reportable Events

In addition to the immediate and 24 hour reports listed above, 30 day written reports are also required for each incident. There are also other reportable conditions. See 10 CFR 20 .2203 for details.

13.0 RECORDS

13.1 Record Maintenance

13.1.1 Authorized User

The Authorized User will maintain all records required by this DCP, the Radiation Project Authorization, the NRC license, and 10 CFR 20, Subpart L, with copies provided to the RSO. These shall include but may not be limited to: records of radiation exposure

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(Forms NRC 4 & 5), records of surveys, records of individual monitoring results, inventories, and records of receipt, transfer, and disposal of radioactive materials. After completion of the project a disposition for the records will be made. Title 10 CFR Part 20 Subpart L and NPD 1441.1; Records Retention Schedules, will be used for disposition of the records. A record of all radioactive materials used in projects under DFRC control must be included. The AU shall maintain all such records in an ordered and accessible manner as they are subject to periodic RSO and NRC review.

13.1.2 Radiation Safety Officer

The RSO is responsible for maintaining a copy of records and receipts such as approval requests and authorizations, procurement, inventories, surveys, calibrations, bioassay results, individual dose records, waste disposal, and any other records that pertain to the NRC license under which the Center is operating.

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APPENDIX A

ILLUSTRATED IONIZING RADIATION CONTROL FORMS

The illustrations of Safety, Health, and Environmental Office (SH) radiation control forms on the following pages are for the guidance of Authorized Users, RSO and others who must make applications, requests and reports, with respect to the use of radioactive materials and equipment.

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DFRC-210 - Radiation Project Approval Request	27
DFRC-211 - Radiation Project Authorization	28
DFRC-212 - Application for Radioisotope Procurement	29
DFRC-213 - Radiation Experience Record	30
DFRC-214 - Receipt of Radiation Regulations	31
DFRC-215 - Radioisotope Inventory Record	32
DFRC-216 - Radiation Work Permit	33

RADIATION PROJECT APPROVAL REQUEST

PROJECT TITLE _____

PROJECT OBJECTIVE _____

AUTHORIZED USER'S ORGANIZATION _____

Maximum Quantity of Radioisotopes Required at One Time.

Specific Isotopes	Quantity	Chemical Form
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Area and Facility to be Used:

Building _____ Rooms _____

Radioisotope Hood Located in Room _____

Survey Meter Type _____ Decal No. _____

Scintillation Counter Liquid Crystal Located in Rm. _____

Attachments:

1. An outline of the operational steps involving radiation.
2. Radiation safety procedures to be used including self-monitoring.
3. Radiation experience record, SH Form 23, for all workers.
4. Receipt of radiation regulations, SH Form 24, for all workers.

Submitted by _____ Date _____

APPLICATION FOR RADIOISOTOPE PROCUREMENT

- | | |
|--|-----------------------------|
| 1. NAME OF AUTHORIZED USER _____ | 4. RSC PROJECT # _____ |
| 2. BRANCH CHIEF _____ | 5. DATE OF REQUEST _____ |
| 3. NAME AND ADDRESS OF SUPPLIER

_____ | 6. PURCHASE REQUEST # _____ |
| | 7. DATE OF DELIVERY _____ |
| | 8. BLDG./ROOM _____ / _____ |

RADIOISOTOPE REQUESTED

9. CATALOG OR ITEM NO.	10. RADIOISOTOPE	11. CHEMICAL FORM	12. ACTIVITY REQUIRED mCi	μCi
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

STATEMENT OF USE

13. STATE PROPOSED USE OF RADIOACTIVE MATERIAL.
- _____
- _____

- | | |
|---|---|
| 14. JOB ORDER NO. _____ | 15. ISOTOPE USED IN HUMAN BEINGS Yes ___ No ___ |
| 16. IN ANIMALS YES ___ NO ___
DATE _____ | APPROVED _____
RADIATION SAFETY OFFICER |

RECEIVING INFORMATION

For shipping and packaging instructions see (49 CFR 173.448)

Distribution: 1 copy to Radiation Safety Officer
 1 copy to procurement
 1 copy to originator

DATE RECEIVED _____	DELIVERED TO BLDG./ROOM _____ / _____
REMOVABLE CONTAMINATION	TIME/DATE OF DELIVERY _____ / _____
TYPE ACTIVITY	DELIVERER'S INITIALS _____
1. _____	RECEIVER'S INITIALS _____
2. _____	
3. _____	

DFRC-212,
8/00

RADIATION EXPERIENCE RECORD

NAME _____ ORGANIZATION CODE _____

1. TYPE OF TRAINING	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB (CIRCLE ONE)	FORMAL COURSE
a. PRINCIPLES OF RADIATION PROTECTION			YES NO	
b. ACTIVITY MEASUREMENT TECHNIQUES			YES NO	
c. MATHEMATICS BASIC TO USE OF RADIOACTIVITY			YES NO	
D. BIOLOGICAL EFFECTS OF RADIATION			YES NO	
2. EXPERIENCE WITH RADIATION (ACTUAL USE OF RADIOISOTOPES OR EQUIVALENT EXPERIENCED)				
ISOTOPE	MAX. AMOUNT	WHERE EXPERIENCE WAS GAINED	DURATION OF EXPERIENCE	TYPE OF USE
3. RADIATION DETECTION INSTRUMENTS USED				
TYPE OF INSTRUMENT	RADIATION DETECTED	USE (MONITORING, SURVEYING, MEASURING)		

Signature _____ Date _____

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RECEIPT OF RADIATION REGULATIONS

The Nuclear Regulatory Commission (NRC) requires that persons using radioisotopes are aware of the Code of Federal Regulations governing the use and handling of radioisotopes. If a NRC license is required NRC can require DFRC to furnish proof that these regulations have been seen by all users.

Please read and understand the following Dryden Centerwide Procedure and Federal Regulations before engaging in any program using ionizing radioactive material.

Contact the DFRC Safety Office for assistance in obtaining these documents .

I HAVE READ AND UNDERSTAND THE FOLLOWING:

Check:

- 1. Dryden Centerwide Procedure (DCP) Ionizing Radiation Safety.
- 2. Title 10, Code of Federal Regulations, Part 19, 20 & 30.

DATE _____ SIGNATURE _____

DFRC-214
8/00

