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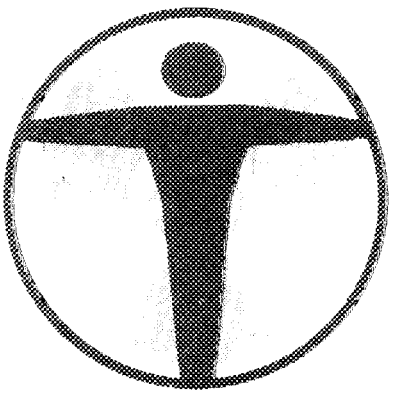
Technical Qualification Requirements and Training Programs for Radiation Protection Personnel at Oak Ridge National Laboratory



OPERATED BY
MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

ORNL/TM-10119

TECHNICAL QUALIFICATION REQUIREMENTS AND TRAINING PROGRAMS FOR RADIATION PROTECTION PERSONNEL AT OAK RIDGE NATIONAL LABORATORY

Approved by Environmental and Occupational Safety Div. Director — Date 4/15/86

Approved by Health Physics Department Head — Date 4/15/86

Approved by Radiation and Safety Surveys Department Head — Date 4/15/86

Approved by DOE Representative — Date 6-25-86

Prepared by the
Oak Ridge National Laboratory
Oak Ridge, Tennessee 37831
operated by
Martin Marietta Energy Systems, Inc.,
for the
U.S. DEPARTMENT OF ENERGY
under Contract No. DE-AC05-84OR21400

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TECHNICAL QUALIFICATION REQUIREMENTS AND TRAINING PROGRAMS FOR RADIATION PROTECTION PERSONNEL AT OAK RIDGE NATIONAL LABORATORY

Prepared by:

Environmental and Occupational Safety Division

E. D. Copenhaver
Technical Resources Group

with the assistance of

B. S. Houser, H. M. Butler, Jr., J. S. Bogard,
M. F. Fair, C. E. Haynes, and D. C. Parzyck

Date Published: April 1986

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Printed in the United States of America. Available from
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road, Springfield, Virginia 22161
NTIS price codes—Printed Copy: A07; Microfiche A01

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FOREWORD

The Environmental and Occupational Safety Division (EOSD) Technical Resources Group, which is a multidiscipline group, was appointed by the EOSD Director to perform the following tasks:

1. Audit the existing training programs in the Division against the requirements stipulated in DOE Order 5480.1A, Chapter V, Chapter VI, and EPA RCRA Regulations.

2. Make recommendations for any needed improvements in the current training program to comply with DOE Orders, and EPA regulations.

3. Prepare training-program documentation as required by the DOE Orders, and ensure that the document is amenable for audit by internal and DOE auditors.

4. Periodically review the documentation, procedures, and/or operations at the various facilities and report the status of implementation of the recommended changes, as applicable, to the Division Director.

5. Keep abreast of training needs, problems, accomplishments, etc., at other DOE facilities.

6. Keep abreast of any new requirements in the field so that these changes can be incorporated into the Division's training program.

This guide to training of radiation protection personnel has evolved from current procedures and practices at ORNL and elsewhere, guidance from DOE, and our efforts to establish performance-based training strategies. Many persons have assisted us. In particular, we would like to acknowledge the assistance of the group leaders and other staff within the two EOSD departments covered; John Robinson and Ned Rockwell of Westinghouse Idaho Nuclear; Bill Culbert of Operations Division, ORNL; and Marcus Weseman and the other members of the TRADE Radiation Protection Special Interest Group (SIG). They have provided relevant materials, reviewed drafts, or made substantive suggestions to improve this effort. In addition, the clerical efforts of Frances Neal have helped to make it possible to incorporate that technical assistance into a coordinated plan for ORNL radiation protection staff.

LIST OF ACRONYMS

ABHP	American Board of Health Physicists
ALARA	As Low As Reasonably Achievable
ART	Aerosol Release and Transport
BSR	Bulk Shielding Reactor (3010)
CAAM	Continuous Alpha Air Monitor
CAM	Continuous Air Monitor
CEF	Critical Experiments Facility (9213)
CEUSP	Consolidated Edison Uranium Solidification Program
CHP	Certified Health Physicist
CTA	Alpha Counter
CTB	Beta Counter
DOE	Department of Energy
DOSAR	Dosimetry Applications Research (7700)
EBT-P	Elmo Bumpy Torus - Proof of Principle
EBT-S	Elmo Bumpy Torus - Scale
EOSD	Environmental and Occupational Safety Division
FPDL	Fission Products Development Laboratory (3517)
GMSM	Geiger Muller Survey Meter
HFIR	High Flux Isotopes Reactor (7900)
HHIRF-ORIC	Holifield Heavy Ion Research Facility-Oak Ridge Isochronous Cyclotron (6000)
HP	Health Physics
HPRR	Health Physics Research Reactor (7700)
HRLAL	High Radiation Level Analytical Laboratory (2026)
HVL	High Voltage Laboratory (5500)
IVGS	In Vivo Gamma Spectrometry
INPO	Institute of Nuclear Power Operations
LITR	Low Intensity Test Reactor (3005)
MPBB	Maximum Permissible Body Burden
MPC	Maximum Permissible Concentration
MPOB	Maximum Permissible Organ Burden
NERP	National Environmental Research Park
NRRPT	National Registry for Radiaton Protection Technologists
NSPP	Nuclear Safety Pilot Plant (7500)
OGR	Oak Ridge Graphite Reactor (3001)
OJT	On Job Training
ORAU	Oak Ridge Associated Universities
ORELA	Oak Ridge Electron Linear Accelerator (6010)
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Research Reactor (3042)
PCA	Pool Critical Assembly
RSS	Radiation and Safety Surveys
SIG	Special Interest Group
TLD	Thermoluminescent Dosimeter
TRL	Transuranium Research Laboratory
TRU	Transuranium Processing Facility (7920)
TSR-II	Tower Shielding Reactor
TURF	Thorium Uranium Recycle Facility (7930)

1. INTRODUCTION AND APPLICATION

The type of equipment and the nature of the work performed at Oak Ridge National Laboratory are somewhat unique and subject to requirements different from those required of more conventional industries. Of primary importance are requirements regarding the qualifications and training of the individuals performing radiation work at nuclear facilities and managing other hazardous material handling facilities.

This document deals with the policies and practices of the EOSD at the Oak Ridge National Laboratory (ORNL) in regard to the selection, training, qualification, and requalification of radiation protection staff assigned to reactor and nonreactor nuclear facilities. Included are personnel at facilities that: (1) operate reactors or particle accelerators; (2) produce, process, or store radioactive liquid or solid waste; (3) conduct separations operations; (4) engage in research with radioactive materials and radiation sources; and (5) conduct irradiated materials inspection, fuel fabrication, decontamination, or recovery operations.

The EOSD personnel also have environmental surveillance and operational and industrial safety responsibilities related to the total Laboratory.

There are four departments within EOSD (see Figure 1). These departments include the Environmental Management Department, the Health Physics Department, the Radiation and Safety Surveys Department and the Safety Department. While all of these departments have responsibilities related to reactor and nonreactor nuclear facilities, Radiation and Safety Surveys and Health Physics Department staff are assigned to specific nuclear facility support and will be required to comply with all formal training and certification requirements of DOE Order 5480.1A (Chapters V and VI).*

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* DOE Order 5480.1A. Environmental Protection, Safety, and Health Protection Program for DOE Operations (Chapter V: Safety of Nuclear Facilities; Chapter VI: Safety of Department of Energy-Owned Reactors).

DOE Order 5500.2. Emergency Planning, Preparedness, and Response of Operations.

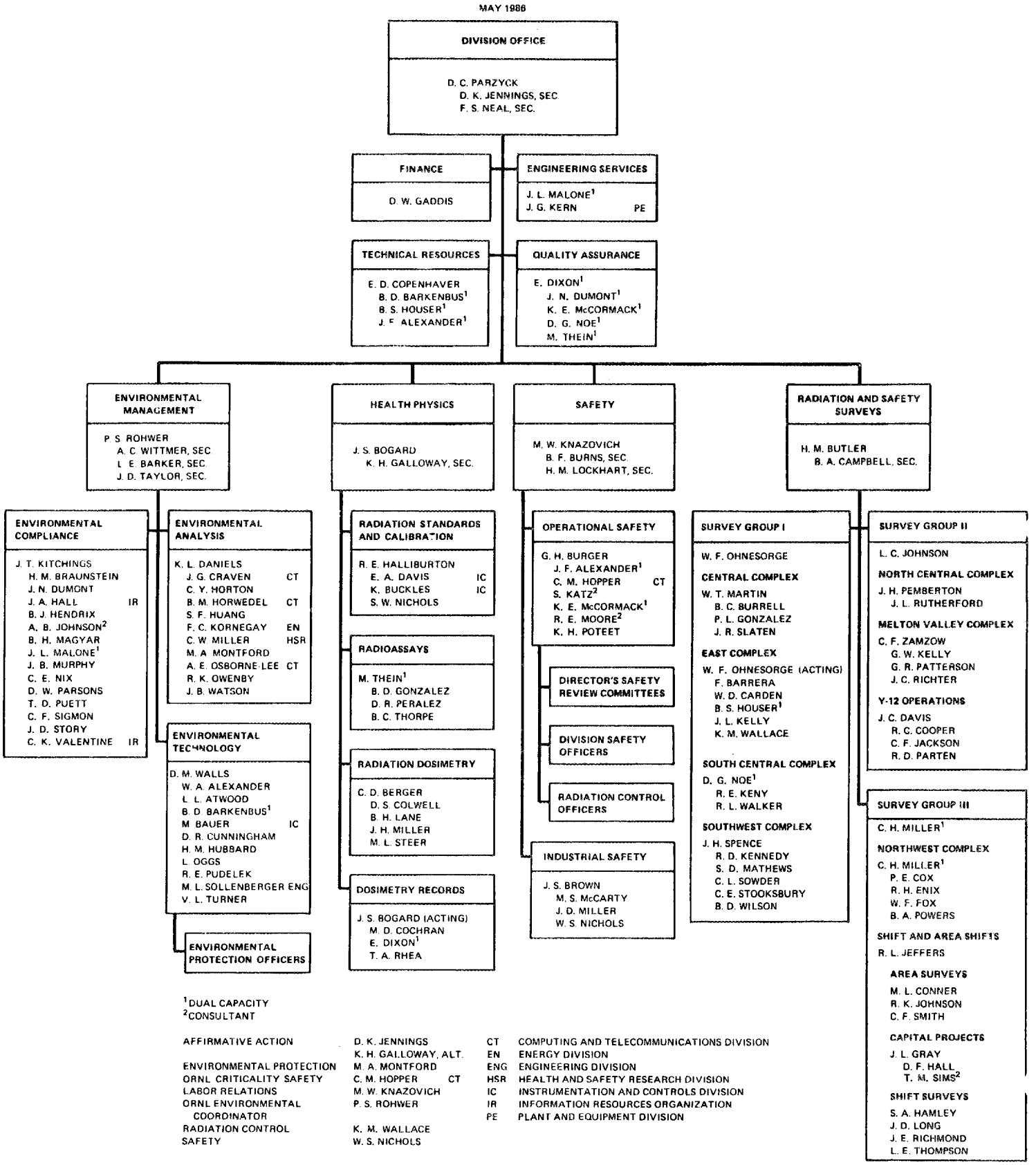
DOE Order 5500.3. Reactor and Nonreactor Nuclear Facility Emergency Planning, Preparedness, and Response Programs for DOE Operations.

DOE Order 5480.2. Hazardous and Radioactive Mixed Waste Management.

Martin Marietta Energy Systems, Inc., Policy Procedure ESH-8. Safety Review and Documentation Program.

Oak Ridge National Laboratory, Standard Practice Procedure 29. Safety Review and Documentation Program.

ENVIRONMENTAL AND OCCUPATIONAL SAFETY DIVISION



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SAFETY	K. M. WALLACE
	W. S. NICHOLS

CT	COMPUTING AND TELECOMMUNICATIONS DIVISION
EN	ENERGY DIVISION
ENG	ENGINEERING DIVISION
HSR	HEALTH AND SAFETY RESEARCH DIVISION
IC	INSTRUMENTATION AND CONTROLS DIVISION
IR	INFORMATION RESOURCES ORGANIZATION
PE	PLANT AND EQUIPMENT DIVISION

Figure 1

The EOSD requires that all technical staff be formally trained in order to perform their work in a safe and efficient manner so as to provide for their health and safety, that of their coworkers, and members of the public.

The requirements for reactor and nonreactor nuclear facilities are stipulated in several different, yet interrelated, documents. The Division's policies and procedures for the selection, training, qualification, and requalification of personnel are covered in this document and are based on, and in compliance with, requirements and/or guidelines stipulated primarily in DOE Orders 5480.1A (Chapters V and VI), 5500.2, 5500.3, 5480.2, and Martin Marietta Energy Systems, Inc., Policy Procedure ESH-8, ORNL Standard Practice Procedure 29, and the ORNL Guide for Nonreactor Nuclear Facility Training.

In the following chapters, the functional job descriptions, qualification requirements, responsibilities and duties, are outlined for all of the EOSD's technical staff; training needs are assessed; and training program content, conduct, and documentation are detailed.

2. POSITION REQUIREMENTS

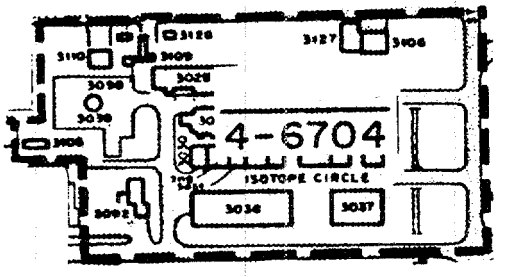
The complexity of radiation protection requirements at ORNL is determined by the broad range of radiological environments to be monitored within a research and development laboratory. The current document provides an outline of specific tasks to be done, an outline of task responsibilities and an enumeration of qualification requirements. This information was developed through an evaluation of existing position descriptions and an augmentation of these position descriptions to ensure that the descriptions were consistent with current organizational responsibilities. The position descriptions were developed from technical input derived from professional staff in the field. The level of detail is appropriate to the current situation where technicians are supervised in the field by the professional staff. Detailed job task analyses were not done on these positions due to this strong supervisory role. Our job descriptions were also augmented through development of learning objectives adapted from the Institute of Nuclear Power Operations (INPO) Radiological Protection Technician Qualifications, and additional comparisons with similar programs by other DOE contractors were made.

The two radiation protection departments in ORNL's Environmental and Occupational Safety Division have approximately 60 positions to meet the need for several levels of technical competence and quite varied facility services. These two departments--the Radiation and Safety Surveys Department and the Health Physics Department--provide radiation protection to ORNL operations using different devices and techniques.

The RSS Department provides radiation protection coverage to the laboratory by dividing it geographically into complexes. The following is a very brief description of the Complexes; a more complete description is given in Appendix A.

Central Complex

This complex consists of all the buildings (15 structures) in the radioisotopes area (the 3030 series buildings).

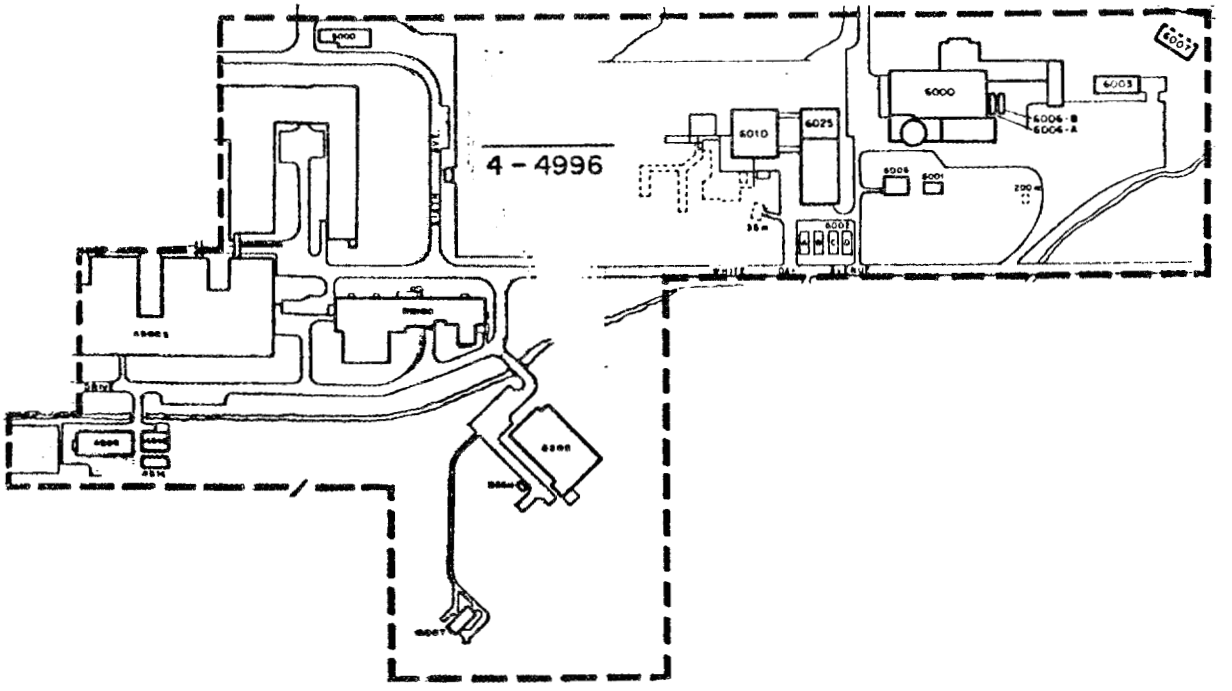


Major activities taking place in this Complex relate to the separation, packaging and shipment of radioisotopes. Some research and development work takes place but it is not a major effort. However, radiation protection guidance is provided. Both exempt and nonexempt radiation protection employees are assigned to this Complex.

The division responsible for most of the operations taking place in this area is the Operations Division, with the Health and Safety Research and the Metals and Ceramics Divisions supporting some small part of it. A major modification to the cell ventilation system has just been completed, requiring close surveillance by RSS Department staff. There are two radiation survey offices in the Complex, one in Building 3038 and one in Building 3047.

East Complex

The East Complex contains three wings of Building 4500S, two wings of Building 4500N, Building 5500 (High Voltage Laboratory), Building 5505 (Transuranium Research Laboratory), Building 6010 (Oak Ridge Electron Linear Accelerator) and Building 6000 (Holifield Heavy Ion Research Facility-Oak Ridge Isochronous Cyclotron).



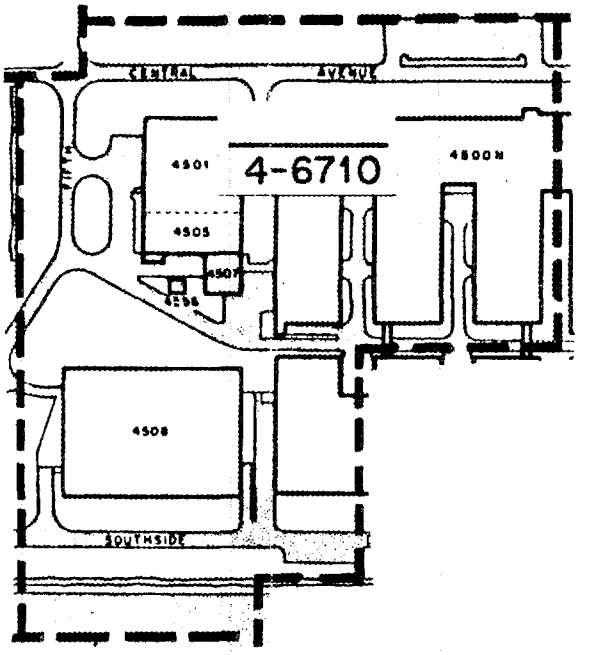
The activities requiring radiation protection surveillance in this Complex are those related to radiochemical labs (hoods and glove boxes) and accelerators. The 4500 building has experiments which involve slightly higher than trace quantities of radioactive material and which have contamination control as a concern. The Transuranium Research Laboratory (TRL) has significant quantities of heavy element radioisotopes present and has contamination control as well as control of external exposures as a concern. Three unique accelerators exist in the 6000 area, presenting potential radiation protection problems. While they are operating, extremely high levels of radiation can be produced, requiring interlocks and other safeguards to ensure protection of personnel (particularly at ORELA). Additionally, radiation may be produced at these machines in a manner that makes its presence difficult to quantify (extremely high level, minutely short pulses of radiation).

In addition, the East Complex office maintains a list of all radio frequency generating equipment (including microwave) and surveys the equipment periodically to insure compliance with Laboratory regulations.

Both exempt and nonexempt radiation protection staff are assigned to the East Complex. There are three offices where RSS staff perform their work in this complex. These offices are located in Bldgs. 5505, 4500S, and 6010.

South Central Complex

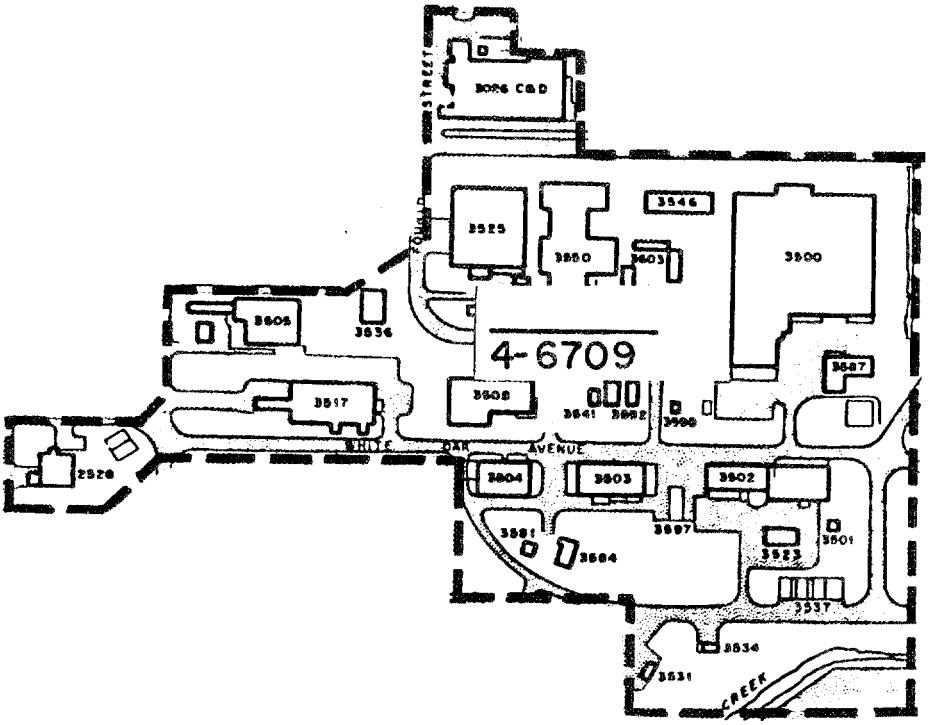
The South Central Complex is made up of three wings of Building 4500N, one wing of Building 4500S and Buildings 4501, 4505, 4507 and 4508.



The Complex Leader is assisted by exempt staff and other temporary help as needed. Much of the work that takes place in this Complex is supported by the Chemical Technology Division and the Metals and Ceramics Division and involves fuel recycle and/or fuel element development projects. Radiochemical laboratories are located in Buildings 4500 and 4501. Operations in Building 4507 have been discontinued, but the facility has not been decontaminated and decommissioned. Until that is done, limited surveillance of conditions in that building will be required. The Metals and Ceramics Divison has a number of laboratories in Building 4508 where sizeable quantities of natural and enriched uranium are present. There are three radiation survey offices in the Complex, located in Bldgs. 4500N, 4501, and 4508.

Southwest Complex

The Southwest Complex consists of all buildings bounded by Third and Fifth Streets as east and west boundaries and Central and White Oak Avenues as north and east boundaries. Some few buildings on the southeast side of White Oak Avenue are also included.

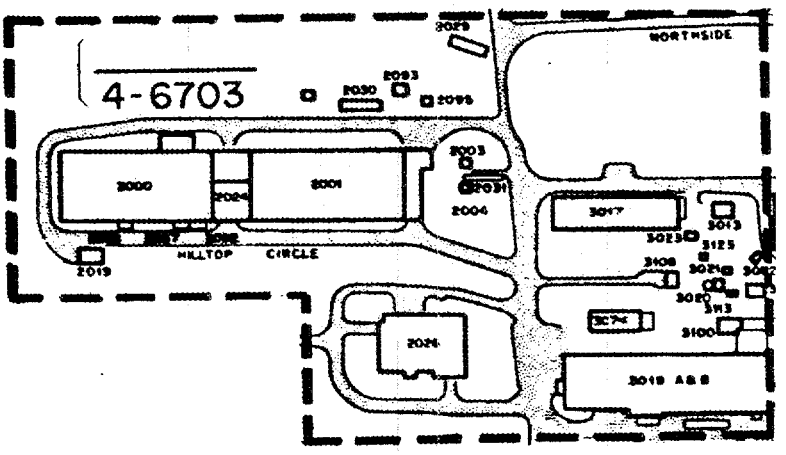


The divisions responsible for most of the activities in this Complex are the Operations, Chemical Technology and Instrumentation and Controls Divisions. Activities in two of the buildings (3525 and 3517) offer a challenge to the radiation protection staff because of the large inventories of radioactive material that exist there. Building 3525 is used as a high-level radiation examination laboratory and is a place where irradiated fuel elements (containing kilocurie quantities of fission products) can be inspected, segmented, repackaged, etc. Criticality control measures are administered in Building 3525, requiring some knowledge of criticality safety by the RSS staff. Building 3517 (Fission Products Development Laboratory) is a facility where megacurie quantities of ^{90}Sr and ^{137}Cs have been handled. Consequently, large residual quantities continue to exist there in piping and other facility fixtures. The waste systems within this complex are undergoing inspection and renovation. Decontamination and decommissioning efforts are currently taking place at the Metal Recovery Facility (Building 3505). Contaminated cells and other building surfaces in this structure will be cleaned for possible reuse.

Exempt and nonexempt employees are assigned here. There are four radiation survey offices and two remote work stations in this Complex. Along with the main office in Bldg. 3550, there are offices in 3517, 3525, and 3026D. The work stations are located in 3505 and 3508.

Northwest Complex

The Northwest Complex consists of those buildings in the northwest portion of the Laboratory, as well as five others outside that geographical boundary. They are Buildings 1503, 1504, 1505, 1506 (Environmental Sciences Division) and Building 2011 (Metal and Ceramics Division).

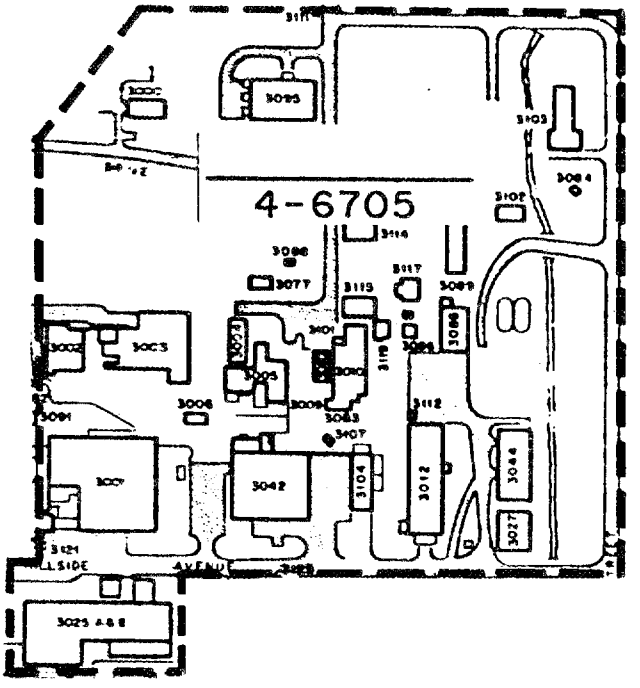


Two major facilities exist in this Complex: Buildings 3019 (Radiochemical Pilot Plant) and 2026 (High Radiation Level Analytical Laboratory). Building 3019 currently houses one of the largest radioactive inventories at ORNL and is the facility where programs such as uranium solution solidification and storage operation is taking place. The CEUSP (Consolidated Edison Uranium Solidification Program) is underway. The Complex Leader and other staff in this Complex have played a significant role in the development of procedures and processes to be used during this program. The High Radiation Level Analytical Laboratory (HRLAL) offers challenging contamination control problems as it is a facility where extremely radioactive samples are sent for analysis. Hot cells and glove boxes are used in this process. Criticality control measures are used in Building 3019, requiring the RSS staff to be familiar with criticality safety. The Environmental Sciences Division uses trace quantities of radioisotopes in a variety of ways requiring surveillance and advice from the Radiation and Safety staff.

This Complex contains two offices located in Bldgs. 3019 and 2026, and the Complex Leader is assisted by both exempt and nonexempt staff members.

North Central Complex

The North Central Complex consists of approximately 25 structures bounded by Hillside Avenue on the south, Fifth Street on the east and Building 3001 on the west.

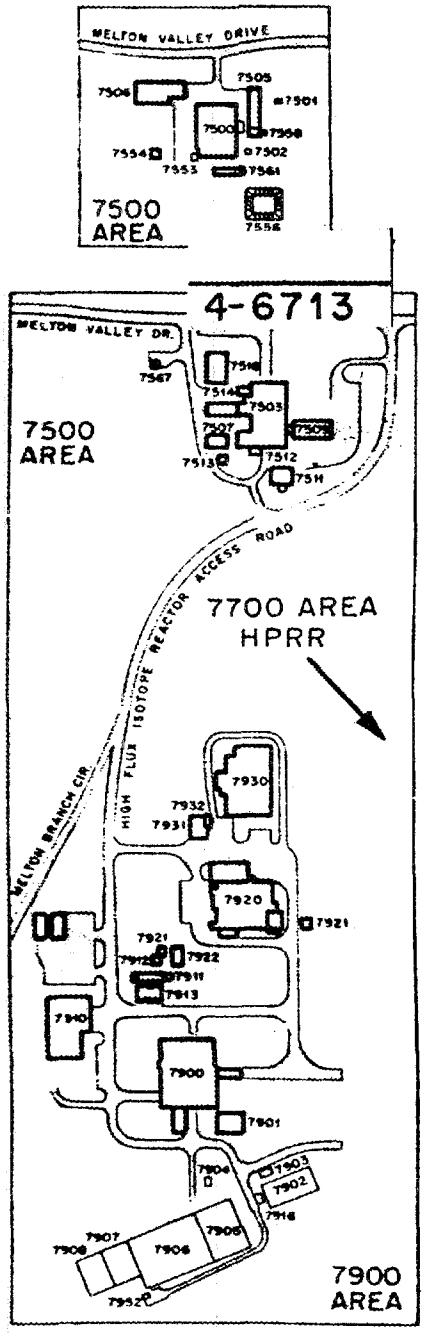


It contains three reactors (Oak Ridge Research Reactor-3042), (Bulk Shielding Reactor-3010) and (Pool Critical Assembly-3010) as well as the laboratories and hot cells used by the Solid State Division in Building 3025. It also includes the Hot Shop (Building 3044) and a major storage vault (Building 3027) used by the Laboratory Protection Division for storage of radioactive material. The Complex also contains two decommissioned reactors, the Old Graphite Reactor (3001) and the Low Intensity Test Reactor (3005). Demand for radiation protection surveillance increases during reactor shutdown periods and additional staff are sometimes added to accommodate these increased demands. Exempt-level employees usually man this Complex and the Complex has two radiation survey offices in Bldgs. 3001 and 3042.

Melton Valley Complex

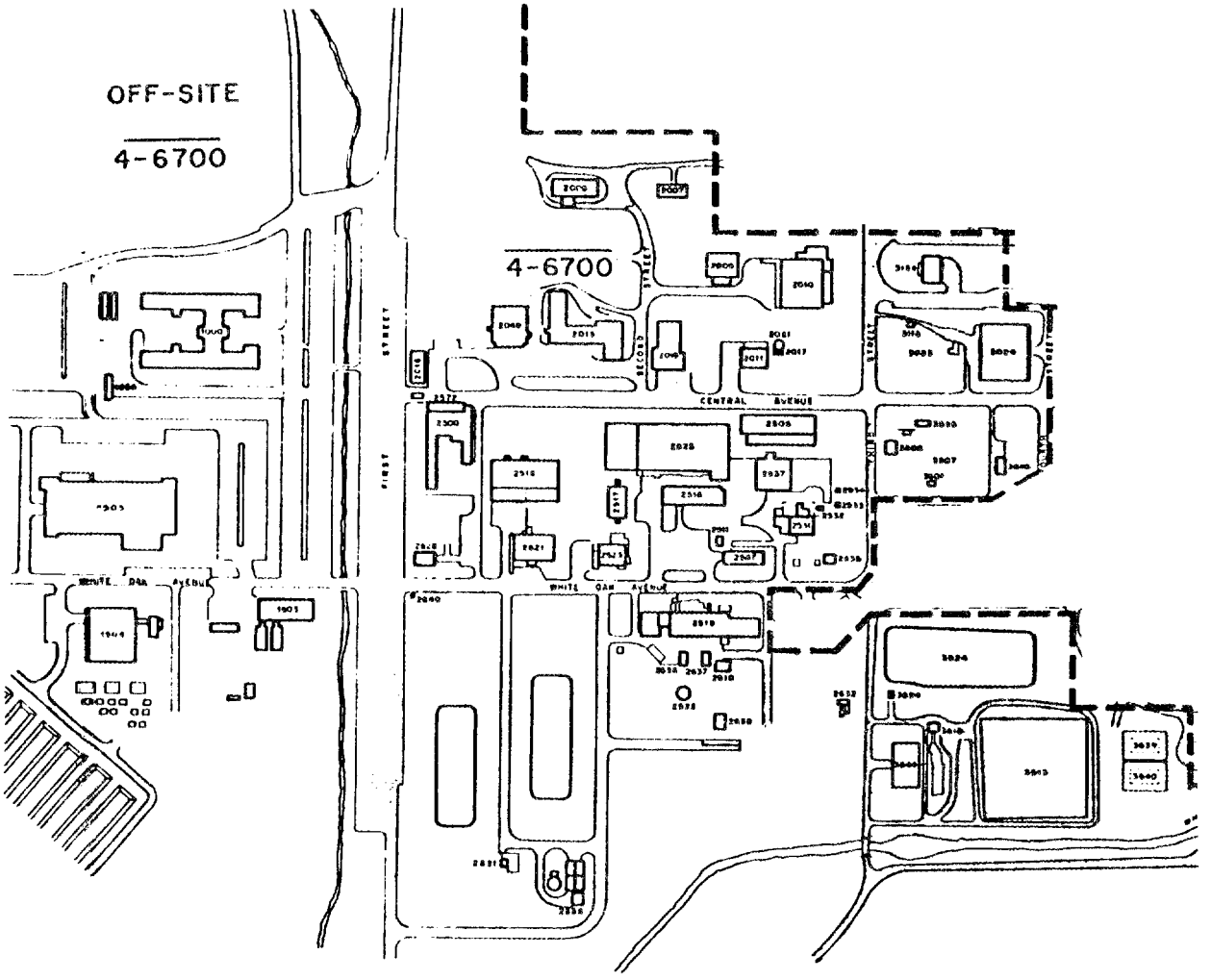
The Melton Valley Complex consists of the buildings in a second valley; this includes the High Flux Isotopes Reactor (HFIR) (Bldg. 7900) and Transuranium Processing Facility (TRU) (7920), Transuranium Recovery Facility (TURF)(7930), as well as the Health Physics Research Reactor (HPRR) (also known as DOSAR) (7700) and the Tower Shielding Reactor (TSR-II). TURF (7930) is being redesigned to perform the tasks now assigned to the Radiochemical Pilot Plant (Bldg. 3019).

The HFIR reactor provides an intense neutron source and is used primarily to produce elements heavier than plutonium. Those produced are transferred to TRU for processing and shipment. The presence of these heavy elements, which emit neutrons spontaneously, creates a neutron environment that is responsible for a sizeable fraction of neutron exposures by Solid State Division personnel and visiting scientists. The HFIR also provides neutrons used by the National Center for Small Angle Scattering Research. The two remaining reactors in the Complex are operated intermittently, requiring radiation protection services. The Complex Leader is assisted by exempt-level employees, and this staff is stationed in three radiation survey offices located in Bldgs. 7900, 7920, and 7010.



Y-12 Operations

The Y-12 Complex consists of the entire geographical area at Y-12 within which ORNL has operations taking place (11 operating buildings). The Biology, Fusion Energy and Engineering Technology Divisions are involved in major research and developments at Y-12, and much of what they are doing involves radiation-producing machines and radioisotopes. For example, radiobiological research involving the use of radioisotopes is being conducted by the Biology Division; and development of high voltage generating devices, which produces x-rays, is being conducted by the Fusion Energy Division. In addition, there is a Critical Experiments Facility (CEF) operated by Operations Division. Complicating the radiation safety problem at Y-12 is the existence of alpha contamination which was left behind by World War II operations in buildings now occupied by ORNL Divisions. The Complex Leader at Y-12 is assisted by exempt and nonexempt staff members. There are four radiation survey offices in this Complex; they are located in Bldgs. 9211, 9207-3, 9201-2, and 9208.


OFF-SITE
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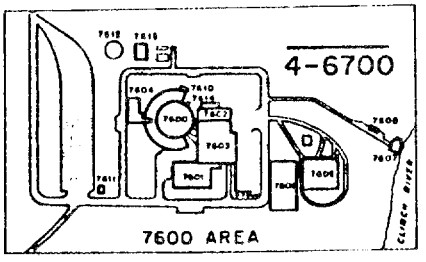
4-6700
FIRST STREET
SECOND STREET
CENTRAL AVENUE
WHITE OAK AVENUE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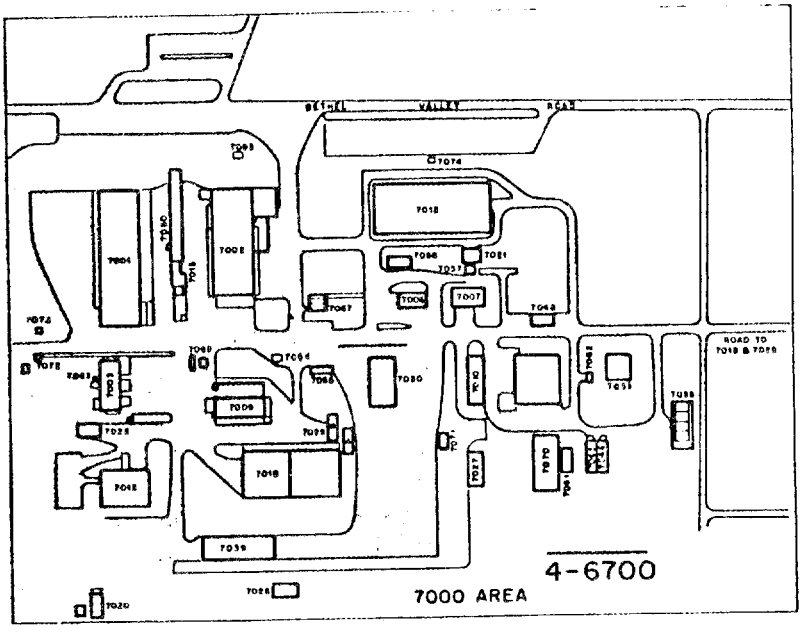
7600 AREA


4-6700
7000 AREA

Shift and Area Surveys Complex

The Shift and Area Surveys Complex provides radiation and safety surveillance needs at all "outside" areas not provided by the geographical complexes. This includes the waste disposal areas, the National Environmental Research Park (NERP), the laundry, the 7000 area (radioisotopes are shipped and received there and the salvage yard is there) and operations conducted by the Fuel Recycle Division in the 7600 area. Both exempt and nonexempt radiation protection staff members are assigned to this Complex. Offices exist in Buildings 2008 and 7601.

The following section deals with the responsibilities, qualification requirements, and duties for all levels of staffing in the two departments plus the division management positions.

2.1 EOSD DIVISION DIRECTOR

Qualification Requirements

1. Education. The Director of EOSD at ORNL shall have a MS/PhD in radiation protection, environmental health, or one of the related sciences.

2. Experience. The EOSD Director shall have sufficient technical management experience and education to demonstrate adequate capabilities for the responsibilities listed below.

3. Training. The EOSD Director shall have specialized training, as appropriate, for upper-level (corporate) management personnel in the ORNL organization. Such training shall be in DOE and Company policies and procedures, responsibilities, handling of allocated funds, planning needs (i.e., workforce needs) for future projects, communications with other levels of management, and report requirements. In addition, special training shall be given (if not already acquired) on nuclear facilities by DOE and other federal agencies.

Responsibilities

The EOSD Director shall be responsible for the following:

1. Ensuring the overall efficient and safe operation and direction of all the departments under his/her jurisdiction.

2. Controlling expenditures allocated for operation of the various departments within EOSD.

3. Providing needed services or advice on matters relating to operations or projects under his/her jurisdiction to various personnel both within and outside the ORNL organization.

4. Establishing and implementing a Quality Assurance Program for EOSD.

5. Investigating, reporting, and providing remedies for deficiencies or failures in operations by monitoring the overall operation of the various facilities, and total workforce, and effecting improvements in procedures, training, or equipment as needed to ensure safe and reliable operations.

6. Evaluating the existing facilities and operations and effecting the necessary plans to ensure that future needs in equipment, manpower, funding, etc., are accommodated according to planned schedules.

7. Having a high degree of knowledge of all Company policies, industry standards, and DOE/EPA regulations regarding nuclear and hazardous material management facilities and the qualification of operational personnel, and taking the necessary measures to ensure that such policies and regulations are acknowledged and adhered to by all personnel under his/her jurisdiction.

8. Having effective communication with higher levels of Corporate management and preparing certain status reports required by the Laboratory Director.

9. Ensuring that emergency services and equipment are available, as required, for nuclear and hazardous material management facilities.

10. Evaluating and disseminating safety-oriented literature regarding the operation of facilities so that ORNL personnel are made aware of changes in industry standards, unusual occurrences at facilities, design changes, etc.

Duties

The duties of the EOSD Director shall be to acknowledge his/her responsibilities and execute them in accordance with established Martin Marietta Energy Systems, Inc., and ORNL management guidelines.

The EOSD Director or his/her designated alternate shall be available to make needed management-level decisions presented by operating or administrative supervisors at any of the facilities or programs under his/her jurisdiction during all scheduled operational activities.

The EOSD Director's duties shall include the following:

1. Provide an environment which allows and encourages effective individual and group effort toward meeting the organization's objectives through sound decision-making processes, open communication, and proper selection, motivation, and development of people.

2. Periodically monitor operational and other activities performed in the various departments within the Division and effect any changes necessary to ensure that the Division is functioning in a safe and reliable manner and is accomplishing intended goals and objectives.

3. Serve in emergency situations in the capacity of a technical advisor to ORNL's Emergency Director or the Local Emergency Director.

4. Effect measures necessary to implement recommendations by the Laboratory Director's Review Committees; or work with the Office of Operational Safety and the Review Committee (Chairman) to resolve disagreements concerning recommendations.

5. Maintain a practical working knowledge of the numerous requirements applicable to nuclear and hazardous materials management facilities, their environmental effects, and the qualifications and health surveillance for operating personnel.

6. Ensure that an evaluation is made of applicable safety-oriented or other pertinent literature received from similar facilities and that such literature is distributed to training personnel.

7. Become actively involved in the selection, evaluation, and qualification of operating personnel by conducting interviews and monitoring performance records of the various individuals. The Division Director shall be the highest level of corporate management required to finalize the certification process of operating personnel.

2.2 EOSD DEPARTMENT HEAD

Qualification Requirements

1. Education. The Department Head in EOSD shall have a BS/MS degree in radiation protection or in a scientific or engineering field. He/she should be certified as a Health Physicist by the American Board of Health Physics or possess equivalent experience.

2. Experience. The Department Head shall have operations or management experience in radiation protection activities pertinent to the departmental functions. The level of experience shall be adequate to demonstrate the ability to manage the departmental responsibilities as outlined.

3. Training. The Department Head shall have the management capability associated with management-level personnel in the ORNL organization. Areas of competence include DOE and Company policies and procedures, responsibilities of management personnel, funding, manpower requirements at the various nuclear facilities, human relations, and decision analysis. The Department Head shall be required to become thoroughly familiar with the detailed operations of all the programs and facilities under his/her jurisdiction. This shall include operational procedures, funding, and communications with other facility staff and/or corporate management.

Four individuals hold this position in each of four departments, two of which are addressed in this training document.

Responsibilities

The Department Head shall be responsible for:

1. Planning, scheduling, and/or reviewing operational activities in programs and facilities under his/her jurisdiction to ensure that each operation is carried out in a safe and reliable manner by qualified personnel in accordance with ORNL, state, and federal requirements.

2. Preparing certain periodic status reports which are required by corporate management and/or DOE.

3. Selecting and/or hiring operating personnel and being actively involved in their development.

4. Maintaining records and projecting operational cost estimates for each facility or program under his/her jurisdiction.

5. Creating and/or serving on various committees which function to ensure safe operation of the nuclear facilities and, within the limits of his/her authority, effecting changes recommended by the various committees.

6. Ensuring that industrial safety standards are acknowledged and adhered to.

7. Implementing the division quality assurance program established by the EOSD Director.

8. Evaluating and disseminating applicable safety-oriented literature received from DOE or from outside ORNL so that operating personnel at the ORNL facilities are made aware of changes in industry standards, failures at other facilities, etc.

Duties

The duties of the Department Head shall be to acknowledge responsibilities and execute them in accordance with established DOE, Martin Marietta Energy Systems, Inc. and ORNL management guidelines and procedures.

The Department Head, or designated alternate, shall be available to make necessary management-level decisions presented by operating or administrative supervisors at any of the facilities under his/her jurisdiction during all scheduled operational activities. In the support functions to nuclear facility operators, he/she shall be available to advise the facility manager on radiation protection responsibilities.

The Department Head shall:

1. Review all qualification and requalification examinations prepared within his/her department. Review and approve all qualifications granted within his/her department along with Division Training Coordinator and Division Director.

2. Periodically monitor the quality of the work performed by individuals in the various groups reporting to him/her and effect changes as needed to ensure that each group is functioning in a safe and reliable manner and is accomplishing intended goals and objectives.

3. Review orders and regulations to remain cognizant of existing and new Martin Marietta Energy Systems, Inc., ORNL, Division, and DOE requirements applicable to the type of operations conducted at the facilities and programs under his/her jurisdiction.

4. Serve, in emergency situations, in the capacity of an advisor to the Laboratory's Emergency Director or to the Local Emergency Director.

2.3 RADIATION AND SAFETY SURVEYS (RSS) DEPARTMENT POSITION TASK ANALYSES

The Radiation and Safety Surveys (RSS) Department provides radiation and safety surveillance services at facilities operated by research and operating groups to keep exposures to personnel, concentrations of airborne radioactivity, and levels of surface contamination well within permissible limits and in agreement with the as-low-as-reasonably-achievable (ALARA) philosophy. These surveillance responsibilties are performed by RSS Deparment staff working nine geographical areas referred to as Complexes. Figure 2 shows the boundaries of each Complex. Each area contains a mix of RSS Department staff that is dictated by the type and magnitude of hazard that exists in the area.

2.3.1 RSS Department Group Supervisor

Qualification Requirements

1. Education. The Group Supervisor for RSS shall have a Bachelor's degree in radiation protection or related science or engineering degree. He/she should be certified as a Health Physicist by the American Board of Health Physics or possess equivalent experience.

2. Experience. Each Group Supervisor shall have a minimum of 7 years of experience in radiation protection or a related field, 5 years of this experience shall include work relating to projects carried out at one or more ORNL nuclear facilities.

3. Training. Each Group Supervisor shall have management capability and familiarity with the overall design and operating procedures of the ORNL nuclear facilities commensurate with his/her job responsibilities. This includes DOE, Martin-Marietta, and ORNL policies and procedures, manpower requirements and human relations.

Responsibilities

Each Group Supervisor shall be responsible for:

1. Coordinating and directing all EOSD radiation protection activities at the Complexes in which he/she is in charge to help facility

RADIATION AND SAFETY SURVEYS AREA COMPLEXES

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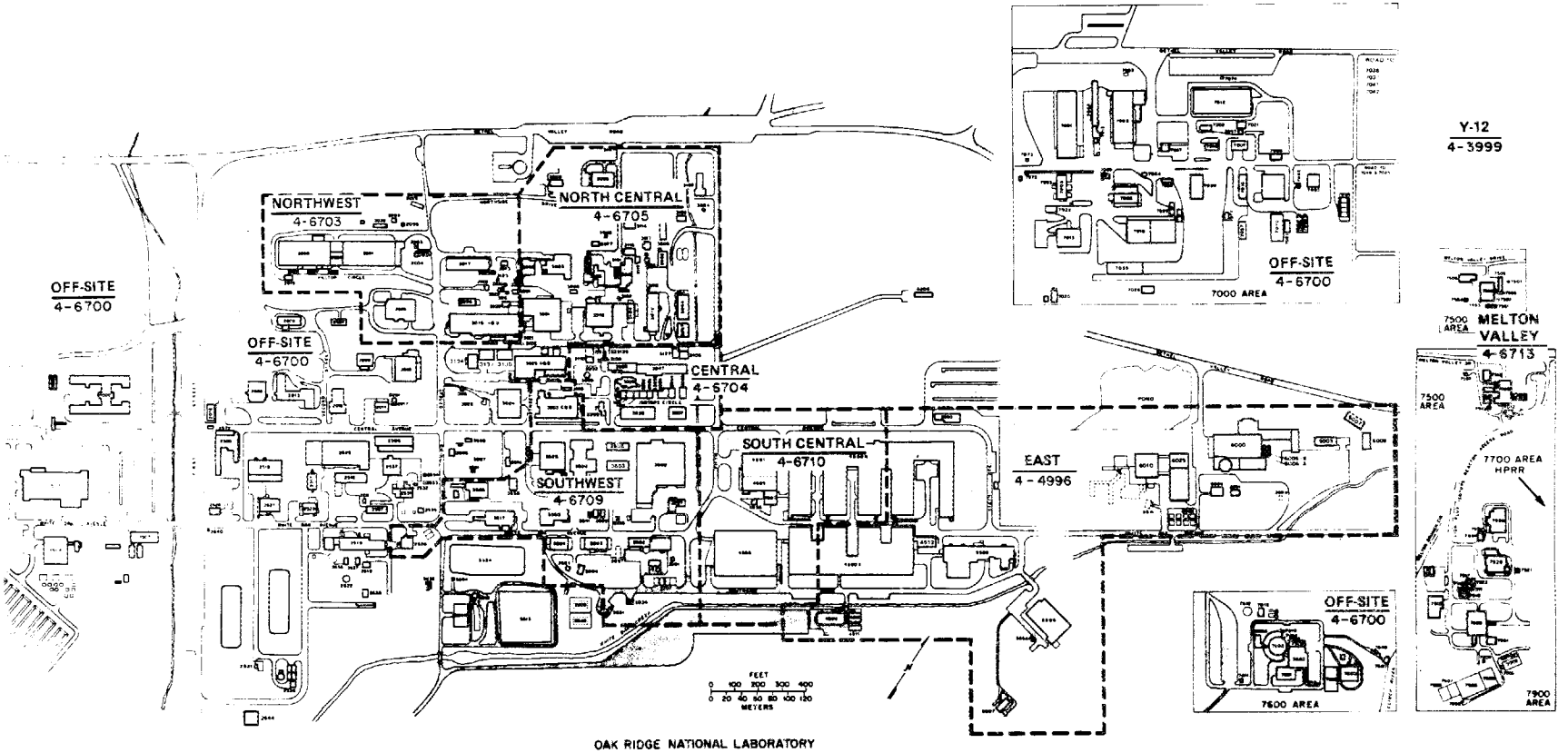

Figure 2

management ensure that the facilities are operated in a safe and reliable manner and in accordance with Martin Marietta Energy Systems, Inc. and DOE procedures and guidelines.

2. Advising on all radiation protection facility and procedural changes.

3. Preparing certain reports as required by upper-level management.

4. Evaluating manpower and taking the necessary actions to ensure continued, efficient radiation protection operations at the facility.

5. Giving technical assistance and advice on radiation protection matters relative to the facility to individuals both inside and outside the ORNL organization.

6. Performing special assignments as originated by the Department Head and/or EOSD Director.

7. Evaluating the performance of the radiation protection staff at the various facilities and preparing required, periodic reports.

8. Conducting certain radiation protection projects and/or quality assurance programs.

Duties

The duties of each Group Supervisor shall be to acknowledge his/her responsibilities and execute them in accordance with established Martin Marietta Energy Systems, Inc., DOE, and ORNL guidelines and procedures.

1. Provides a second echelon of technical expertise and work leadership directed toward properly coping with radiation survey and contamination control problems existing or arising within several specified geographical areas of ORNL, or for the coordination and guidance of radiation survey personnel assigned to rotating shifts to provide radiation protection survey services Laboratory-wide for continuously operating facilities.

2. Provides direct supervision of first level supervisors who may also function as Complex Leaders and the indirect supervision of technical or technical support personnel, including personnel assignments, absence control, performance appraisals, determining staff requirements for the area, and other duties normally handled by supervisors.

3. Remain cognizant of the numerous DOE regulations applicable to radiation protection and remain abreast of any changes that may effect the safety of the facility for which his/her group provides surveillance.

4. Review the qualifications of the individuals requiring qualification at the facility and approve them for requalification, as applicable.

5. Review for official approval all procedural changes, all experiment changes, and all changes in the design of the facility related to radiation protection surveillance.

6. Participate in the continuing requalification program for Supervisors.

7. May function as Radiation Protection Representative for one or more Laboratory Divisions and may serve on one or more of the Director's Review Committees which report through the Office of Operational Safety.

2.3.2 RSS Department Complex Leaders

Complexes are geographical areas in which facilities and/or operations possessing radiation or contamination hazards exist. Each Complex has a Leader who is responsible for an on-going radiation and safety surveillance program within that geographical area.

Qualification Requirements

1. Education. The RSS Complex Leader shall have a Bachelor's degree in radiation protection or related science or engineering degree. He may be certified as a Health Physicist by the American Board of Health Physics as a Radiation Protection Technologist or by the National Registry of Radiation Protection Technologists or possess equivalent experience.

2. Experience. Each Complex Leader shall have a minimum of 5 years of experience in radiation protection or a related field. 3 years of this experience shall include work relating to projects carried out at one or more ORNL nuclear facilities or equivalent.

3. Training. Each Complex Leader shall be given training required of ORNL management personnel and shall also be given training in the overall design and operating procedures of the ORNL nuclear facilities commensurate with his/her job responsibilities.

Responsibilities

Each Complex Leader shall be responsible for:

1. Coordinating and/or performing all health physics operational activities within his complex to help facility management ensure that the facilities are operating in a safe and reliable manner and in accordance with Martin Marietta Energy Systems, Inc. and DOE procedures and guidelines.

2. Reviewing and commenting on engineering transmittals.

3. Helping prepare, review and comment on project safety summaries.

4. Assisting in the preparation of health physics procedures.

5. Attending and sometimes presenting safety meetings at facilities within his/her Complex.

6. Reporting to facility and responsible division management on the state of radiation safety at facilities for which his/her staff provides surveillance.

Generic Duties

Under the general supervision of the Group Supervisor, each Complex Leader:

1. Provides first level leadership and work direction for one or more technical and technical support personnel in day-to-day contacts with operating, maintenance, or research divisions in order to keep them currently informed on matters involving radiation exposure and industrial safety in their programs and facilities.

2. Provides competent personnel and appropriate equipment and participate in the monitoring and evaluation of the radiation/contamination hazards in his/her area of responsibility.

3. Originates recommendations to help facility management assure proper control over personnel exposures and contamination releases.

4. Initiates and follows surveillance monitoring programs to assess whether compliance with Laboratory standards is continuous in all programs, and reports and recommends changes whenever adverse situations develop.

5. Must be alert to unsafe acts or conditions which impact on industrial safety in the working environment and recommend corrective action to responsible supervision.

6. Facilitates the interchange of information between his/her department and those working in his/her area, most usually at the supervisory level.

7. May function as Radiation Protection Representative to one or more ORNL Divisions.

8. May function as Radiation Control Officer and/or Division Safety Officer for facility within his/her complex.

9. May also be required to serve on Director's Review Committees.

2.3.3 RSS Department Radiation Protection Staff Member

Qualification Requirements:

1. Education. RSS Radiation Protection Staff Member shall have a Bachelor's degree in radiation protection, a related science, engineering or equivalent experience.

2. Experience. Each RSS Radiation Protection Staff Member shall have a minimum of 2 years experience in radiation protection work, laboratory-type work, or the equivalent in related fields. Exceptions to the experience requirement may be made in cases where individuals have advanced degrees or some special expertise.

3. Training. RSS Health Physicist Staff Member shall be required to complete the training program, and/or demonstrate his/her competence via comprehensive examination.

Responsibilities

Each RSS Radiation Protection Staff Member shall be responsible for performing his/her assigned tasks in a manner so as to accomplish the various technical projects safely, expeditiously, and in accordance with approved Martin Marietta Energy Systems, Inc. and DOE guidelines and procedures.

Each RSS Radiation Protection Staff Member shall be responsible for:

1. Performing radiation surveillance.

2. Supplying certain technical assistance and/or information to persons within or outside of the ORNL organization.

3. Preparing, editing, and issuing log record of surveys made as well as preparing other reports as they are required.

4. Maintaining a degree of flexibility in schedules in order to perform special projects or projects of an emergency nature.

5. Assisting in the training of new personnel.

Duties

Each RSS Radiation Protection Staff Member shall acknowledge his/her responsibilities and execute them in a safe and reliable manner.

Each RSS Raditaion Protection Staff Member shall:

1. Provide detailed radiation surveillance information at the working level for each job or program involving the hazards of radiation or radioactive materials.

2. Monitor and evaluates the radiation and contamination potential of proposed work.

3. Recommend protective equipment and procedures to limit exposures and control contamination releases.

4. Monitor as required as the job progresses to completion and do follow-up surveys through to achievement of satisfactory conditions.

5. Maintain direct communications with radiation workers and provide the information essential for exposure and contamination controls, issuing step-wise guidance as necessary.

6. Perform regular audit monitoring of established zones and work areas to ensure compliance with Laboratory standards.

7. Keep a log record of surveys made, conditions encountered, limitations and recommendations stipulated, personnel involved, etc.

8. Report to his/her supervisor any inadequacies in procedures and/or equipment for the purpose of ensuring safe operation and/or effecting needed maintenance or change.

9. Maintain awareness of criticality safety program, if required by area conditions.

10. Serve as a Radiation Protection Representative to one or more ORNL Divisions.

2.3.4 RSS Department Radiation Protection Technician

Qualification Requirements

1. Education. The RSS Radiation Protection Technician shall have at least a high school degree and preferably an Associate or Bachelor's degree in radiation protection or related science or be registered as a Radiation Protection Technologist by the National Registry of Radiation Protection Technologists or possess equivalent experience.

2. Experience. Each Radiation Protection Technician shall have a minimum of 1 year of experience in radiation protection or a related field. All of this experience shall include work relating to projects performed at one or more ORNL nuclear facilities.

3. Training. Each Radiation Protection Technician shall be given training in the radiation protection aspects of the overall design and operating procedures of the ORNL nuclear facilities commensurate with his/her job responsibilities. Qualification will be based on written examination and on-job walk-through examination.

Responsibilities

Four levels of responsibility exists in the RSS Radiation Protection Technician program, progressing from entry level to Health Physics Technologist based on degree of competence and level of supervision required. Most of the nonexempt staff are "clustered," permitting guidance of their activities. Most of their time is spent carrying out routine surveillance functions such as performing surface contamination evaluations, clearing materials, checking on the operability of instruments, etc.

Duties

Under general supervision of the Complex Leader, the RSS Radiation Protection Technician shall:

1. Perform radiation surveillance of a project, personnel, work areas, and items leaving contamination or radiation zones to assist in the control of exposures from internal and external sources and the spread of radioactive contamination.

2. Inspect, tend, and calibrate radiation detection instrumentation and equipment. Requests maintenance when required.

3. Obtain, process, read, record, evaluate, and report data from radiation detection devices and samples.

2.3.5 RSS Department Shift Radiation Protection Technician

Qualification Requirements

1. Education. The RSS Shift Radiation Protection Technician shall have an Associate or Bachelor's degree in radiation protection, engineering or related science or be registered as a Radiation Protection Technologist by the National Registry of Radiation Protection Technologists or possess equivalent experience.

2. Experience. Each Shift Radiation Protection Technician shall have a minimum of 1 year of experience in radiation protection or a related field. All of this experience shall include work related to projects performed at one or more ORNL nuclear facilities.

3. Training. Each Shift Radiation Protection Technician shall be given training in the radiation protection aspects of the overall design and operating procedures of the ORNL nuclear facilities commensurate with his/her job responsibilities. Qualification will be based on written examination and on-job walk-through examination.

Responsibilities

The Radiation and Safety Surveys Department has one staff member present at the Laboratory on off-shifts (weekends, holidays and hours other than 8 a.m.-4 p.m. on weekdays). The Shift Radiation Protection Technician shall:

1. Perform and make log entries of radiation protection surveillance on the operations being conducted at the reactors, TRU and other facilities requiring radition protection services during off-shifts, and;

2. Help analyze "early on" the significance of radiation-related events and assists in the mobilization of other staff required to manage the event.

Duties

This group consists of four (one for each shift) nonexempt staff members, and their activities are supervised by the Group Leader of the Shift and Area Surveys Complex and his/her assistant. The Shift Radiation Protection Technician shall:

1. Provide Radiation and Safety Survey services for all of the Laboratory's continuously operating facilities on nights (4 p.m.–12 a.m. and 12 a.m.–8 p.m. shifts), week-ends, and holidays.

2. Maintain contact between his/her office and all operating, maintenance, and research personnel on his/her assigned shift to keep them informed on matters involving radiation hazards and industrial safety.

3. Initiate or personally conduct surveillance monitoring programs to assure that compliance with Laboratory standards is achieved on shifts on a continuing basis. This includes collection of specified data on weekends and holidays for the Department of Environmental Management.

4. Assist in the distribution, collection, reading, recording, and reporting of data from pocket meters and badge dosimeters.

5. Serve as Radiation Protection representative in emergency situations until relieved by ranking supervision.

2.4 Health Physics (HP) Department Position Task Analyses

All persons who enter laboratory areas where they may be exposed to radiation or radioactive materials are monitored for probable kinds of exposure. External radiation exposure is assessed by personnel dosimeters and direct-reading pocket meters. Hand exposure meters are used to assess extremity dose. Internal deposition of radionuclides is estimated from *in vitro* (body fluid) and *in vivo* (whole-body counting) radioassays.

The Health Physics Department is responsible for both the external and internal dose assessments for ORNL employees, non-employees, and visitors. To meet this responsibility, the Department is divided into four functional groups: (1) Monitoring Instrumentation, (2) Radioassays, (3) Radiation Dosimetry, and (4) Dosimetry Records. These four functional groups also support the monitoring functions of all the EOSD departments.

2.4.1. HP Department Group Leaders

Qualification Requirements

1. Education. The HP Department Group Leader shall have a Bachelor's or Master's degree in radiation protection and/or related science or certification as a Health Physicist or equivalent experience.

2. Experience. Each HP Department Group Leader shall have a minimum of 5 years of experience in radiation protection or a related

field; 3 years of this experience shall include projects relating to work performed at one or more ORNL nuclear facilities or equivalent.

3. Training. Each HP Department Group Leader shall be given training required of ORNL management personnel and shall also be given training in the overall design and operating procedures of the ORNL nuclear facilities commensurate with job responsibilities.

Responsibilities

Each HP Department Group Leader shall be responsible for:

1. Coordinating and directing all radiation protection operational support facilities and program under his supervision to ensure that the facilities are operated in a safe and reliable manner and in accordance with Martin Marietta Energy Systems, Inc., and DOE procedures and guidelines.

2. Approving all radiation protection facility and procedural changes.

3. Preparing certain reports as required by upper-level management.

4. Evaluating manpower and funding needs and taking the necessary actions to ensure continued, efficient radiation protection operations within his/her area of responsibility.

5. Giving technical assistance and advice on matters relative to the facility to individuals both inside and outside the ORNL organization.

6. Performing special assignments as originated by the Department Head and EOSD Director.

7. Evaluating the performance of the staff at the support facilities and preparing required periodic reports.

8. Conducting certain radiation protection projects and/or quality assurance programs.

Duties

The duties of each Group Leader shall be to acknowledge his/her responsibilities and execute them in accordance with established Martin Marietta Energy Systems, Inc., DOE, and ORNL guidelines and procedures.

1. Provides technical expertise and work leadership directed toward proper monitoring and documentation of external and internal radiation dose of ORNL employees, non-employees, and visitors.

2. Provides direct supervision of technical or technical support personnel, including personnel assignments, absence control, performance appraisals, determining staff requirements for the area, and other duties normally handled by supervisors.

3. Reviews orders and regulations to remain cognizant of the numerous DOE regulations applicable to radiation dose monitoring and

documentation requirements and remain abreast of any changes that may affect the overall facility.

4. Review the qualifications of the individuals requiring qualification at the Radiation Protection operations support facilities under his/her supervision and recommends them for requalification, as applicable.

5. Review all procedural changes, and all changes in the design of the Radiation Protection operations support facilities.

6. Participate in the continuing requalification program for radiation protection staff.

7. May serve on one or more of the Director's Review Committees which report through the Office of Operational Safety.

Group-Specific Duties

1. The Monitoring Instrumentation Group operates the support facility for calibration of existing instrumentation.

2. The Radioassays Group operates the support facility for coordination and analyses of the various samples taken by EOSD, such as in vitro, facility monitoring, and environmental samples.

3. The Radiation Dosimetry Group operates the support facility for whole body counting and conducts the ORNL dosimetry program for radiation workers, and the ORNL pocket meter program for external/internal dose assessments.

4. The Dosimetry Records Group collects and maintains employee exposure information for reporting to DOE, other employers, or to individual personnel.

2.4.2 HP Department Radiation Protection Staff Member

Qualification Requirements

1. Education. HP Department Radiation Protection Staff Member shall have a Bachelor's or Master's degree in radiation protection or related science or equivalent experience.

2. Experience. Each HP Department Radiation Protection Staff Member shall have a minimum of 2 years experience in radiation protection work, laboratory-type work, or the equivalent in related fields. Exceptions to the experience requirement may be made in cases where individuals have advanced degrees or some special expertise.

3. Training. HP Department Radiation Protection Staff Member shall be required to complete the training program and/or demonstrate competency via comprehensive examination.

Responsibilities

Each HP Department Radiation Protection Staff Member shall be responsible for performing his/her assigned tasks in a manner so as to accomplish the various technical projects safely, expeditiously, and in accordance with approved Martin Marietta Energy Systems, Inc., and DOE guidelines and procedures.

Each HP Department Radiation Protection Staff Member shall be responsible for:

1. Monitoring and documenting external and internal radiation doses.

2. Supplying certain technical assistance and/or information to persons within or outside of the ORNL organizations.

3. Preparing, editing, and issuing radiation dosimetry records.

4. Maintaining a degree of flexibility in schedules in order to perform special projects or projects of an emergency nature.

5. Assisting in the training of new personnel.

Duties

Each HP Department Radiation Protection Staff Member shall acknowledge responsibilities and execute them in a safe and reliable manner.

Each HP Department Radiation Protection Staff Member shall:

1. Provide detailed radiation monitoring of external and internal dose level for each job or program involving the hazards of radiation or radioactive materials (via personnel dosimetry, whole body counting, body fluid samples, etc).

2. Monitor as required special high radiation jobs and programs through completion and do follow-up surveys through to achievement of satisfactory conditions.

3. Maintain communications with radiation workers through the Radiation and Safety Surveyors and provide the information essential for exposure and contamination controls, issuing step-wise guidance as necessary.

4. Keep a log record of analyses, conditions encountered, limitations and recommendations stipulated, personnel involved, etc.

5. Report to supervisor any inadequacies in procedures and/or equipment for the purpose of ensuring safe operation and/or needed maintenance or change.

2.4.3 HP Department Radiation Protection Technician

Qualification Requirements

1. Education. The HP Department Radiation Protection Technician shall have at least a high school degree and preferably an Associate or Bachelor's degree in radiation protection or related science or certification as a Radiation Protection Technologist by the National Registry of Radiation Protection Technologists or equivalent experience.

2. Experience. Each Radiation Protection Technician shall have 2 years of experience in radiation protection or a related field; 1 year of this experience shall include projects relating to work performed at one or more ORNL nuclear facilities.

3. Training. Each Radiation Protection Technician shall be given training in the overall design and operating procedures of the ORNL nuclear facilities commensurate with job responsibilities. Qualification will be based on written examination and on-job walk-through examination.

Responsibilities

Four levels of responsibility are available in the HP Department Radiation Protection Technician program, progressing from entry level to Radiation Protection Technologist based on degree of competence and level of supervision required. Most of the nonexempt staff are "clustered," permitting guidance of their activities by supervisors. Most of their time is spent carrying out routine surveillance and laboratory functions.

Duties

Under general supervision of the Group Leader, the HP Department Radiation Protection Technician:

1. Performs routine radiation analyses of personnel working in contamination or radiation zones for control of exposures from internal and external sources.

2. Maintains, standardizes, and calibrates radiation protection process instrumentation and equipment.

3. Obtains, processes, reads, records, evaluates, and reports data from radiation detection devices and samples.

3. QUALIFICATION/REQUALIFICATION REQUIREMENTS

3.1 INTRODUCTION

There are several programs which are designed to provide qualified people to work at the various reactor and nonreactor nuclear facilities, at hazardous materials control facilities, and in the development and management of health and safety programs of ORNL. The programs for radiation protection technicians are covered in detail in this document.

3.2 OBJECTIVES

The training programs for EOSD personnel have been developed to ensure that qualified personnel can perform those tasks delegated to EOSD and that such training, testing and documentation, etc., are in compliance with DOE, EPA, and ORNL requirements.

The objectives of the program are to:

1. Describe the functional positions to which the training program applies.

2. Describe the training requirements which are commensurate with the degree of skill, knowledge, and responsibility required.

3. Describe the required content and depth of material to be covered.

4. Specify the nature of the oral and written examinations administered for the purpose of qualification.

5. Specify the requirements for personnel to remain qualified.

6. Maintain required documentation amenable for internal and external audits by the various review committees.

7. Provide a means for the dissemination of significant information regarding changes in ORNL, DOE, or industry standards, procedures, and/or requirements.

3.3 PROFESSIONAL STAFF QUALIFICATION

Many of the radiation protection positions at ORNL are filled by professional staff with academic training and/or specialized degrees in health physics. In addition, several are certified Health Physicists, as evaluated by the American Board of Health Physics, or Radiation Protection Technologists, as evaluated by the National Registry of Radiation Protection Technologists. The qualifications of these professional staff members are evaluated before assignment. They will not be subject to the Technician Training Program unless it is deemed that they can benefit from additional review of one or more sections of the training. Training records will be maintained. Certifications by outside professional organizations will not be valid unless current. Professional staff members are expected to maintain currency in their respective work areas via additional coursework and training programs administered by outside professional or training organizations, academic institutions, or in-house training directed to specific technical

objectives. Training milestones will be reviewed and evaluated by the supervisor during the annual performance review cycle already in place at the Laboratory.

3.4 INITIAL QUALIFICATION FOR TECHNICIANS

In accordance with the requirements of DOE Order 5480.1A, Chapter V, qualification of technicians shall be by the EOSD Director.

The qualification evaluation shall be based on the successful completion of the required training program and the written and operating qualification examinations administered by a trainer. This information must be reviewed by the Department Head, and then be submitted to the Division Director in order for him/her to evaluate the individual and finalize the necessary qualification documentation.

Qualification is for a specific time (i.e., two years) and shall apply to a specific complex or group; it shall not allow the individual to perform work in another complex/group unless specifically stated on the qualification. An interim qualification shall be initially required for individuals that have not completed the required training period.

3.4.1 Procedures for Qualification

1. Upon completion of the individual's training program, the Training Coordinator will initiate the handling of the required documentation for qualification by signing and dating that section of the form applicable to his/her approval of the candidate. If the individual has earned certification from an accepted professional society (American Board of Health Physics, etc.), or has completed an accepted academic degree program, it may not be necessary to retrain except for assignment-specific activities. Certain exemptions from training may be allowed in cases where: (1) the individual has had previous experience in a similar job at another facility, (2) an individual has many years of experience and has continuously demonstrated proficiency, and (3) certain material is not applicable to that facility. For such cases, the training material listed in the training schedule may be altered as appropriate. The EOSD Director will determine whether the professional society certification or degree is acceptable basic training for the position being filled. Job-specific examinations would still be required.

2. The written examination will be scheduled by the trainer and department heads. (The written examination will normally be scheduled first, followed by the on-job examination). Upon completion of the written and operating examinations, the trainer will record the grades and other results on the Initial Qualification forms, as applicable, then sign and date those sections applicable to his/her approval of the candidate. The forms shall then be delivered by him/her to the Department Head.

3. The Department Head will review and evaluate the candidate's qualification record, sign and date the form, and then deliver it to the EOSD Director.

4. If the requirments submitted to the EOSD Director indicate a satisfactory appraisal, he/she will sign and date the qualification form.

5. The EOSD Director will notify the Department Head of the qualification process. The latter, in turn will notify the individual's supervisor. The newly qualified technical staff/technician subsequently will be informed. The training records and qualification statements will be maintained in the Department offices.

3.4.2. Testing and Grading Requirements

1. The initial qualification examinations will be administered by the individuals performing the training (i.e., the trainers). These examinations, as well as all subsequent requalification examinations shall be reviewed by the Training Coordinator or, in some cases, his/her designated alternate. (Some of the requalification orals may be administered to the technician by the supervisor in charge.)

2. Prior to use, all examinations shall be reviewed by the Department Head and/or Group Supervisor.

3. The written and operating examinations will be prepared and administered in accordance with DOE guidelines and/or standards.

4. The point value for each question on the written examination will be based on such factors as the level of knowledge required, the relative importance, the complexity of the expected answers, and the amount of time estimated to answer the questions in acceptable depth.

5. In order to pass the written examination, the candidate must achieve an overall score of 70%.

3.4.3. Policy Toward Candidates who Fail the Examinations

After the trainer has evaluated the written and operating examinations, and it is learned that the candidate has failed one or more of the testing requirements, the information shall be conveyed to the Training Coordinator, Supervisor, and Department Head. The group will review the magnitude of the failure and the overall performance of the candidate during the training program. If only one section is failed, the employee may be retested. If the failure is considerably more than marginal, the candidate may be reviewed for reassignment. If the failure is marginal, the candidate will be given additional training in the weak areas pointed out by the trainer.

3.5 REQUALIFICATION FOR TECHNICIANS

Qualification expires after a two-year period of time from the date the Division Director signs the individual's form. If the individual is to continue to perform in the same capacity, he/she must have satisfactorily completed a continuing retraining program during the two years his/her qualification was in effect or pass a challenge requalification examination designed to reflect continuing proficiency in the area of qualification.

INITIAL QUALIFICATION FOR TECHNICIAN

Effective for a two-year period of time
(starting on _____ and ending on _____)

Name _____ Badge No. _____ Special Program _____

Complex and/or Specialized Equipment _____ Date of Initial Qualification _____

Technician Qualification*

A. The above-named individual has satisfactorily completed the required training program at the complex indicated as required for initial qualification. This includes: (1) having demonstrated an acceptable level of knowledge of radiation safety and control practices and emergency procedures; (2) having completed OJT checklist(s); (3) having performed hands-on operation of equipment at the facilities to which he will be assigned; (4) having performed routine checkouts and surveillance of certain equipment as applicable; and (5) having indicated that he can execute his/her duties in a safe and reliable manner in accordance with specified performance standards.

Trainer _____ Date _____ Training Coordinator _____ Date _____

B. The above-named individual has satisfactorily completed the written, oral, and/or operating examinations, as applicable.

Examiner (and grade) for written _____ Date _____ Examiner for OJT _____ Date _____

C. The above-named individual's qualifications have been reviewed and approved by the following people:

Group Supervisor _____ Date _____ Department Head _____ Date _____

EOSD Director _____ Date _____

The Division Director will fill in the STARTING AND EXPIRATION DATES at the top of this document.

*The basis for qualification for nonreactor nuclear facilities is stipulated in DOE Order 5480.1A, Chapter V, Safety of Nuclear Facilities. The basis for qualification for reactor nuclear facilities is stipulated in DOE Order 5480.1A, Chapter VI, Safety of DOE-Owned Reactors.

As stipulated in DOE Order 5480.1A, it is required that a retraining program be established to maintain the proficiency of the operating personnel through periodic training exercises, lectures, and review covering those items and equipment which relate to the safe operation of the facility.

All subjects in which training was required for initial qualification are to be reviewed in the requalification process.

It is also required that requalification examinations, equivalent to those required for initial qualification, be given.

If a qualified technician has not completed all of the requalification program within two years (not to exceed 27 months) from the previous or initial qualification, the individual shall not be allowed to function as a qualified technician.

3.5.1. Requalification Training Programs

The primary objective of the requalification training program is to ensure that operating personnel maintain a high degree of proficiency in their specific job assignments and continue to provide radiation protection services to the various facilities in a safe and reliable manner.

The basic objectives of the retraining programs for technicians are the same as those listed for the initial training programs. In general, it is intended that all the requirements for the initial qualification be repeated on a biennial basis.

A reasonable amount of Company time will be provided for retraining purposes. The trainers and/or supervisors will assume responsibility of scheduling guest lecturers and the viewing of videotapes. They will also conduct safety meetings and general-information meetings to cover such things as facility and/or procedural changes.

The documentation indicating the participation and performance of qualified technicians in the requalification training programs will be maintained amenable for audit by internal review committees and DOE auditors. These records will be maintained in the Department offices.

The various retraining methods will be essentially the same as those used for the initial training; however, there will be less emphasis on the one-on-one training conducted by the trainer with a trainee. One-on-one training may be utilized for special topics and/or circumstances. Much of the training may be accomplished by self-study.

Where applicable, retraining should be accomplished primarily as a group effort. The Trainer and/or Supervisor will assume the responsibility of scheduling guest lecturers, conducting safety meetings or general-information meetings, and/or conducting training sessions themselves.

3.5.2 Requalification

The requalification of technicians shall be the responsibility of the EOSD Director. He/she shall be the highest level of management necessary to qualify all personnel in the EOS Division.

The evaluation of an individual for requalification shall be based, in part, on the successful completion of written and operating examinations. Evaluations of each individual will also be made by the training staff, the Supervisors, and the Department Head prior to the final evaluation by the EOSD Director. The final, overall evaluation made by the Division Director may also include interviews with the candidates.

Procedure for Requalification

Throughout the two-year qualification period, the requalification program will be in progress. Trainers will prepare, administer, and evaluate all the examinations given during this requalification period. During the last two months that qualification remains in effect, it will be necessary to complete requalification.

Testing and Grading Requirements

The requirements pertaining to testing individuals and grading requalification examinations shall be the same as those listed for the initial qualification examinations.

Requalification Examinations

The content and scope of the written and operating examinations for technicians shall be essentially the same as indicated for the initial qualification. Some of the more elementary items may be de-emphasized while responses to emergency procedures are to be covered in detail.

The checklists that are used during the initial qualification training programs may also be used for the oral portion of the retraining programs; however, only selected portions are required to be reviewed.

Policy Toward Technicians who Fail the Examinations

When it has been determined by the trainer that a qualified technician has not made a passing grade on a requalification examination (i.e., he/she did not make an overall 70% or above), the trainer will inform the Department Head of the individual's failure status.

The Department Head will review any information supplied by the trainer and then inform the supervisor at the facility at which the individual is assigned that the individual has not satisfactorily met the requalification testing requirements and that the individual must repeat either the entire examination or a certain portion of the examination, as applicable.

RENEWAL OF TECHNICIAN QUALIFICATION

Effective for a two-year period of time
(starting on _____ and ending on _____)

Name _____ Badge No. _____ Position _____

Complex and/or Specialized Equipment _____ Date of Initial Qualification _____

Review of Technician Qualification*

The above-named individual has been actively and extensively engaged as Technician under his/her existing qualification. This individual has performed his/her required duties in a safe, responsible, and reliable manner and is considered capable of continuing to do so. Since there is a continued need for his services, and since his/her physical/mental condition and general health are acceptable and considered such as to present no potential problems during normal and emergency situations, the individual's qualifications to continue to perform his/her assignments are considered satisfactory. In addition, this individual has successfully completed the Requalification Training Program for the period of _____through _____; hence, official qualification shall be extended for the period of _____ through _____, unless said qualification is terminated by the Department Head prior to the indicated expiration date.

This individual's qualifications have been reviewed and approved by the following people:

Trainer _____ Date _____ Training Coordinator _____ Date _____

Group Supervisor _____ Date _____ Department Head _____ Date _____

EOSD Director _____

NOTE: The Division Director will fill in the STARTING and EXPIRATION DATES at the top of this document.

*The basis for Technical Staff/Technician qualification for the non-reactor facilities is stipulated in DOE Order 5480.1A, Chapter V, Safety of Nuclear Facilities. The basis for qualification for reactor nuclear facilities is stipulated in DOE Order 5480.1A, Chapter VI, Safety of DOE-Owned Reactors.

An individual will be allowed a reasonable period of time to prepare for re-examination (i.e., up to two weeks for a single-subject examination and up to four weeks for an entire requalification examination). If the second requalification examination is not administered within two months, the individual shall be automatically disqualified.

Until the individual repeats a required requalification examination and makes a satisfactory grade, he/she will be allowed to perform his normal duties as a technician; however, if the individual does not pass the second requalification examination satisfactorily, the examiner will inform the Department Head, who, in turn, will disqualify the individual. If there are extenuating circumstances, the individual will be considered for retesting a third time; if there are none, he/she will no longer be permitted to be a candidate for requalification. Reinstatement as a technician will require repetition of the initial qualification examination and approval by the EOSD Director.

4. TRAINING PROGRAM

Because of the tremendous diversity in tasks performed by radiation protection personnel, it is not surprising that the employee training requirements cover a broad spectrum of professional levels and subject matter. General EOS Division employee training needs are outlined.

4.1. GENERAL EMPLOYEE TRAINING

Since the work performed at a nuclear facility is unique in several respects, all persons regularly performing work at one of the ORNL faciities are to be given some training, commensurate with their job duties, in areas which shall include:

1. general description of the plant and facilities,
2. job-related safety procedures and instructions,
3. radiological health and safety,
4. Laboratory emergency plans,
5. industrial safety,
6. fire protection,
7. security,
8. quality assurance, and
9. environmental protection.

These required subjects may be covered by a combination of technician training programs, facility support-group training programs, and/or general ORNL orientation training programs. Oak Ridge National Laboratory has developed a two-level General Employee Training to review the major health, safety, and emergency preparedness program at ORNL.

Level I is being given to all employees of the Laboratory during a safety or staff meeting with one exercise on building-specific information to be prepared by each employee. Each employee will sign and verify that he/she has received this training and the immediate supervisor of each employee will sign and verify that the building-specific information is correct. The file copy will be retained by the employee's division.

The items in the reference guide include:

1. General Employee Training notes from video script
2. ORNL Telepone List
3. ORNL Map with Facility Key
4. Average Personnel Radiation Dose Worksheet
5. General Employee Training Information Checksheet

This kit is designed to be kept with other reference manuals; we hope the employees will be able to use it when questions arise regarding health, safety, and emergency response.

Level II is additional training for workers in or near radiation facilities. It is given by the division controlling the facility with the concurrence of the General Employee Training Coordinator.

4.2. CLASSROOM TRAINING PROGRAM

Training requirements for the RSS and HP Departments are primarily based on academic training, experience, or professional society certification in the area of radiation protection.

A Basic Radiation Protection Technology Training course is recommended for all radiation protection technicians and technical staff members unless qualifications have been established by the other means outlined in Chapter 3. This course may be basically the course prepared by Daniel A. Gollnick for use as an examination preparation course for the National Registry of Radiation Protection Technologists. Gollnick's text, Basic Radiation Protection Technology (Pacific Radiation Press, Temple City, California, 1983), covers (1) fundamentals, such as basic mathematics and science review, radioactivity, interaction of radiation with matter, biological effects of radiation, radiation dosimetry fundamentals, and radiation sources; (2) instrumentation, such as radiation detection instrumentation, external personnel monitoring systems, internal dosimetry techniques, and environmental survey techniques; and (3) operational aspects, such as protection principles and shielding, operational surveys and inspections, radioactive waste management, handling nuclear emergencies, and protection standards and regulations. It is currently taught by Roane State Community College, Chattanooga State Technical Community College, Texas State Technical Institute, Oak Ridge Associated Universities (ORAU), and others. It is also taught in-house as a part of the qualification for RSS radiation protection personnel.

In addition, there are other radiation protection training courses offered by ORAU and local colleges, with Associate degrees currently available from the Community Colleges and BS/MS/PhD programs being considered for implementation at the University of Tennessee-Knoxville.

The training program consists of a classroom phase and an on-the-job skills review. The classroom phase is divided into the following eight broad categories:

- Section 1 - Fundamental Mathematics, Sciences, and Techniques
- Section 2 - Health Physics Theory
- Section 3 - General Principles and Administration
- Section 4 - Radiation Survey
- Section 5 - Radioactive Contamination Control
- Section 6 - Radioactive Material Control, including Transportation and Waste Disposal
- Section 7 - Health Physics Dosimetry
- Section 8 - ORNL Systems/Operations/Experiments

The learning objectives have been adapted directly from the Institute of Nuclear Power Operations (INPO) Radiological Protection Technician Qualifications (INPO, 1982) where applicable or modified where necessary to cover the broader range of activities at ORNL. The INPO guidelines were prepared utilizing input from two sources: existing industry programs and the experience of INPO staff and industry reviewers. INPO represents some of the earliest efforts at using systematized approaches to training (SAT) (Andrews and Goodson, 1980).

The documentation accompanying each section is available primarily in three of the laboratory's procedure manuals and three training guides. Those procedures listed as "HP" are in the Health Physics Procedure Manual, "IP" are in the EOSD Internal Procedures Manual, and "EP" are in the EOSD Assignments and Responsibilities During Laboratory Emergency Operations. The annotations for the three training guides are listed in full.

SECTION 1 - FUNDAMENTAL MATHEMATICS, SCIENCES, AND TECHNIQUES AS APPLIED TO RADIATION PROTECTION TECHNICIAN ACTIVITIES

Learning Objective: Basic Mathematics

The purpose of this subject is to enable the trainee to perform the following tasks:

- o add, subtract, multiply, and divide whole numbers, fractions and decimals
- o calculate percentages
- o determine significant figures
- o convert metric to English and English to metric units for length, volume, and flow rate measurements

Learning Objective: Algebra

The purpose of this subject is to enable the trainee to perform the following tasks:

- o add, subtract, multiply, and divide algebraic expressions, use parentheses, factor algebraic expressions, and change signs to the depth required in radiological protection technology
- o apply the concept of exponential buildup and decay to solve radioactive decay and gamma ray shielding problems
- o use exponents, radicals, and scientific notation in radiological protection technology
- o graph sample data

Learning Objective: Mechanics

The purpose of this subject is to enable the trainee to demonstrate knowledge of the following:

- o systems of units
- o the concepts and relationships between work, energy, and momentum

Learning Objective: Chemistry

The purpose of this subject is to enable the trainee to demonstrate knowledge of the following:

- o atoms, elements, molecules, compounds, chemical formulas and chemical bonding
- o the properties of acids, bases, and chemical and ionic equilibria
- o the solution of simple chemical equations and calculations
- o preparation of chemical reagents and solutions

Learning Objective: Nuclear Physics

The purpose of this subject is to enable the trainee to demonstrate knowledge in these areas:

- o nuclear terminology and symbols
- o isotopes
- o mass-energy equivalence
- o nuclear forces
- o binding energy and binding energy per nucleon
- o fission yield curve

Learning Objective: Communication

Each trainee should be able to demonstrate practical knowledge and skills in the following areas:

- the importance of accurate communications
- proper oral communication using face-to-face, radio, and telephone communication systems
- proper communication in the writing of work logs, maintenance requests, radiation work permits, and other required written records

SECTION 2 - HEALTH PHYSICS THEORY

The summary objective of Health Physics Theory is to enable the trainee to perform the following:

- o identify the modes of radioactive decay, perform radioactive decay calculations, and demonstrate the practical application of the chart of the nuclides
- o identify the interaction of radiation with matter and select the type(s) of shielding material required for each type of radiation
- o identify and use radiological quantities and their units
- o identify the major sources of radiation
- o relate radiation exposure risk to the underlying biological concepts
- o minimum detectable activity calculations when necessary

Learning Objective: Radioactivity and Radioactive Decay

The purpose of this subject is to enable the trainee to perform the following:

- o identify the modes of radioactive decay
- o write simple equations describing each mode of decay
- o perform radioactive decay calculations using exponential equations and appropriate graphs
- o characterize alpha particles, beta particles, gamma rays, and neutrons
- o write simple equations describing the process of neutron activation
- o demonstrate the practical application of the chart of the nuclides

Specific Areas To Be Covered:

- o Atomic Models
  - Rutherford's
  - Bohr's
- o Nuclear Structure
  - Modeling
  - Stability
  - Binding Energy
- o Nuclear Decay
  - Radioactivity
  - Alpha Decay
  - Beta Decay
  - Gamma Decay
  - Radioactive Decay and Growth Equations
  - Half-Life
  - Fission

Documentation:

Basic Radiation Protection Technology by Daniel A. Gollnick (Pacific Radiation Press, Temple City, CA, 1983).
Radiation Monitoring, A Programmed Instruction Book by J. E. Wade and G. E. Cunningham, General Electric Company, for U. S. Atomic Energy Commission, Office of Information Services, EDM-123 (August 1967, reprinted September 1981).
Radiation Safety Technician Course by H. J. Moe, S. R. Lasuk, and M. C. Schumacher, Argonne National Laboratory, ANL-7291 (September 1966).

Learning Objective: Interaction of Radiation with Matter

The purpose of this subject is to enable the trainee to perform the following:

- o define the terms excitation, ionization, and specific ionization
- o identify the characteristics of energy loss by charged particles (alpha and beta particles) and uncharged particles (gamma rays and neutrons)
- o select the type(s) of shielding material required for each type of radiation

Specific Areas To Be Covered:

- o Energy Loss Mechanism
  - Ionization
  - Excitation
  - Bremstrahlung
- o Absorption
  - Ionization
  - Linear Energy Transfer
  - Photoelectric Effect
  - Compton Scattering
  - Pair Production
- o Neutron Interactions
  - Thermal
  - Fast

Documentation:

Basic Radiation Protection Technology by Daniel A. Gollnick (Pacific Radiation Press, Temple City, CA, 1983).

Radiation Monitoring, A Programmed Instruction Book by J. E. Wade and G. E. Cunningham, General Electric Company, for U. S. Atomic Energy Commission, Office of Information Services, EDM-123 (August 1967, reprinted September 1981).

Radiation Safety Technician Course by H. J. Moe, S. R. Lasuk, and M. C. Schumacher, Argonne National Laboratory, ANL-7291 (September 1966).

Learning Objective: Radiological Quantities and Units

The purpose of this subject is to enable the trainee to identify and use the radiological quantities and their units, differentiate between dose and dose rate, equate radioactivity to dose rate through simple rules of thumb and associated simple calculations, and convert radiological units to their respective subunits.

Specific Areas To Be Covered:

- o Quantities
  - Activity
  - Dose
  - Exposure
  - Dose Equivalent

  Units
  - Traditional
  - SI
- o Dose Calculations
  - Point Sources
  - Neutrons

Documentation:

Basic Radiation Protection Technology by Daniel A. Gollnick (Pacific Radiation Press, Temple City, CA, 1983).

Radiation Monitoring, A Programmed Instruction Book by J. E. Wade and G. F. Cunningham, General Electric Company, for U. S. Atomic Energy Commission, Office of Information Services, EDM-123 (August 1967, reprinted September 1981).

Learning Objective: Sources of Radiation

The purpose of this subject is to enable the trainee to identify and quantify the major sources of natural background radiation, man-made sources of background radiation, and radioactive sources routinely found in ORNL facilities.

Specific Areas To Be Covered:

- o Terrestrial
  - External
  - Internal
- o Cosmic
- o Artificial Radiation Sources
  - Electronic Production
  - Product Radioactivity
- o X-ray Tubes
- o Medical Radionuclide
- o Nuclear Particle Accelerators
- o Nuclear Reactors

Documentation:

Basic Radiation Protection Technology by Daniel A. Gollnick (Pacific Radiation Press, Temple City, CA, 1983).

Learning Objective: Biological Effects and Risks Associated with Exposure to Ionizing Radiation

The purpose of this subject is to introduce the trainee to the following concepts so that he/she can objectively base radiation exposure risk on the present knowledge, assumptions, and experiences of the scientific community:

- o simple mechanisms of radiation interactions with cells
- o acute radiation syndrome
- o somatic effects of radiation exposure
- o genetic effects of radiation exposure
- o long-term health effects of low-level radiation exposure
- o radiation risk and how it relates to other risks accepted in everyday life
- o the important aspects of low-level radiation exposure and its relationship to public health concerns

Specific Areas To Be Covered:

- o General Nature of Biological Damage from Radiation
  - Damage to cell nucleus and cytoplasm
  - Lethal damage to cells and carcinogenic and genetic transformations
  - Repair of biochemical lesions
  - Dependence of repair and biological effects on dose rate, linear energy transfer, and fractionation of dose
- o Acute radiation syndrome
- o Low dose effects

Documentation:

Basic Radiation Protection Technology by Daniel A. Gollnick (Pacific Radiation Press, Temple City, CA, 1983).

Learning Objective: Counting Statistics

The purpose of this subject is to enable the trainee to perform the following:

- o relate the statistical nature of radioactive decay to uncertainties encountered when measuring radioactivity
- o perform minimum detectable activity calculations when necessary
- o explain how to improve the statistical accuracy of a measurement

Specific Areas To Be Covered:

- o Binomial, Poisson, and Normal distributions
- o Standard deviation from the mean
- o Type I and Type II errors
- o Propagation of errors
- o Minimizing errors

Documentation:

Basic Radiation Protection Technology by Daniel A. Gollnick (Pacific Radiation Press, Temple City, CA, 1983).

Radiation Safety Technician Course by H. J. Moe, S. R. Lasuk, and M. C. Schumacher, Argonne National Laboratory, ANL-7291 (September 1966).

SECTION 3 - GENERAL PRINCIPLES AND ADMINISTRATION

The summary objective in General Principles and Administration is to enable the trainee to:

- o demonstrate proficiency in applying radiation protection standards in practical situations
- o apply proper ORNL guidelines and procedures to each task performed
- o identify and control the radiological conditions that might result from different accidents and incidents

Learning Objective: Radiation Protection Standards

The purpose of this subject is to enable the trainee to perform the following:

- o explain the purpose of radiation protection standards and guidelines and identify the regulatory and advisory organizations that have cognizance in this area
- o demonstrate proficiency in using DOE Orders [which may include acceptance of American National Standards Institute (ANSI), Nuclear Regulatory Commission (NRC) and Department of Transportation (DOT) standards] and other administrative limits in practical situations
- o implement guidelines when necessary

Documentation:

HPP 3.1 - Radiation Protection Standards for Occupational Exposure.

Learning Objective: ORNL Policies and Procedures

The purpose of this subject is to enable the trainee to demonstrate knowledge of the following:

- o chain of command, responsible for radiological safety
- o the importance of strict procedure adherence
- o the policy for making temporary or permanent changes to procedures
- o scope and content of appropriate health physics administrative procedures
- o quality assurance/quality control procedures and their application
- o the procedural requirements for replacing instruments and components (as appropriate)
- o the procedural requirements for calibrating instruments (as appropriate)
- o radiological emergency procedures
- o departmental surveillance procedures
- o ALARA program

Documentation:

HPP 1.1	ORNL Radiation Safety Policy
HPP 1.1A	Responsibilities for Radiation Safety
HPP 1.2	Training in Radiation Protection
HPP 1.3	Radiation Protection in the Design of Experiments and Plant Operations
HPP 1.4	Operating Procedures
HPP 1.5	Radiation Safety Review and Authorization of Operations and Experiments
HPP 6.1	ALARA Radiation Protection Program
EP-1	EOSD Emergency Coordination Unit Personnel

IP 102	Use of Form for Reporting Unsafe Conditions and Unsafe Practices at the Laboratory
IP 801	Reporting Work Injuries
IP 311	Coordinating Health Physics and Safety Activities Within Laboratory Divisions
IP 313	Temporary Badges for ORNL Employees
IP Appendix G	- Recommended Minimum Requirements for Radiation Exposures Control in Planned Irradiation Facilities

Learning Objective: Radiological Accident and Incident Evaluation and Control

The purpose of this subject is to enable the trainee to be able to do the following:

- identify the radiological conditions that might result from different accidents and incidents
- recognize the potential for an accident or incident from observations of improper work practices or instrument responses and alarms
- take immediate action to control the accident or incident
- evaluate the accident or incident to determine the cause
- take follow-up action to correct the cause

Documentation:

HPP 2.6	Reporting of Radiation Incidents
HPP 2.12	Emergency Fire Protection
IP 207	Compliance with DOE Manual Chapter 0525 (Notification of Exceeding Radiation Protection Standards)
IP 301	Reporting Radiation Incidents
IP 305	Mobilization of Health Physics Personnel During Off-Shifts
IP 306	Mobilizing Off-Site Health Physics Assistance
IP Appendix B	- Off Shift Emergency Coordinators
IP Appendix H	- MMES Policy Procedures GP-13. Occurrence Notification, Investigation, and Reporting
EP-2	Emergency Site Survey Unit
EP-3	Personnel Survey Unit
EP-A	Appendix A. FOSD Personnel and Telephone Listing
EP-D	Appendix D. Procedure for Mobilization of Off-Duty FOSD Personnel
EP-E	Appendix E. Procedure for Mobilizing Health Physics Off-Shift Assistance
EP-F	Appendix F. FOSD Emergency Coordinators During Off-Shifts

SECTION 4 - RADIATION SURVEY

The summary objective in Radiation Survey is to enable the trainee to perform the following tasks:

- o all routine surveys at ORNL
- o all Radiological Work Permit surveys
- o personnel surveys
- o surveys that may be required during emergency conditions
- o other surveys, as necessary
- o review of survey results, as necessary

Learning Objective: Radiation Detection Instrumentation and Measurement Principles

The purpose of this subject is to enable the trainee to demonstrate a knowledge of the following:

- o the basic theory of operation and operating characteristics of gas-filled detectors, scintillation detectors, semiconductor detectors, thermoluminescent dosimeters (TLDs) or film badges, and accident dosimeters
- o the basic theory of operation and operating characteristics of single-and multi-channel analyzers (for technicians who use this equipment)
- o instrument efficiency, the factors that affect instrument efficiency, and calculation of efficiency from given information
- o the effects of background radiation
- o familiarization with the operating characteristics of a radiation field survey instrument and a radioactive contamination survey instrument

Documentation:

Radiation Monitoring, A Programmed Instruction Book by J. E. Wade and G. E. Cunningham, General Electric Company, for U. S. Atomic Energy Commission, Office of Information Services, EDM-123 (August 1967, reprinted September 1981).

Radiation Safety Technician Course by H. J. Moe, S. R. Iasuk, and M. C. Schumacher, Argonne National Laboratory, ANL-7291 (September 1966).

Learning Objective: Radiological Survey and Monitoring Instruments and Techniques

The purpose of this subject is to enable the trainee to perform the following:

- o identify the operating characteristics of each survey instrument
- o demonstrate the proper use of all survey and monitoring instruments including physical checks prior to use, source and response checking, background determination, and use of head sets
- o demonstrate the proper use of all counting and spectroscopy equipment (as required)
- o identify unusual conditions that might affect instrument response, such as high humidity or mixed radiation fields

Specific Areas To Be Covered:

Alpha Radiation

- o Alpha Sources and Properties of Alpha Radiation
- o Alpha Contamination Limits
  - Material Clearances
  - Skin
  - Clothing
- o Smear Surveys
  - Smear Sampling Procedures and Exercises
  - Operation and Calibration of Smear Counter
  - Recording, Interpreting, and Reporting Data
  - Use of EOS Central Counting Room Services
- o Portable Alpha Detectors
  - Eberline Instruments PAC - 3G&4G
    - Operation
    - Limitations
    - Survey Procedures and Exercises
  - Portable Scintillation Counter
    - Operation
    - Limitations
    - Survey Procedures and Exercises
  - Alpha Response of Other Instruments
    - Cutie Pie
    - End Window GM
- o Continuous Alpha Air Monitor (CAAM)
  - Operation/Calibration
  - Limitations
  - Interpretation of Data
  - Adjustments and Maintenance
- o Alpha Laboratory Monitor
  - Operation
  - Testing/Calibrations
  - Limitations
  - Adjustments and Detector Replacements

Beta-Gamma Radiation

- o GM Survey Meter
  - Characteristics
  - Application
  - Limitations
- o Ionization Chambers
  - Characteristics
  - Applications
  - Limitations
- o Continuous Air Monitoring (CAM)(Beta-Gamma)
  - Characteristics
  - Applications
  - Servicing
- o Lab Monitor (Beta)
  - Characteristics
  - Application

- o Sample Counter (G-M)
  - Use
  - Calibration
- o Beta-Gamma Survey Techniques
  - Use of GMSM
  - Use of Cutie Pie
  - Routine Surveys
  - Surveys for pure beta emitters
  - Smear Techniques

Survey Techniques for Tritium

- o Characteristics of Tritium
- o Air Monitoring
- o Smearing Techniques
- o Operation of Tritium Smear Counter

Documentation:

HPP 2.1	Radiation Surveys
HPP 2.3	Warning Signs, Tags and Labels
IP 201	Servicing of Portable Instruments
IP 210	Hand Exposure Dosimetry with the ORNL Hand Exposure Meter
IP 211	Procedure for Use of Pocket Meter
IP 213	Radiation Monitoring of Photo-Badged Non-Employees
IP 215	Use of Non-Record Films
IP 216	Assignment of Recordkeeping of Health Physics Instruments
IP 217	Calibration of Stationary Health Physics Instruments
IP 307	Use of Green "Container-OK for Use" Tag
IP 310	Implementing and Follow-up on Salient Recommendations Suggested by Radiation Survey Personnel
IP 312	Continuous Air Monitor Data Reports

IP Appendix F - A Method for Adequately Monitoring for Neutrons

Radiation Monitoring, A Programmed Instruction Book by J. E. Wade and G. E. Cunningham, General Electric Company, for U. S. Atomic Energy Commission, Office of Information Services, EDM-123 (August 1967, reprinted September 1981).

Radiation Safety Technician Course by H. J. Moe, S. R. Lasuk, and M. C. Schumacher, Argonne National Laboratory, ANL-7291 (September 1966).

Learning Objective: Access Control and Work Monitoring

The purpose of this subject is to enable the trainee to perform the following:

- o define all access control requirements
- o demonstrate proper operating procedures at all permanent access control points
- o demonstrate the proper construction of a temporary access control point and use of correct operating procedures
- o identify when a radiation work permit (RWP) is required and demonstrate the proper issuance of an RWP
- o identify the criteria used to determine health physics coverage as a function of the work to be done

Documentation:

HPP 3.2	Personnel Exposure Control
HPP 3.3	Personnel Monitoring
HPP 3.4	Personnel Radiation Monitoring
HPP 3.6	Radiation Work Permit
IP 101	Approvals for Planned HP Personnel Exposure

Learning Objective: External Radiation Exposure Control

The purpose of this subject is to enable the trainee to perform the following:

- o demonstrate the ability to utilize the principles of time, distance, and shielding to reduce personnel exposure
- o solve simple distance attenuation problems for line and point sources
- o perform gamma ray shielding calculations using these items:
  - exponential shielding equation
  - half and tenth thickness values
  - empirically derived graphs from sources such as National Council on Radiation Protection and Measurement
- o explain the concept of buildup
- o identify common shielding practices for beta particles and neutrons
- o define all radiation field standards (i.e., radiation area) and demonstrate the ability to post radiation and high radiation areas properly
- o explain the "as low as reasonably achievable" (ALARA) concept, its purpose, and methods of implementation
- o implement exposure control systems

Specific Areas To Be Covered:

Principles of ALARA

- o Applications
  - Use of Shielding
  - Use of Time and Distance

Documentation:

HPP 6.1	ALARA Radiation Protection Program
HPP 6.2	ALARA Radiation Monitoring and Exposure Control
HPP 6.3	Facility and Equipment ALARA Design
HPP 6.4	ALARA Education and Training
HPP 6.5	ALARA Program Evaluation

Radiation Safety Technician Course by H. J. Moe, S. R. Lasuk, and M. C. Schumacher, Argonne National Laboratory, ANL-7291 (September 1966).

SECTION 5 - RADIOACTIVE CONTAMINATION CONTROL

The summary objective in Radioactive Contamination and Control is to enable the trainee to:

- o identify the sources of radioactive contamination
- o define ORNL working limits and implement them
- o establish contamination control by zoning, decontamination, and use of other protective measures such as protective apparel, respirators, and monitors
- o demonstrate proper procedures for decontamination of site, equipment, and personnel

Learning Objective: Radioactive Contamination Control

The purpose of this subject is to enable the trainee to perform the following:

- o identify the sources of radioactive contamination
- o define all ORNL working limits
- o demonstrate proper survey techniques (e.g., swipes, fixed contamination, personnel contamination) using appropriate instrumentation
- o demonstrate proper techniques and procedures for limiting the spread of contamination
- o demonstrate the ability to post a contamination area properly with the required signs
- o identify the plant contamination monitoring system and their operating principles and capabilities
- o demonstrate proper donning and removal of anticontamination clothing
- o convert meter reading to radioactivity levels
- o determine surface contamination levels resulting from various working conditions and incidents.

Specific Areas To Be Covered:

- o Contamination Zones
  - Definition
  - Signs/Tags
  - Entrance Requirements
  - Exit Procedures
- o Protective Apparel
  - Purposes
  - Types
  - Limitations
  - Donning Techniques/Procedures
  - Unsuiting Techniques/Procedures
  - Exercise in Donning/Removal
  - Care of Apparel
    - Laundry Contamination Limits
    - ORNL Respirator Program
- o HP Personnel Policies
  - Mobilization
  - Personnel Sampling Procedures

Documentation:

HPP 2.5	Radioactive Contamination Control
HPP 2.7	Radiation Control Zones
HPP 2.9	Zone Portals
HPP 2.10	Contamination Zone Change Facilities
HPP 2.11	Contamination Zone Clothing
HPP 2.12	Protection of Emergency Personnel from Radioactivity While Combatting Fire
HPP 5.2	Entry Control of Materials to Contaminated Zones
HPP Appendix A-1	A discussion of Surface Contamination Levels
A-2	Contamination Levels within Designated Contaminated Zones
A-3	Zoning and Protective Equipment Recommendations for Bonded Surfaces Involving Alpha Emitters
A-8	Returnable Beverage Bottles
A-13	Recommended Limits for Clearance of Liquids Not for Human Consumption
IP 101	Approvals for Planned HP Personnel Exposures
IP 303	Contamination Check of Vehicles
IP 304	Coordinator for Radiochemical Analyses in an Emergency
IP 305	Procedure for the Mobilization of Off-Duty Health Physics Personnel During Off-Shifts
IP 306	Procedure for Mobilizing Health Physics Off-Site Assistance
IP 701	Procedure for Sampling Personnel Subjected to Internal Radiation Exposure as a Result of a Contamination Event
IP 703	Procedure for Bioassay Request Cards, Form UCN-2716
IP 704	General Procedure for Bioassay Sampling, Analysis, and Reporting
IP 705	General Procedures for Requesting and Reporting Whole Body Counting (IVGS) Results
IP App. A	Dosimetry of Contaminated Skin
IP App. B	"New Laboratory Emergency Proc. Doc."
IP App. C	Points to be Considered During and Following an Incident Involving Radioactive Materials
EP-2	Emergency Site Survey Unit
EP-3	Personnel Survey Unit
EP-5	Environs Assessment Unit
EP-8	List of Equipment for Shift Office

Radiation Monitoring, A Programmed Instruction Book by J. E. Wade and G. E. Cunningham, General Electric Company, for U. S. Atomic Energy Commission, Office of Information Services, EDM-123 (August 1967, reprinted September 1981).

Learning Objective: Airborne Radioactivity Control

The purpose of this subject is to enable the trainee to perform the following:

- define maximum permissible concentration in air (MPC_a), maximum permissible body burden (MPBB), maximum permissible organ burden (MPOB), and critical organ
- explain how the MPBB, MPOB, and the critical organ relate to the appropriate MPC_a
- estimate dose to internal organs from swallowing and breathing radioactivity
- demonstrate the ability to find MPC_a values and to use them in practical situations

- o discuss biological half-life and effective half-life
- o identify the airborne radionuclides of concern in ORNL
- o identify the main ventilation and filtration systems in the plant
- o explain the concept of airborne radioactivity elimination as a function of ventilation rate
- o explain the operation of the continuous air monitors (CAMs) and other air sampling and monitoring equipment
- o demonstrate the use of portable air sampling equipment
- o identify techniques that can be used to reduce airborne activity
- o response to CAM alarms
- o determine airborne radioactivity levels based on appropriate measurements

Documentation:

IP 312 Continuous Air Monitor Data Reports

Radiation Safety Technician Course by H. J. Moe, S. R. Lasuk, and M. C. Schumacher, Argonne National Laboratory, ANL-7291 (September 1966).

Learning Objective: Respiratory Protection

The purpose of this subject is to enable the trainee to demonstrate knowledge of the following:

- o the proper use of all respiratory equipment used at ORNL
- o the required conditions under which each type of respiratory equipment must be used
- o entrance into confined spaces and work under subatmospheric conditions (if applicable)

Established Training Program: ORNL Respirator Program Training provided by Industrial Hygiene Department, Health Division, ORNL

Documentation:

IP 309 Radiation Survey Functions Relating to the Cleaning and Decontamination of Respiratory Equipment

IP 314 Guide for Obtaining Nasal Wipes

Regulatory Guide 8.15 - "Acceptable Programs for Respirator Protection" will also be covered.

Learning Objective: Decontamination

The purpose of this subject is to enable the trainee to perform the following:

- o demonstrate the proper procedures and techniques for personnel, equipment, clothing, and area decontamination
- o identify the problems that might be encountered during decontamination efforts
- o demonstrate proper procedures for handling contaminated personnel or injured personnel who may be contaminated

Specific Areas To Be Covered:

- o Personnel Decontamination Facility
  - Operation of Facility
  - Responsibilities in an Emergency

Documentation:

IP 302	Guide for Skin Decontamination
IP 303	Identification and Clearance of Vehicles and Heavy Equipment Which Require Repair and May Be Contaminated
IP 315	Contamination Limits for Garments to be Laundered
EP-3	Personnel Survey Unit

SECTION 6 - RADIOACTIVE MATERIAL CONTROL, INCLUDING TRANSPORTATION AND WASTE DISPOSAL

The summary objective in Radioactive Material Control (including Transportation and Waste Disposal) is to enable the trainee to:

- o identify the radioactive materials and sealed sources that must be controlled and demonstrate familiarity with control procedures
- o identify the radioactive material storage areas and demonstrate knowledge of storage procedures
- o demonstrate knowledge of fissile material control and criticality safety when appropriate
- o understand and implement the regulations that regulate the shipping and receiving of radioactive materials
- o identify and implement the health physics support required to carry out proper disposal of wastes with radioactive components

Learning Objective: Radioactive Material Control

The purpose of this subject is to enable the trainee to perform the following:

- o identify the radioactive sources that must be controlled and demonstrate familiarity with the control procedures
- o identify radioactive material storage areas and demonstrate knowledge of storage procedures
- o demonstrate knowledge of procedures that prevent the loss of radioactive materials

Specific Areas To Be Covered:

- o Registry of Radioactive Materials and Sealed Sources
- o Material Clearance Procedures
  - Contaminated Surfaces
  - Clothing
  - Items to be Returned to Stores or Salvage (see Transportation)
  - Transfer of Materials Within Laboratory (see Transportation)
  - Responsibilities
- o Principles of Zoning
  - Regulated Zones
  - Contamination Zones
  - Radiation Zones
- o Sale of Contaminated Materials
- o Criticality Safety

Documentation:

HPP 4.1 Handling and Transfer of Radioactive Materials
HPP 2.14 Registering Radioactive Materials and Sealed Sources
HPP 4.2 Sale of Contaminated Materials
HPP 5.2 Entry Control of Materials to Contaminated Zones

ORNL Criticality Safety Course by Calvin M. Hopper is available to all employees who have need for this specialized training.

Radiation Monitoring, A Programmed Instruction Book by J. E. Wade and G. E. Cunningham, General Electric Company, for U. S. Atomic Energy Commission, Office of Information Services, EDM-123 (August 1967, reprinted September 1981).

Learning Objective: Transportation of Radioactive Materials

The purpose of this subject is to enable the trainee to perform the following:

- o list the regulations that govern the shipping and receiving of radioactive materials
- o demonstrate the ability to implement those regulatory procedures if necessary

Specific Areas To Be Covered:

- o Pertinent Regulations
  - Type A and B Packaging
  - Control of Radiation During Transport (Transport Index)
  - Warning Labels
- o Transfer Operations On Site
  - From Contaminated Areas
- o Transfer Off-site

Documentation:

HPP 4.1 Handling and Transfer of Radioactive Materials Within the Laboratory
HPP 4.3 Shipment of Fissile and Other Radioactive Materials
HPP App. A-4 - General Factors to be Considered in On-Site Transfer Operations
HPP App. A-5 - General Rules Covering Shielded Containers for Shipments of Radioactive Materials
HPP App. A-9 - Guide for the Transfer of Materials Between Contaminated Enclosure Systems and Non-Contaminated Areas
HPP App. A-10 -Supplementary Information for Shipments of Fissile and Other Radioactive Materials

Learning Objective: Waste Disposal

The purpose of this subject is to enable the trainee to perform the following:

- o identify the liquid and gaseous control engineered systems and explain the procedure controls and demonstrate use of records for control of effluent discharges; explain how MPCs and technical specification limits are used
- o explain the radiological problems associated with solid waste operations
- o explain the radiological controls that govern the radiological waste system and the contaminated laundry
- o demonstrate knowledge of procedures and practices that minimize solid and liquid radioactive waste, wherever possible
- o demonstrate knowledge of waste solidification systems, processing procedures, and hazards associated with processing (if applicable)

Specific Areas To Be Covered:

- o Waste Disposal
  - Solid Waste
  - Liquid Waste
  - Gaseous Waste
  - Use of Burial Ground Forms

- o Waste Disposal Operations
  - Solid Waste Storage Area #5
    - Storage of Retrievable Waste Material
    - Low Level Waste Compactor
    - Above Ground Storage of Transuranium Wastes
  - Solid Waste Storage Area #6
    - Low Level Trenches, Auger Wells, Landfills
  - Liquid Waste Disposal
    - Hydrofracturing Facility
    - Liquid Waste Evaporator
    - Waste Treatment Plant
    - Tank Farm
  - Formerly Used Seepage Pits
  - Solid Waste Storage Areas #3 and #4

Documentation:

HPP 5.1 Segregation and Management of Radioactive Waste Materials
HPP 5.3 Disposal of Liquid Radioactive Wastes
HPP App. A-6 - Outline of Burial Ground Operations

SECTION 7 - HEALTH PHYSICS DOSIMETRY

The summary objective in Health Physics Dosimetry is to enable the trainee to:

- o define personnel dosimetry requirements for alpha and gamma and X rays, beta particles, and neutrons
- o identify the personnel dosimetry administration control requirements and exposure records methodology
- o understand the operating characteristics and use of film badges, TLD dosimeters, and other dose-measuring instruments
- o identify all bioassay requirements and analysis procedures
- o demonstrate the proper operation of the whole body counter
- o demonstrate the proper calibration of each instrument or piece of equipment used by the health physicist

Learning Objective: Dosimetry

The purpose of this subject is to enable the trainee to perform the following:

- o define personnel dosimetry requirements for gamma rays, beta particles, and neutrons
- o explain the operating characteristics of thermoluminescent dosimeters (TLDs) or film badges and pocket ionization chambers, including operating ranges, as well as fading and drift problems
- o identify the personnel dosimetry administrative control requirements and exposure records methodology
- o demonstrate the proper use of all personnel dosimetry
- o identify the uncertainties associated with internal dosimetry determinations
- o identify analysis methods for internal dose

Specific Areas To Be Covered:

- o Personnel Monitoring
  - Determination of Exposures
    - External Exposure
    - Internal Exposure
  - Exposure Control
    - Working Time
    - Permissible Concentrations (derived limits)
- o Personnel Monitoring Devices
  - Personnel Dosimeters
  - Pocket Meter Program
  - Instruments
    - Assignment and Record Keeping
    - Calibration
- o Bioassay Analysis
- o Whole Body Counting

Documentation:

HPP 3.2	Personnel Exposure Control
HPP 3.3	Personnel Monitoring
HPP 3.4	Personnel Radiation Monitoring
HPP 3.5	Personnel Contamination Monitoring
HPP A-12	Guides for Internal Exposure Monitoring
IP 101	Approvals for Planned HP Personnel Exposure
IP 202	Procedures for Personnel Monitoring of ORNL Employees
IP 207	Compliance with DOE Order 5484.1A (Notification of Exceeding Radiation Protection Standards)

IP 209	Personnel Radiation Dosimetry Supplement, UCN-2872 (Dose Data)
IP 213	Radiation Monitoring of Photo-Badged Non-Employees
IP 701	Procedure for Sampling Personnel Subjected to Internal Radiation Exposure as a result of a Contamination Event

Learning Objective: Personnel Dosimetry Procedures and Operations

The purpose of this subject is to enable the trainee to perform the following:

- o explain the operating characteristics of thermoluminescent dosimeters (TLDs) and pocket ionization chambers, including operating ranges, as well as fading and drift problems
- o carry out the meter assignment, distribution, and periodic change-over of personnel dosimeters and pocket meters

Specific Areas To Be Covered:

- o Personnel Monitoring Devices
  - MMES Meter
  - Supplementary ORNL Dosimeters
  - Pocket Meters
  - Extremity Dosimeters
  - Specialized Instruments and Techniques
- o Dose Evaluation
  - Responsibilities
  - Dose Recorded
  - Supplementary Dosimetry
- o Meter Assignment
- o Meter Distribution
- o Meter Changeover

Documentation:

HPP 3.4	Personnel Radiation Monitoring
HPP A-12	Guides for Internal Exposure Monitoring
IP 202	Procedures for Personnel Monitoring of ORNL Employees
IP 203	Procedure for ORNL Supplementary Meters
IP 206	Non-Routine Processing
IP 210	Hand Exposure Dosimetry with the ORNL Hand Exposure Meter
IP 211	Procedure for Use of Pocket Meter
IP 213	Radiation Monitoring of Photo-badged Non-employees
EP-4	Radiation Dosimetry Unit

Learning Objective: Bioassay Procedures and Operations

The purpose of this objective is to enable the trainee to perform the following:

- o Monitoring procedures for personnel internal dose
- o Radiochemical analyses procedures
- o Documentation and reporting of results

Specific Areas To Be Covered:

- o Description of Radioassay Laboratory
  - Radiochemistry Laboratories
  - Counting Rooms
  - Detectors and Counting Instrumentation
  - Calibration of Counting Instruments
  - Performance check on counting instruments and Quality Assurance

- o Radiochemical Procedures
  - Logging in of Samples
  - Sample Preparation
  - Radiochemical Separation
  - Counting Techniques
  - Calculation of Results
- o Monitoring Procedures
  - General
  - Urine Sample Monitoring
  - Feces Sample Monitoring
  - Body Tissue Analysis
- o Documentation and Reporting Results
  - Sampling Protocols
  - Documentation of calibrations and analysis results
  - Reporting Results

Documentation:

HPP 3.4	Personnel Radiation Monitoring
HPP 3.5	Personnel Contamination Monitoring
HPP A-12	Guides for Internal Exposure Monitoring
IP 304	Coordinator for Radiochemical Analysis in an Emergency
IP 314	Guide for Obtaining Nasal Swipes
IP 701	Procedure for Sampling Personnel Subjected to Internal Radiation Exposure as a result of a Contamination Event
IP 702	Priorities for IVGS and Bioassay Analyses
IP 703	Procedure for Bioassay Request Cards, Form UCN-2716
IP 704	General Procedures for Bioassay Sampling, Analysis, and Reporting
IP App. D	Table of Excretion indices (E.I.) for Radioisotopes Listed in NBS Handbook 69
EP-4	Radiation Dosimetry Unit

<u>Learning Objective: Whole Body Counting (IVGS) Procedures and Operations</u>

The purpose of this objective is to enable the trainee to perform the following:

- o Calibrate and use the special facility for a whole body counting of personnel
- o Interpretation of results
- o Request for Analysis and Reporting results

Specific Areas To Be Covered:

- o Description of Facility
  - Shielded Room
  - Detectors
    - Sodium Iodide Crystals
    - Phoswich
    - Hyperpure Germanium
- o Calibration Procedure
  - Resolution
  - Energy
  - Timing
- o Whole Body Counting Procedure (Includes actual count of trainee)
- o Request for Analysis and Reporting Results

Documentation:

HPP 3.3	Personnel Monitoring
HPP 3.4	Personnel Radiation Monitoring
HPP 3.5	Personnel Contamination Monitoring
HPP A-12	Guides for Internal Exposure Monitoring
IP 701	Prodedure for Sampling Personnel Subjected to Internal Radiation Exposure as a result of a Contamination Event
IP 702	Priorities for IVGS and Bioassay Analyses
IP 705	General Procedure for Requesting and Reporting Whole Body Counting (IVGS) Results
EP-4	Radiation Dosimetry Unit

Learning Objective: Dosimetry Records

The objective of this is to enable the trainee to:

- o define and tabulate the exposure records of all personnel
- o prepare all required reports on personnel exposure

Specific Areas To Be Covered:

- o Dosimetry Records
  - Personal Folder
  - Computerized Data Base
- o Dosimetry Reports
  - Pocket Meter
  - Quarterly Report
  - Annual Report
  - Individual Reports
- o Preliminary analysis of dosimetry data

Documentation:

HPP 3.2	Personnel Exposure Control
HPP 3.3	Personnel Monitoring
HPP 3.4	Personnel Radiation Monitoring
HPP 3.5	Personnel Contamination Monitoring
HPP A-12	Guides for Internal Exposure Monitoring
IP 202	Procedures for Personnel Monitoring of ORNL Employees
IP 207	Compliance with DOE Order 5484.1A (Notification of Exceeding Radiation Protection Standards)
IP 209	Personnel Radiation Dosimetry Supplement, UCN-2872 (Dose Data)

Learning Objective: Calibration of Instruments

The purpose of this objective is to enable the trainee to perform the following:

- o Demonstrate the proper use of calibration sources, equipment, and procedures to the specifications required for each instrument or piece of equipment
- o Maintain instrument inventory

Specific Areas To Be Covered:

- o Calibration Facility
  - Primary and Secondary Calibrations
    - Sources Available
      - Gamma
      - Neutron

- Beta
- Alpha
- Source Geometries
- Calibration Instruments

o Portable Instrument Calibration
- Ionization Chambers
- GM Survey Meters
- Neutron Survey Meters
- Alpha Survey Meters
- Miscellaneous Calibrations

o Instrument Inventory

o Calibration Forms and Procedures

o Field Support Services

Documentation:

IP 201 Servicing of Portable Instruments
IP 216 Assignment and Recordkeeping of Health Physics Instruments
IP 217 Calibration of Stationary Health Physics Instruments
Radiation Monitoring, A Programmed Instruction Book by J. E. Wade and G. E. Cunningham, General Electric Company, for U. S. Atomic Energy Commission, Office of Information Services, EDM-123 (August 1967, reprinted September 1981).

SECTION 8 - ORNL SYSTEMS/OPERATIONS/EXPERIMENTS

The summary objectives of ORNL Systems/Operations/Experiments is to enable the trainee to understand the purpose, major components and operation of several types of systems that may be in use at ORNL. These include:

- o reactors
- o accelerators
- o radiochemical plants and laboratories
- o x-ray equipment
- o radio frequency generating equipment
- o radioactive sources

Learning Objective: Systems/Operations/Experiments

The purpose of this subject is to enable the trainee to understand the purpose, major components, major flow paths, interactions, and importance of process experimental systems. Emphasis should be placed on the systems' importance to facility safety and containment of radioactivity. The scope and depth of material should be consistent with the responsibilities and duties of the technicians. The following are example systems/experiments/operations from which the curricula may be selected:

- o reactors
- o accelerators
- o radiochemical plants and laboratories
- o x-ray equipment
- o radio frequency generating equipment
- o radioactive sources

This will provide the trainee with an overview of the following:

- o system/experiment operations, including start-up, shutdown, and engineered safety features
- o system/experiment maintenance authorization and control practices as they relate to radiological protection

Reactors

Specific Areas To Be Covered:

- o Primary Water System
  - Pumps
  - Heat Exchangers
  - Ion Exchange Units
  - Filter Cubicles
  - Pipe Chase
  - Sampling Stations
- o Off-Gas System
  - Normal Off-Gas
  - Cell Ventilation System
- o Horizontal Beam Ports
  - Removal of Experiments
  - Installation of Experiments
  - Equipment Maintenance
- o Refueling

Documentation:

HPP 1.3 Radiation Protection in the Design of Experiments and Plant Operations

HPP 2.13 Radiation Protection Guide for High Level Irradiation Facilities

IP 304 Coordinator for Radiochemical Analyses in an Emergency

IP App. G Recommended Minimum Requirements for Radiation Exposure Control on Planned Irradiation Facilities

Radiation Safety Technician Course by H. J. Moe, S. R. Lasuk, and M. C. Schumacher, Argonne National Laboratory, ANL-7291 (September 1966).

Accelerators

Specific Areas To Be Covered:

- Principles of Accelerators
  - Linear Accelerators
  - Cyclotrons
  - Van de Graaff Machines
- Accelerator Surveys
  - Beams
  - RF Interference
  - Pulsed Radiation
  - Targets
  - Machine Intervals
  - Shield Penetrations
- Accelerator Safety Standards

Documentation:

HPP 2.13 Radiation Protection Guide for High Level Irradiation Facilities

ANSI N43.1 Radiological Safety in the Design and Operation of Particle Accelerators

Radiation Safety Technician Course by H. J. Moe, S. R. Lasuk, and M. C. Schumacher, Argonne National Laboratory, ANL-7291 (September 1966).

Radiochemical Plants and Laboratories

Specific Areas To Be Covered:

- Irradiation chambers
  - Hot Cells
  - Glove Boxes
  - Hoods
- Ventilation
- Filters
- ALARA Guidance

Documentation:

HPP 2.13 Radiation Protection Guide for High Level Irradiation Facilities

HPP 1.3 Radiation Protection in the Design of Experiments and Plant Operations

HPP App. A-7, Operating Guide for Radiochemical Laboratories at Various Activity Levels

HPP App. A-11, Design Criteria Guide for Radiochemical Plants and Laboratories

IP 304 Coordinator for Radiochemical Analyses in an Emergency
IP App. G Recommended Minimum Requirements for Radiation Exposure Control on Planned Irradiation Facilities
Radiation Safety Technician Course by H. J. Moe, S. R. Lasuk, and M. C. Schumacher, Argonne National Laboratory, ANL-7291 (September 1966).

X-Ray Equipment

Specific Areas To Be Covered:
- o Registration, Installation, and Operation
- o Health Physics Audit
- o Survey Procedures

Documentation:
HPP 2.8 Installation, Registration and Operations of X-ray Equipment
ANSI N43.2 X-ray Unit Safety
IP App. 6 Recommended Minimum Requirements for Radiation Exposure Control for Planned Irradiation Facilities

Radio Frequency-Generating Equipment (includes Microwaves)

Specific Areas To Be Covered:
- o Microwave Generating Equipment
- o Microwave Hazards
- o Operation and Registration of Microwave Generating Equipment
- o Microwave Surveys
  - Survey Meters
  - Survey Techniques

Documentation:
HPP 2.15 Operation and Registration of Radio Frequency-Generating Equipment

Radioactive Sources

Specific Areas To Be Covered:
- o Unsealed Sources
- o Sealed Sources

Documentation:
HPP 2.14 Registry of Radioactive Materials and Sealed Sources

4.3 SKILLS OBJECTIVES (OJT)

The purpose of the skills objectives or on-the-job training (OJT) is to enable the trainee to become proficient in the accomplishment of required job tasks. There are 16 sections devoted to skills objectives, based on the RSS Department and HP Department assignment areas described previously. Not all sections are appropriate to each job assignment, and it is not necessary to complete those not appropriate to the given assignment. In Section 16, the required sections are circled and reviewed.

NAME_____

SKILL OBJECTIVES (OJT)

Section 1 General Routines
- 1.1 Direct Reading Dosimeters
- 1.2 Waste Removal & Disposal
- 1.3 Source Leak Test
- 1.4 Green Tags
- 1.5 Establish Contamination Zone
- 1.6 Personnel Survey
- 1.7 Portable Instrument Preoperational Checks
- 1.8 Portable Air Samples
- 1.9 HP Survey Report
- 1.10 Nasal Smears & Sputum Samples

Section 2 Central Complex
- 2.1 Tour
- 2.2 Routine Fixed Instrument Checks
- 2.3 Routine Surveys
- 2.4 Routine Operations

Section 3 East Complex
- 3.1 Tour
- 3.2 Routine Fixed Instrument Checks
- 3.3 Routine Surveys
- 3.4 Routine Operations

Section 4 South Central Complex
- 4.1 Tour
- 4.2 Routine Fixed Instrument Checks
- 4.3 Routine Surveys
- 4.4 Routine Operations

Section 5 Southwest Complex
- 5.1 Tour
- 5.2 Routine Fixed Instrument Checks
- 5.3 Routine Surveys
- 5.4 Routine Operations

Section 6 Northwest Complex
- 6.1 Tour
- 6.2 Routine Fixed Instrument Checks
- 6.3 Routine Surveys
- 6.4 Routine Operations

Section 7 North Central Complex
- 7.1 Tour
- 7.2 Routine Fixed Instrument Checks
- 7.3 Routine Surveys
- 7.4 Routine Operations

Section 8 Melton Valley Complex
- 8.1 Tour
- 8.2 Routine Fixed Instrument Checks
- 8.3 Routine Surveys
- 8.4 Routine Operations

Section 9 Y-12 Operations Complex
- 9.1 Tour
- 9.2 Routine Surveys
- 9.3 Routine Operations

NAME_____

SECTION 1
GENERAL ROUTINES

While under the supervision of a Radiation Protection Staff Member or Senior RP Technician the trainee will be able to:

1.1 Zero and issue a Direct Reading Dosimeter.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

1.2 Assist in the proper removal of radioactive waste from a Radiologically Controlled Area to the proper radioactive waste receptacle.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

1.3 Perform a leak test survey on a sealed radioactive source and log the results.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

1.4 Issue three (3) green tags for releasing tools, equipment, or other non-personal items as non-radioactive.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

1.5 Establish a Contamination zone including boundaries, tags, and control point.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

1.6 Perform a personnel survey of a simulated contaminated individual exiting a controlled area.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

1.7 Perform necessary preoperational checks on portable survey instruments used for routine contamination and radiation surveys.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

1.8 Perform a portable air sample, calculate, and properly log the results.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

1.9 Complete an HP Survey Report to document the activities involved in while providing HP coverage to support operations.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

1.10 Collect nasal smears and sputum samples from a simulated potentially internally contaminated individual. Count the samples and properly log the results.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

NAME_____

SECTION 2
CENTRAL COMPLEX

While under the supervision of a Radiation Protection Staff Member or Senior RP Technician the trainee will be able to:

2.1 Conduct the Radiation Protection or senior RP technician on a tour of the buildings in the Central Complex and discuss:
- a. Radiologically Controlled Areas and potential radiological risks in each area.
- b. Fixed monitoring instruments and their locations.
- c. Portable survey instruments available for use.
- d. Emergency supplies locations.
- e. Fire alarm pull box locations.
- f. Safety shower kit locations.
- g. Evacuation alarm locations and evacuation routes.
- h. Storage location for RP supplies.
- i. Fissile material control.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

2.2 Perform the required routine fixed instrument checks for the instruments listed below:
- a. CAM
- b. CAAM
- c. Tritium Air Monitor

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

2.3 Perform all routine radiation and contamination surveys in the Central Complex. All surveys shall be properly logged and reviewed.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

2.4 Perform or simulate the HP coverage required for the following routine operations in the Central Complex.
- a. Separation of radioisotopes.
- b. Radioisotope packaging.
- c. Radioisotope movement.
- d. Shipment preparation.
- e. Experiments in research laboratories in Bldg. 3047 and 3038.
- f. Operations with tritium gas.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

NAME_____

SECTION 3
EAST COMPLEX

While under the supervision of a Radiation Protection Staff Member or Senior RP Technician the trainee will be able to:

3.1 Conduct the Radiation Protection Staff Member or senior RP technician on a tour of the East Complex and discuss:
- a. Radiologically Controlled Areas and potential radiological risks in each area.
- b. Fixed monitoring instruments and their locations.
- c. Portable survey instruments available for use.
- d. Emergency supplies locations.
- e. Fire alarm pull box locations.
- f. Safety shower and first aid kit locations.
- g. Evacuation alarm locations and evacuation routes.
- h. Storage location for RP supplies.
- i. Sulfur hexafluoride storage and transfer.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

3.2 Perform the required routine instrument checks for the instruments listed below:
- a. CAM/CAAM
- b. Accelerator interlock systems
- c. Accelerator monitron

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

3.3 Perform all routine radiation and contamination surveys in East Complex. All surveys shall be properly logged and reviewed.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

3.4 Perform or simulate the required HP coverage for the following routine operations in the East Complex:
- a. Experiments in hoods and glove boxes.
- b. Heavy element radioisotope research at TRL.
- c. Ventilation hood surveys and decontamination.
- d. Removal of contaminated items (trash, etc.).
- e. Survey samples.
- f. Accelerator operation.
- g. Radiofrequency-generating equipment (includes microwave).

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

NAME_____

SECTION 4
SOUTH CENTRAL COMPLEX

While under the supervision of a Radition Protection Staff Member or Senior RP Technician the trainee will be able to:

4.1 Conduct the Radiation Protection Staff Member or senior RP technician on a tour of the South Central Complex and discuss:
- a. Radiologically Controlled Areas and potential radiological risks in each area.
- b. Fixed monitoring instruments and their locations.
- c. Portable survey instruments available for use.
- d. Emergency supplies locations.
- e. Fire alarm pull box locations.
- f. Safety shower and first aid kit locations.
- g. Evacuation alarm locations and evacuation routes.
- h. Storage location for RP supplies.
- i. Fissile material control.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

4.2 Perform the required routine fixed instrument checks for the instruments listed below:
- a. CAM
- b. CAAM

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

4.3 Perform all routine radiation and contamination surveys in the South Central Complex. All surveys shall be properly logged and reviewed.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

4.4 Perform or simulate the required HP coverage for the following routine operations in the South Central Complex:
- a. Experiments in hoods and glove boxes.
- b. Fuel element development.
- c. Fuel recycle experiments.
- d. Ventilation hood surveys and decontamination.
- e. Removal of contaminated items (trash, etc.).
- f. Survey samples.
- g. 24000 Gamma Source.
- h. Alpha Laboratory.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

NAME_____

SECTION 5
SOUTHWEST COMPLEX

While under the supervision of a Radiation Protection Staff Member or Senior RP Technician the trainee will be able to:

5.1 Conduct the Radiation Protection Staff Member or senior RP technician on a tour of the Southwest Complex and discuss:
- a. Radiologically Controlled Areas and potential radiological risks in each area.
- b. Fixed monitoring instruments and their locations.
- c. Portable survey instruments available for use.
- d. Emergency supplies locations.
- e. Fire alarm pull box locations.
- f. Safety shower and first aid kit locations.
- g. Evacuation alarm locations and evacuation routes.
- h. Storage location for RP supplies.
- i. Fissile material control.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

5.2 Perform the required routine fixed instrument checks for the instruments listed below:
- a. CAM
- b. CAAM
- c. HF Counter
- d. Tritium Air Monitor
- e. CTA
- f. CTB
- g. Monitron

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

5.3 Perform all routine radiation and contamintion surveys in the Southwest Complex. All surveys shall be properly logged and reviewed.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

5.4 Perform the required RP coverage for the following operation in the Southwest Complex:
- a. High-level radiation examination laboratory.
- b. Examination/repackaging irradiated fuel elements.
- c. Fission product development laboratory.
- d. Survey samples.
- e. Ventilation hood surveys and decontamination.
- f. Sample transfers.
- g. Removal of contaminated items (trash, etc.).

h. Decontamination of Metal Recovery Facility.
i. Kyrpton operations.
j. Tritium operations.
k. Medical isotope research.
l. 3026D Cell Sectioning.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

NAME_____

SECTION 6
NORTHWEST COMPLEX

While under the supervision of a Radiation Protection Staff Member or Senior RP Technician the trainee will be able to:

6.1 Conduct the Radiation Protection Staff Member or senior RP technician on a tour of the Northwest Complex and discuss:
- a. Radiologically Controlled Areas and potential radiological risks in each area.
- b. Fixed monitoring instruments and their locations.
- c. Portable survey instruments available for use.
- d. Emergency supplies locations.
- e. Fire alarm pull box locations.
- f. Safety shower and first aid kit locations.
- g. Evacuation alarm locations and evacuation routes.
- h. Storage location for RP supplies.
- i. Fissile material control.
- j. Nuclear Safety Review (NSR) requirements for operations in Bldg. 3019.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

6.2 Perform the required fixed instrument checks for the instruments listed below:
- a. CAM
- b. CAAM

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

6.3 Perform all routine radiation and contamination surveys in the Northwest Complex. All surveys shall be properly logged and reviewed.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

6.4 Perform or simulate the required HP coverage for the following routine operations in the Northwest Complex:
- a. Radiochemical processing pilot plant.
- b. Uranium solution solidification.
- c. High-level radiation analytical laboratory.
- d. Hot cells.
- e. Glove boxes.
- f. Greenhouse complex.
- g. Survey samples.
- h. Sample transfers.
- i. Ventilation hood surveys and decontamination.
- j. Removal of contaminated items (waste, etc.).

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

NAME_____

SECTION 7
NORTH CENTRAL COMPLEX

While under the supervision of a Radiation Protection Staff Member or Senior RP Technician the trainee will be able to:

7.1 Conduct the Radiation Protection Staff Member or senior RP technician on a tour of the North Central Complex and discuss:
- a. Radiologically Controlled Areas and potential radiological risks in each area.
- b. Fixed monitoring instruments and their locations.
- c. Portable survey instruments available for use.
- d. Emergency supplies locations.
- e. Fire alarm pull box locations.
- f. Safety shower and first aid kit locations.
- g. Evacuation alarm locations and evacuation routes.
- h. Storage location for RP supplies.
- i. Fissile material control.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

7.2 Perform the required fixed instrument checks for the instruments listed below:
- a. CAM

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

7.3 Perform all routine radiation and contamination surveys in the North Central Complex. All surveys shall be properly logged and reviewed.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

7.4 Perform the required RP coverage for the following operations in the North Central Complex:
- a. Three operating reactors (ORR, BSR, PCA).
- b. Two decommissioned reactors (OGR and LITR).
- c. Hot cells (3025).
- d. Research labs.
- e. Hot shop for manipulator assemblies (3044).
- f. Storage vault for fissile materials.
- g. Survey samples.
- h. Removal of contaminated items (trash, etc.).
- i. Access control.
- j. 14 Mev Neutron Generator (2011).

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

NAME_____

SECTION 8
MELTON VALLEY COMPLEX

While under the supervision of a Radiation Protection Staff Member or Senior RP Technician the trainee will be able to:

8.1 Conduct the Radiation Protection Staff Member or senior RP technician on a tour of the Melton Valley Complex and discuss:
- a. Radiologically Controlled Areas and potential radiological risks in each area.
- b. Fixed monitoring instruments and their locations.
- c. Portable survey instruments available for use.
- d. Emergency supplies locations.
- e. Fire alarm pull box locations.
- f. Safety shower and first aid kit locations.
- g. Evacuation alarm locations and evacuation routes.
- h. Storage location for RP supplies.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

8.2 Perform the required fixed instrument checks for the instruments listed below:
- a. CAM
- b. CAAM

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

8.3 Perform all routine radiation and contamination surveys in the Melton Valley Complex. All surveys shall be properly logged and reviewed.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

8.4 Perform the required RP coverage for the following operations in the Melton Valley Complex:
- a. High Flux Isotopes Reactor (HFIR, 7900).
- b. Transuranium Facility (TRU, 7920).
- c. Transfer of heavy elements between HFIR and TRU.
- d. Heavy element processing and shipping.
- e. Experiments at HFIR.
- f. Health Physics Research Reactor (HPRR, also known as DOSAR, 7700).
- g. Tower Shielding Facility.
- h. Ventilation hood surveys and decontamination (7920).
- i. Removal of contaminated items (trash, etc.).
- j. TURF (7930).
- k. Analytical chemistry glove box operations in 7920.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

NAME_____

SECTION 9
Y-12 OPERATIONS COMPLEX

While under the supervision of a Radiation Protection Staff Member or Senior RP Technician the trainee will be able to:

9.1 Conduct the Radiation Protection Staff Member or senior RP technician on a tour of the Y-12 Operations Complex and discuss:
- a. Radiologically Controlled Areas and potential radiological risks in each area.
- b. Fixed monitoring instruments and their locations.
- c. Portable survey instruments available for use.
- d. Emergency supplies locations.
- e. Fire alarm pull box locations.
- f. Safety shower and first aid kit locations.
- g. Evacuation alarm locations and evacuation routes.
- h. Storage location for RP supplies.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

9.2 Perform the required fixed instrument checks for the instruments listed below:
- a. CAM

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

9.3 Perform all routine radiation and contamination surveys in the Y-12 Operations Complex. All surveys shall be properly logged and reviewed.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

9.4 Perform the required HP coverage for the following routine operations in the Y-12 Operations Complex:
- a. Sampling.
- b. Radiobiological experiments.
- c. Development of high voltage generating devices (X-rays produced).
- d. Critical Experiments Facility (CEF).
- e. Residual alpha contamination from WWII operations.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

NAME_____

SECTION 10
SHIFT AND AREA COMPLEX

While under the supervision of a Radiation Protection Staff Member or Senior RP Technician the trainee will be able to:

10.1 Conduct the Radiation Protection Staff Member or senior RP technician on a tour of the waste disposal areas, the Environmental Research Park, the laundry, the 7000 area (radioisotopes shipping and receiving plus salvage yard) and Fuel Recycle operations in 7600 area and discuss the following:
- a. Radiologically Controlled Areas and potential radiological risks in each area.
- b. Fixed monitoring instruments and their locations.
- c. Portable survey instruments available for use.
- d. Emergency supplies locations.
- e. Fire alarm pull box locations.
- f. Safety shower and first aid kit locations.
- g. Evacuation alarm locations and evacuation routes.
- h. Storage location for RP supplies.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

10.2 Perform the required fixed instrument checks for the instruments listed below:
- a. CAM
- b. RAM
- c. CAS
- d. Stack Monitor

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

10.3 Perform all routine radiation and contamination surveys in these areas. All surveys shall be properly logged and reviewed.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

10.4 Perform or simulate the required RP coverage for the following routine operations:
- a. Sampling.
- b. Shipping and Receiving Area.
- c. Decontamination and release in salvage/laundry.
- d. Experiments in NERP and Fuel Recycle.
- e. Removal of contaminated items (trash, etc.)
- f. Recording readings at Sewage Treatment Plant, White Oak Dam, and White Oak and Melton Branch Monitoring Stations.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

NAME_____

SECTION 11
PERSONNEL DOSIMETRY

While under the supervision of a Radiation Protection Staff Member or Senior RP Technician the trainee will be able to:

11.1 Conduct the senior RP technician or supervisor on a tour of the facilities used to distribute and process personnel personal monitoring devices, and discuss the following:
a. Personal monitors available for use and their distribution sites,
b. Fire alarm pull box locations,
c. Safety shower and first aid kit locations,
d. Evacuation alarm locations and evacuation routes,
e. Storage location for RP supplies.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

11.2 Perform all routine distribution and processing steps for personal personnel monitors. All surveys shall be properly logged and reviewed.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

NAME_____

SECTION 12
RADIOASSAY LABORATORY

While under the supervision of a Radiation Protection Staff Member or Senior RP Technician the trainee will be able to:

12.1 Conduct the Radiation Protection Staff Member or senior RP technician or supervisor on a tour of the facilities used to analyze the internal doses received by personnel, and discuss the following:
- a. Use of facilities available for analysis,
- b. Radiologically Controlled Areas and potential radiological risks in each group work area,
- c. Fire alarm pull box locations,
- d. Safety shower and first aid kit locations,
- e. Evacuation alarm locations and evacuation routes,
- f. Storage location for RP supplies.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

12.2 Perform all routine analyses (including sample preparation) for analysis of body tissues and fluids for internal dose. All analyses shall be properly logged and reviewed.
- a. Use and calibration of counting room detectors/instrumentation,
- b. Sample preparation,
- c. Radiochemical and counting procedures,
- d. Body tissue and fluids analysis,
- e. Documentation of results.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

NAME_____

SECTION 13
WHOLE BODY COUNTING

While under the supervision of a Radiation Protection Staff Member or Senior RP Technician the trainee will be able to:

13.1 Conduct the Radiation Protection Staff Member or senior RP technician or supervisor on a tour of the facility used and discuss the following:
- a. Types of detectors and shielding available,
- b. Fire alarm pull box locations,
- c. Safety shower and first aid kit locations,
- d. Evacuation alarm locations and evacuation routes,
- e. Storage location for RP supplies.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

13.2 Perform all routine steps in whole body counting procedure. All analyses shall be properly logged and reviewed.
- a. Shielded Room and Detectors,
- b. Calibration of equipment,
- c. Counting Procedures.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

NAME_____

SECTION 14
DOSIMETRY RECORDS

While under the supervision of a Radiation Protection Staff Member or Senior RP Technician the trainee will be able to:

14.1 Conduct the Radiation Protection Staff Member or senior RP technician or supervisor on a tour of the facilities used for these activities and discuss the following:
a. Dosimetry Records required,
b. Fire alarm pull box locations,
c. Safety shower and first aid kit locations,
d. Evacuation alarm locations and evacuation routes,
e. Storage location for RP supplies.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

14.2 Perform all routine data recording and updating steps required. Reports as necessary.
a. Dosimetry Records,
b. Dosimetry Reports,
c. Preliminary Analyses.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

NAME_____

SECTION 15
CALIBRATION OF INSTRUMENTS

While under the supervision of a Radiation Protection Staff Member or Senior RP Technician the trainee will be able to:

15.1 Conduct the Radiation Protecttion Staff Member or senior RP technician or supervisor on a tour of the Calibration facility and discuss the following:
- a. Type of sources, equipment, and procedures available,
- b. Radiologically Controlled Areas and potential radiological risks in each group work area,
- c. Fire alarm pull box locations,
- d. Safety shower and first aid kit locations,
- e. Evacuation alarm locations and evacuation routes,
- f. Storage location for RP supplies.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

15.2 Perform instrument inventory and calibration of all equipment used by RP.
- a. Portable instruments,
- b. Stationary instruments.

LOC	RPSM/TECH SIG	TRAINEE SIG	DATE

NAME_____

SECTION 16
FINAL ORAL EXAMINATION/WALK-THROUGHS

16.1 The trainee will demonstrate his/her familiarity with RP-covered areas and the RP duties and responsibilities in those areas by conducting an RP supervisor and trainer on an oral examination/walk through of the appropriate areas listed below (Those appropriate to job responsibilities should be circled here):

a. Central Complex,
b. East Complex,
c. South Central Complex,
d. Southwest Complex,
e. Northwest Complex,
f. North Central Complex,
g. Melton Valley Complex,
h. Y-12 Operations Complex,
i. Shift and Area Surveys Complex,
j. Personnel Dosimetry Group,
k. Radioassay Laboratory Group,
l. Whole Body Counting Group,
m. Dosimetry Records Group,
n. Calibration of Instruments Group.

a.

LOC	RP SUPV. SIG	INST. SIG	TRAINEE SIG	DATE

b.

LOC	RP SUPV. SIG	INST. SIG	TRAINEE SIG	DATE

c.

LOC	RP SUPV. SIG	INST. SIG	TRAINEE SIG	DATE

d.

LOC	RP SUPV. SIG	INST. SIG	TRAINEE SIG	DATE

e.

LOC	RP SUPV. SIG	INST. SIG	TRAINEE SIG	DATE

f.

LOC	RP SUPV. SIG	INST. SIG	TRAINEE SIG	DATE

g.

LOC	RP SUPV. SIG	INST. SIG	TRAINEE SIG	DATE

h.

LOC	RP SUPV. SIG	INST. SIG	TRAINEE SIG	DATE

	LOC	RP SUPV. SIG	INST. SIG	TRAINEE SIG	DATE
i.					
j.					
k.					
l.					
m.					
n.					

The Manager (RSS or HP), certifies that the trainee has completed all qualification requirements outlined in this qualification standard, and is fully qualified as a Radiation Protection Technician.

Signature, Manager Date

4.4 TRAINING CHECKLIST FOR SUBJECTS OTHER THAN THOSE SUBJECTS COVERED BY TECHNICIAN QUALIFICATION EXAMINATION(S)

(Note: This form is to be completed by the supervisor in charge).

Name _____ Badge No. _____ Complex and/or Specialized Equipment _____

The above-named individual:	Date/Initial
1. Has periodically participated in building and/or plant evacuation drills (required annually);	_____
2. Has read reports on accidents, training drills, etc. that were generated in other groups but which may be applicable to this work area;	_____
3. Has been made aware of all significant changes in equipment and/or procedures;	_____
4. Has had fire-fighting training;	_____
5. Has had periodic safety meetings;	_____
6. Has periodically reviewed the following ORNL safety literature, where applicable	
a. the Local Emergency Manual,	_____
b. the Emergency Manual,	_____
c. the Safety Manual,	_____
d. the Health Physics Procedure Manual	_____
e. the Industrial Hygiene Manual,	_____
f. the Respiratory Program Manual,	_____
g. the Environmental Protection Manual.	_____

The above-named individual has had the training as indicated: _____ (Supervisor) _____ (Date)

The above-mentioned subjects have been covered by me: _____ (Trainee) _____ (Date)

5. REACTOR AND NONREACTOR NUCLEAR FACILITIES TRAINING REQUIREMENTS

The basis for qualification of support personnel at reactor nuclear facilities is stipulated in DOE Order 5480.1A, Chapter VI, Safety of DOE-Owned Reactors. These requirements have been incorporated into the radiation protection training program outlined in this document. Those complexes at ORNL that contain reactor facilities are: North Central, Melton Valley, and Shift and Area Surveys (on off-shifts).

The basis for qualification of support personnel at nonreactor facilities is stipulated in DOE Order 5480.1A, Chapter V, Safety of Nuclear Facilities. These requirements have been incorporated into the radiation protection training program outlined in this document. All complexes at ORNL contain nonreactor nuclear facilities.

REFERENCES

1. Health Physics Manual - Procedures and Practices for Radiation Protection, Environmental and Occupational Safety Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

2. Emergency Procedures Manual - Environmental and Occupational Safety Division, Assignments and Responsibilities During Laboratory Emergency Operations, Issued 2/19/85.

3. Internal Procedures Manual - Environmental and Occupational Safety Division, Internal Operating Procedures Manual, Oak Ridge National Laboratory, Updated 3/5/85, Oak Ridge, Tennessee.

4. Radiation Monitoring, A Programmed Instruction Book by J. E. Wade and G. E. Cunningham, General Electric Company, for U. S. Atomic Energy Commission, Office of Information Services, EDM-123 (August 1967, reprinted September 1981).

5. Radiation Safety Technician Course by H. J. Moe, S. R. Lasuk, and M. C. Schumacher, Argonne National Laboratory, ANL-7291 (September 1966).

6. Basic Radiation Protection Technology by Daniel A. Gollnick (Pacific Radiation Press, Temple City, CA, 1983).

7. The Institute of Nuclear Power Operations (INPO), Radiological Protection Technician Qualifications (INPO, 1982).

8. Systematic Approaches to Training: Keeping Pace with Changing Technologies and Skill Requirements, Human Resources Forum, Oak Ridge Associated Universities for Office of Industrial Relations, Directorate of Administration, Department of Energy (December 1984).

9. A Comparative Analysis of Models of Instructional Design by D. H. Andrews and L. A. Goodson, Journal of Instructional Development 3 (4): 2-16 (Summer 1980).

10. Guidelines for Job and Task Analysis for DOE Nuclear Facilities by Analysis and Technology, Inc. for the Department of Energy, DOE-EP-0095 (June 1983).

11. Preparation Course for the American Board of Health Physics Certification Examinations, by J. C. Taschner, W. W. Schadt, and R. W. Broseus, available from the Baltimore-Washington Chapter of the Health Physics Society, Second Edition (December 1981).

12. ABHP Examination Preparation Guide, American Board of Health Physics, Rockwell, MD 20852.

13. Qualification Standard #609, Junior Health Physics Technician. Part II. Skill Objectives, by Westinghouse Idaho Nuclear Company, Inc., Idaho Falls, Idaho 83403 (December 1985).

14. Systematic Approaches to Training: An Overview, Booklet from TRADE (Training Resources and Data Exchange), Oak Ridge Associated Universities for the Department of Energy.

15. Proposed Standard Guide for Radiological Protection Training for Nuclear Facility Workers, ASTM Task Group E10.03.04 for Subcommittee E10.03 (Revision 4, August 20, 1985).

16. Guidelines for Evaluating DOE Non-Reactor Nuclear Facility Training Programs by the Department of Energy Nuclear Facility Training Coordination Program (November 1985).

17. DOE Order 5480.1A. Environmental Protection, Safety, and Health Protection Program for DOE Operations (Chapter V: Safety of Nuclear Facilities; Chapter VI: Safety of Department of Energy-Owned Reactors).

18. DOE Order 5500.2. Emergency Planning, Preparedness, and Response of Operations.

19. DOE Order 5500.3. Reactor and Nonreactor Nuclear Facility Emergency Planning, Preparedness, and Response Programs for DOE Operations.

20. DOE Order 5480.2. Hazardous and Radioactive Mixed Waste Management.

21. Martin Marietta Energy Systems, Inc., Policy Procedure D-5-29S. Safety Review and Documentation Program.

22. Oak Ridge National Laboratory Standard Practice Procedures 29. Safety Review and Documentation Program.

23. ORNL Guide for Nonreactor Nuclear Facilities Training Program, by M. Baldwin et al., (1986).

24. A Compilation of the Activities of the Radiation and Safety Surveys Department, Environmental and Occupational Safety, Oak Ridge National Laboratory, by Charlie F. Jackson, Oak Ridge National Laboratory, (1984).

APPENDIX A

DETAILED DESCRIPTIONS OF COMPLEXES

These detailed descriptions of the RSS Complexes have been reprinted from A Compilation of The Activities of the Radiation and Safety Surveys Department, Environmental and Occupational Safety Division, Oak Ridge National Laboratory, by Charlie F. Jackson.

CENTRAL COMPLEX
(Principally Operations Division)

The Central Complex includes ten buildings occupying 56,267 ft². The buildings are of steel frame, metal siding; brick with reinforced concrete; and concrete block construction. The major activity of the Central Complex is the processing and packaging of radioisotopes for shipment to buyers.

Building 3028

West - contains a large manipulator cell used to process and package ^{131}I. A cell for processing xenon gas is also in this facility.

East - contains five manipulator cells that have been used for curium work but are now being decontaminated prior to being used as an alpha powder facility for work with transuranic isotopes. Second Level - Experimental work with white rats using various beta-gamma emitters.

Building 3029

This building contains three multi-curie manipulator cells for high level beta-gamma work and one smaller manipulator cell for processing short-lived fission products.

Building 3030

This building contains one manipulator cell for high level beta-gamma work and three hoods for low to intermediate beta-gamma work.

Building 3031

This building contains one manipulator cell for high level beta-gamma work and two hoods for low and intermediate beta-gamma work.

Building 3032

This building contains one glove box that is used for low level alpha work, and three hoods that are used for low level alpha, beta-gamma work.

Building 3033

This building contains facilities for purifying and packaging Kr and ^{3}H gases for shipment.

Building 3033 Annex

This building contains three glove boxes used for storage and preparation of transuranic targets and a hood used for low to intermediate level work with the same material.

Building 3038

Radioisotope Shipping - contains a barricade for storage and loading radioisotopes. Some shipments are loaded here and all must be processed in this area.

Alpha Handling Facility - contains five H_2O shielded manipulator cells used for storing, processing, and studying high level uranium isotopes, and three glove boxes used in fabricating sources from transuranic elements. The east end of this building contains eleven glove boxes and five hoods. The glove boxes are used for work with transuranic elements, and the hoods for smaller quantities of the same materials. This part of the building also contains a Scanning Electron Microscope, one x-ray diffraction unit, and one x-ray fluorescence unit.

Building 3038 Annex

This facility contains six glove boxes used for weighing and encapsulating gram quantities of transuranic elements.

Building 3047

First Level West - contains a water shielded manipulator cell that is used for high level alpha work with californium and curium. First Level East - contains four large multi-curie manipulator cells used for high level beta-gamma work. Second Level West - contains three furnaces used in compatibility studies on high level transuranic elements and two glove boxes used for work with neptunium and plutonium. Second Level East - contains four labs used to process low level beta-gamma material.

EAST COMPLEX

The East Complex includes six buildings occupying 518,724 ft². The buildings are of brick, brick tile, or transite construction. The activities carried out in this complex include: low-energy accelerator research, the study of radiation damage in reactor components, the production and investigation of short-lived nuclei, the investigation of neutron cross section and neutron activation, and experiments using highly toxic radionuclides of the transuranium elements.

Building 4500S

Building 4500S is a general purpose research complex composed of 200 laboratories of which approximately 120 are used in tracer level (generally < 1 mCi) radiochemical studies. Personnel from eight divisions occupy laboratories in this area.

Building 5500

The High Voltage Laboratory (HVL) houses the 15 MeV Tandem Van de Graaff operated by the Physics Division. This accelerator is used as a research tool in the area of low-energy and atomic physics. The Metals and Ceramics Division operates a 5 MeV Van de Graaff used to simulate radiation damage in reactor components. In addition, the Metals and Ceramics Division occupies several laboratories in the building that contain electron microscopes and small x-ray scattering apparatus designed to investigate voids as well as other damage parameters.

Building 6000

The Oak Ridge Isochronous Cyclotron (ORIC) (see Fig. 3) is a positive ion accelerator employed in the field of nuclear research. UNISOR, a part of ORIC operated by Oak Ridge Associated Universities (ORAU) and ORNL, is an electromagnetic isotope separator used to produce and investigate short lived nuclei far from the line of beta stability. The Holifield Heavy Ion Research Facility (HHIRF) located adjacent to and integrated into the ORIC system is a 25 MV tandem accelerator that explores the structure over the full range of elements.

Building 6010

The Oak Ridge Electron Linear Accelerator (ORELA) is located in Building 6010. This device utilizes neutrons from the (γ, n) reaction in tantalum to investigate neutron cross sections, neutron activation, and radiation damage in reactor component material. A 500 KeV Cochcroft-Walton accelerator is also housed in Building 6010. It uses D-T neutrons to explore shielding requirements for future fusion reactors.

Building 6025

Building 6025 provides office space and computing facilities for the Engineering Physics Division.

Microwave Program

The East Complex office maintains a list of all radio frequency-generating equipment (includes microwaves) and surveys the equipment periodically to insure compliance with Laboratory regulations.

Building 5505

The Transuranium Research Laboratory (TRL) is a laboratory building specifically designed with special containment features for conducting experiments with radionuclides of the transuranium elements. The TRL contains sixteen laboratories equipped with a total of sixteen fume hoods for low level work, and forty-seven glove boxes for higher level experiments.

The facility is under the administrative direction of the ORNL Chemistry Division; however, many studies in the TRL are conducted jointly with staff members of other ORNL Divisions.

The TRL also serves as center for cooperative actinide research for university participants and scientists from many other laboratories both in the U.S. and abroad (45 from U.S. universities and 25 from 12 foreign countries since 1967).

The major research effort in the TRL consists of studies of the chemical and physical properties of the 5f-actinide elements and their compounds and the homologous 4f-lanthanides.

SOUTH CENTRAL COMPLEX

The South Central Complex includes five buildings occupying 559,405 ft^2. The buildings are of brick and/or brick tile construction. The activities carried out in this complex include: central research and administration, high-level radio-chemistry, experimental engineering, high-radiation level chemical development, and metal and ceramics research.

Building 4500N

This facility has radiochemical laboratories where radioactive materials are handled in hoods having high-efficiency filters.

Wing I - occupied by the Chemical Technology Division, houses facilities for the study of water chemistry of nuclear reactors, nuclear waste management, batch sedimentations, microbial isolation, photochemical and spectroscopic investigation of actinides and related fission products, and the dissolution of UO_2 and ThO_2.

Wing II and Part of Wing III - occupied by the Chemistry Division and house facilities for x-ray and neutron diffraction studies, coal chemistry synthesis, and the study of radionuclide adsorption by various minerals and clays.

Part of Wing III - occupied by the Analytical Chemistry Division, houses x-ray and spectroscopic equipment for radionuclides and analyses.

Building 4501

Several divisions have laboratory and engineering scale research facilities in this building. The Chemical Technology Division operates three high-level radiation cells in a program to identify significant fission products released during a high burn-up LWR fuel under accident conditions. A separate but related program involves the study of uranium aerosol behavior under core melt conditions. Other studies conducted by the Chemical Technology Division are: Purex solvent cleanup, the diffusion of uranium in graphite, thermodynamic studies of uranium and thorium compounds, and laboratory-scale plutonium fuel reprocessing.

In addition, the division stores a 12,000 Ci ^{60}Co irradiation device and various isotopes amounting to several thousand curies in shielded vaults and carriers in this building.

The Metals and Ceramics Division prepares metallurgical specimens from highly irradiated samples from HFIR. Also, process development studies are done on the production of uranium and thorium microspheres by the sol-gel technique. In addition, the distribution of iodine (labeled with ^{131}I) between aqueous and gas phases is being investigated.

Building 4505

The Chemical Technology Division is studying the sorption of tritium from liquid lithium in a glove box operation involving the use of approximately 100 Ci of ^{3}H.

Building 4507

The Chemical Technology Division's High-Level Chemical Development Building is a double containment facility containing four "hot cells." All operations have been shut down since October 1, 1981, and the building is now in standby status.

Building 4508

The Metal and Ceramics Division operates various research and development laboratories in which ^{235}U is used in reactor fuel development and waste management. There is also a large scale metal-forming operation involving refractory metals, ceramics, and graphite R&D programs, and physical properties laboratories. In addition, the division has a microscopy laboratory housing a million KV electron microscope.

SOUTHWEST COMPLEX

The Southwest Complex includes eleven buildings occupying 188,972 ft^2. The buildings are of wooden frame, brick tile, steel frame, metal siding construction. The activities carried out in this complex include: radioisotope development; instrumentation and control high radiation engineering; geoscience research; fission product development; coal conversion studies; fission product development; hot cell operations; high alpha extraction studies; and destructive and non-destructive testing of reactor components.

Building 3026-C

The Metals and Ceramics Division is studying radiation damage to various metals and alloys in the southwest cell bank. Samples are irradiated in a reactor, electropolished to a very thin layer, then viewed and studied with an electron microscope comparing them with samples that have not been irradiated.

The northwest cell bank is being used by the Health and Safety Research Division for production of various isotopes, such as ^{191}Os, which is used in medical research.

The east cell bank is used for the concentration of ^{85}Kr by the Operations Division.

Building 3500

This facility is operated by the Instrumentation and Controls Division. Radioactive materials handled within this building consist primarily of irradiated components from the reactors and sources including alpha, beta-gamma, and neutrons. Strict administrative control is maintained on the high level sources when in use. These include 6 Ci Pu-Be, 130 Ci ^{137}Cs, and the 15 mCi ^{252}Cf sources.

Building 3541 and 3503

Operated by the Chemical Technology Division, Building 3541 has been utilized to produce microspheres of various sizes using depleted uranium for testing as power reactor fuel rods. Work in this building has been stopped at present. Building 3503 has a facility for producing microspheres from depleted uranium. After testing, this process has been moved to Building 3019 for the production of uranium and plutonium microspheres.

Building 3504

Work in this building is performed by the Environmental Sciences Division and involves collecting samples such as rocks, water, soil sediment, core samples, etc., for radioactive analysis for environmental studies. One group is involved with studying samples from all over the country. Another group devotes studies to the Rocky Flats area. Still another group is involved with environmental sampling at ORNL waste disposal areas. These samples are taken from the exit waters of White Oak

Creek, White Oak Dam, the Settling Basin, and Melton Branch; ground and water samples in the burial ground; core samples; etc., for continuous data on radiation build-up in these areas.

Building 3508

The Chemical Technology Division performs glove box operations in five labs in this building. Some of the studies presently going on in these labs include: mixed oxide dissolution studies with UO_2PuO_2 powder dissolved in nitric acid to determine nature of any insoluble residue; thermal denitration - plutonium studies - electrochemical oxidation of Plutonium IV to Plutonium VI; solvent extraction studies with solutions containing high plutonium concentrations corresponding to breeder fuel composition; studies relating to waste disposal in concrete using actinides in concrete specimens; and solvent extraction studies for Purex modifications using depleted uranium.

Building 3517

This building is used by the Operations Division. Present operation in this building is primarily source fabrication of ^{90}Sr and ^{137}Cs. Cell 10-W is used as a storage area for kilogram quantities of curium that is used for source fabrication and development elsewhere. An electro-polisher was installed on the second level north section to be used in cleaning and decontaminating equipment. Decontamination and decommissoning work has begun in this building. Most of the equipment, piping, tanks, etc., have been removed from Cells 8 and 9.

Building 3525 and 3026-D

Both of these buildings, used by the Operations Division, contain remote handling hot cell facilities for destructive and non-destructive testing of reactor components, fuel assemblies and activated samples. Some of the operations performed by experimenters are visual inspections, mensurations, measurement of burn-up of fuel and induced activity, and sampling and analysis of fission gases, and evaluation of corrosion, metallographic examinations, x-ray diffraction, and electron microscope analysis.

Building 3592

This building, assigned to the Chemical Technology Division, was formerly used in MSRE Salt Studies but has been dismantled and decontaminated. Some coal conversion studies have been conducted here.

Building 3505

This building is assigned to the Operations Division. It was built in 1951 as a pilot plant for reactor fuel separation by solvent extraction. It was operated by the Chemical Technology Division. The plant was shut down in 1959. Decontamination and Decommissioning (D&D) was started on this building in October, 1984.

NORTHWEST COMPLEX

The Northwest Complex includes 12 buildings occupying 256,914 ft^2. The buildings are of concrete block, steel-frame, metal siding, concrete, steel, and glass construction. The activities in this complex include: the study of the uptake and elimination of radionuclides in plants and animals, radioactive waste studies, analytical studies of highly radioactive samples, spectral analyses, and the production of $^{239}PuO_2$-$^{238}UO_3$ microspheres.

Buildings 1503, 1504, 1505 and 1506

The Environmental Sciences Division utilizes a variety of radionuclides (tracer to mCi quantities) in these facilities for uptake, elimination, and tracer studies in plants, animals, soils, and water.

Building 2000

In Room 36 the Quality Assurance and Inspection Department operates two radiography cells utilizing x-ray, ^{192}Ir, and ^{60}Co sources. In Room 14 samplers and injection apparatus, used for in-situ testing of radioiodine systems, are disassembled and assayed for ^{131}I.

Building 2011

The Analytical Chemistry Division analyzes samples of Na, Cs, K, and Li for oxygen by activation analysis utilizing a 14 MeV neutron generator. The neutron generator accelerates duterium ions onto a ^{3}H target (~ 5 Ci). The Metals and Ceramics Division performs stress rupture tests on metal specimens.

Building 2024

The Solid State Division is conducting some radioactive waste isolation studies in Rooms 43 and 54 using depleted uranium (< 100 g), thorium, and ^{137}Cs. This division also operates a Mossbouer spectrometer in Room 42 using a 30 mCi ^{57}Co source.

The Operations Division uses small quantities of ^{3}H in Room 41.

Building 2026

The Analytical Chemistry Division operates a bank of manipulator cells in which analytical procedures are performed on highly radioactive samples such as flux monitors, fuel specimens and fission product samples. Samples with relatively low radiation levels and alpha emitters are analyzed in laboratories equipped with hoods and/or glove boxes. Spectral analyses are also performed.

Building 3017

The three west laboratories have been renovated for use in development work on cementitious waste forms suitable for isolating radioactive wastes. Tracer quantities (< 1 mCi) of ^{85}Sr or ^{137}Cs will be used

in these studies. Room 19, the Counting Room, is used for counting samples containing ^{239}Pu, ^{241}Am, ^{85}Sr, and ^{137}Cs for evaluation of nuclear waste forms.

Building 3019

The present Radiochemical Pilot Plant is located in this building. Pilot Plant Cell 1 is currently used for storage of containers with kilogram quantities of thorium oxide pellets and pellets of mixed oxides of ^{233}U and ^{232}Th.

Pilot Plant Cell 2 will be used as secondary containment for a "short term" project designed to recover about 26 kg of irradiation UO_2-ThO_2 microspheres from the KSTR [KEMA (the Netherlands) Suspension Test Reactor] fuel storage vessel currently stored in the cell.

Pilot Plant Cells 3 and 4 were renovated for the Consolidated Edison Uranium Solidification Process (CEUSP). Alpha containment enclosures were installed in Cell 3 to solidify and package this material in weld sealed cans. The cans have been placed in vertical storage wells installed in Cell 4. CEUSP is now complete.

Pilot Plant Cells 5, 6, and 7 contain equipment for dissolving ^{233}U solids and for solvent extraction and/or ion exchange purification of ^{233}U feed solutions. Facilities between or adjacent to the cells provide for storage of ^{233}U solutions and oxide forms.

Room 502 contains equipment in glove boxes for converting ^{233}U solutions to oxide forms. This equipment is maintained in operational readiness even though production runs are infrequent.

Rooms 209 and 211 contain glove boxes and equipment for the production of $^{239}PuO_2$-$^{238}UO_3$ microspheres for evaluation as feed for reactor fuel pellet pressing.

The Analytical Chemistry Division operates laboratories in the west section of Building 3019 (3019-B) where radiochemical and/or spectral analyses are conducted on a variety of radioactive samples in support of other Laboratory programs.

The activities in 3019 will be moved to the TURF (7920) as feasible, following the completion of the CEUSP tasks.

Building 3074

This building houses facilities for the decontamination and repair of master-slave manipulators and vacuum pumps.

Building 3100

Uranium-233, uranium-235, and plutonium, primarily in solid form, are stored in critically safe arrays. A glove box facility is used for sampling and repackaging.

NORTH CENTRAL COMPLEX

The North Central Complex includes 10 buildings occupying 175,918 ft^2. The buildings are of steel-frame, metal siding, concrete block, wooden frame, brick, or brick tile construction. The activities in this complex include: low irradiation experiments, uranium fuel fabrication, gamma irradiation, neutron research, and cleaning and repair of contaminated equipment.

Building 3001

This building houses the Old Graphite Reactor (OGR). The control room and the area around the reactor face is now a historical landmark, open to the general public, and has been turned over to the National Park Service.

Building 3003

This building, composed of two sections, the East and West Rooms, is operated by the Solid State Division. A 2.5 MeV Van de Graaff accelerator and a 200 kV ion implanatation accelerator are located in the West Room; and a 2.5 MV positive ion accelerator is located in the East Room. Also, a Q switched 20 J ruby laser is located in Building 3003.

Building 3005

This building formerly housed the 3 MW Low Intensity Test Reactor (LITR). All reactor components have been removed from the reactor vessel except 13 beryllium pieces. The reactor vessel is under constant off-gas.

Building 3010

This facility houses the 2 MW Bulk Shielding Reactor (BSR) which is a "swimming pool" type and is operated by Operations Division personnel for the Solid State Division. The principal research conducted by the Solid State Division is low temperature irradiation experiments. The Pool Critical Assembly (PCA), formerly in the BSR pool, is no longer operating.

Building 3012

This Roller Mill facility is operated by the Metals and Ceramics Division and contains furnaces, presses, rollers and other related equipment for fabricating uranium fuel elements. Very little work is being done in this building at the present time.

Building 3025

This building is occupied jointly by members of the Solid State Division and Operations Division. In the portion of the building occupied by Solid State there are two electron microscopes (MS-102 & ML-106) and two x-ray diffraction labs (ML-100 & ML-108). A gamma source room with two ^{60}Co irradiation facilities containing 30,000 Ci when installed in 1966, and 11,500 Ci when installed in 1963. This facility also contains a 9,000 Ci ^{137}Cs irradiator when installed in 1963. There is a low level "hot" storage area in EL-100.

The Operations Division's part of the building consists of six cells for high level radiation work of all kinds along with the associated research area.

Building 3027

A Laboratory Protection Division facility which serves as a storage vault for special nuclear materials.

Building 3042

This building houses the 30 MW pool type Oak Ridge Research Reactor (ORR) and associated equipment such as pool heat exchanger, primary lines, demineralizer units, etc. The reactor has an average thermal flux of 2.6×10^{14} N/cm²/sec and is operated chiefly for research.

Building 3044

This Special Materials Shop is a machine shop operated entirely by Plant and Equipment personnel and commonly referred to as the "hot shop."

Building 3088

This building is unoccupied.

Building 3127

A Laboratory Protection Division facility which serves as a storage vault for nuclear materials and precious metals.

MELTON VALLEY COMPLEX

The Melton Valley Complex includes six buildings occupying 165,186 ft^2. The buildings are of concrete block, steel-frame, metal siding construction. The activities in this complex include: the evaluation of shielding materials, unshielded reactor studies, neutron studies, the purification of elements above plutonium, radioactive waste reduction, and studies involving simulated fuel meltdown in light water nuclear reactors.

DLEA

The DOSAR Low-Energy Accelerator (DLEA) has been decontaminated and decommissioned.

TSF (7702)

The Tower Shielding Facility (TSF) is operated by the Operations Division. Tower Shielding Reactor II (TSR-II) serves as a source of nuclear radiation to permit the quantitative evaluation of a great variety of shielding materials and configurations. Data from the experimental programs has proved invaluable in the shielding design of many other facilities. This facility is also used to prove the integrity of shielded casks by drop testing from various heights.

HPRR (7709)

The Health Physics Research Reactor (HPRR) is an unshielded reactor that can operate at a steady state power level up to 10 KW or in a burst of up to 10^{17} fissions for about 10 microseconds. It is used primarily for research in radiobiology and radiation dosimetry.

HFIR (7900)

The High Flux Isotope Reactor (HFIR) produces approximately 500 mg of ^{252}Cf per year as its primary function. It also provides facilities for research in neutron diffraction, neutron activation analysis, isotope irradiation, materials development for the fusion energy program, and various other experiments in basic research.

TRU (7920)

The Transuranium Processing Facility (TRU) separates and purifies heavy elements above plutonium on the atomic scale, primarily ^{252}Cf. Curium target rods for irradiation in the HFIR are fabricated here and then processed after irradiation. Research in chemistry and chemical technology of the heavy elements is also conducted in TRU. A small scale solvent extraction test facility has been installed in Cell 5 to perform reprocessing studies on full activity level power reactor fuel.

TURF (7930)

The Thorium Uranium Recycle Facility (TURF) was originally constructed as a pilot plant for the recycling of thorium and ^{233}U. One of the cells in the building is being used for the final purification of ^{252}Cf in an environment free of ^{244}Cm. Sources of ^{252}Cf are fabricated and x-rayed in this cell. Long-lived ^{248}Cm is also recovered as an end-product of ^{252}Cf decay.

Radioactive Waste Reduction Facility (WRF) has been constructed adjacent to TURF, and a glove box facility in the basement of TURF has been set up to be used in determining the curie content of drums of radioactive waste containing transplutonium elements. An attempt will be made to relate a chemical analysis of the waste to computerized radiation measurements taken around the drums prior to unloading them into the glove boxes.

NSPP (7500)

The Nuclear Safety Pilot Plant (NSPP) conducts experiments that simulate a fuel meltdown in light water nuclear reactors. A fine mesh uranium powder sample is burned by a plasma torch in a containment vessel located in Cell B. Up to as many as 500 samples of the uranium aerosol are taken in the containment vessel system to measure the fallout rate as a function of time. This confirms experimentally the computer models based on Aerosol Release and Transport (ART) codes.

ORNL Y-12 OPERATIONS COMPLEX

The Y-12 operation includes 11 operating buildings occupying 1,182,935 ft^2 and are of steel and concrete structure.

The activities in this operation include fusion energy research, electromagnetic separation of stable and radioactive isotopes, and the study of the effects of environmental agents - teratogens, mutagens, carcinogens, and mutagens - on human health.

Building 9207, LP and BT Sections

The Molecular and Cellular-Sciences Section is concerned with the damage done by ionizing radiation, UV radiation and chemicals in cellular systems and the repair of such damage. Sources of ionizing radiation are primarily X rays, but there is also a 3,000 curie ^{60}Co source in use. Carbon-14, ^{3}H, ^{35}S, and ^{32}P are used extensively in labeling DNA in this work. They also investigate cellular development, protein synthesis, and the mechanisms of genetic determination.

The Toxicology Section studies the toxic effects of chemicals and radiation on laboratory animals. Hydrogen-3, and ^{32}P are used as tracers in these studies and X rays as a source of radiation.

Building 9207, 9211 and 9220

The Carcinogenesis Section uses the mouse and rat as laboratory animals to study the effect of radiation and chemicals on mammalian systems. Somatic effects such as inducing cancers and senescence are investigated. The problems of the recovery of animal systems from radiation injury and the mechanisms which immunize such systems are also considered. Primary sources of radiation are a 2000, 100, and 1 curie ^{137}Cs source. X rays are also used as sources of ionizing radiation. They also investigate the interactions between external agents and internal mechanisms which result in the development of cancer. Defense mechanisms and the induction of cancer by viruses are also considered. Tracers used are ^{32}P, ^{3}H, ^{14}C, ^{125}I, and ^{131}I.

Building 9210

The Mammalian Genetics and Teratology Section has a large mouse population. One of its objectives is to understand the mutation process in mammals. Emphasis is being placed on the mutation repair process that can occur after low doses and low dose rates of ionizing radiation, and after administration of chemicals. X rays and ^{137}Cs are the sources of ionizing radiation. Tracers used are ^{32}P, ^{3}H, ^{14}C, and ^{35}S.

Building 9224

The Cellular and Comparative Mutagenesis Section studies effects of chemicals on mutation in microorganisms, invertebrates, and human cells. Tracers used are ^{3}H, ^{32}P, and ^{51}Cr.

Building 9201-2

The Fusion Energy Division has eight major programs related to fusion energy research. These are the EBT-P Project, the Alloy Development for Irradiation Performance Project, the Tokamak Experimental Program, the Plasma Theory Program, the Plasma Technology Program, the EBT-S Program, and the Large Coil Program. The division also operates the Fusion Engineering Design Center.

X rays are emitted from the plasma and/or from runaway electrons in collision with the cavity wall with energies up to 8 MeV, and in the deuterium plasma neutrons with energies up to 10 MeV. Operating procedures and design of the devices dictate the amount and the energy of the X rays and/or the neutrons produced by each machine.

Building 9204-3

The Electromagnetic Process (Calutron) located in Building 9204-3 is operated by the Operations Division. Stable and radioactive isotopes of elements are separated. Isotopes of the radioactive element uranium are separated. Small amounts of (U all isotopes) (per all isotopes) (^{151}Sm, ^{229}Th, ^{230}Th) are separated and shipped to customers.

SHIFT AND AREA SURVEYS COMPLEX

This group provides radiation safety service to the "outside" area not covered within the earlier described geographical complexes (as listed below). In addition, this group provides radiation protection for all the complexes, that is, the entire Laboratory during the off hours (4:00 p.m. - 8:00 a.m.) as the need arises. The staffs of the other complexes work only the day shift except under extraordinary circumstances. The activities are varied -- ranging from checking personnel monitors to monitoring a nuclear reactor during the critical start-up stage.

Bldg. 2523

This is a decontamination laundry facility operated by Operations Division.

Bldgs. 2531 and 2537

This is used by Operations Division for evaporation and/or condensation of mid-level liquid waste.

Bldg. 3518

This houses the pumping system between the retention pond and treatment plant.

Bldg. 3544

This is the Operations Division low-level liquid treatment plant.

Tank Farm

Operations Division has a sludge removal project here.

Retention Ponds

These are used by Operations Division for storage of low-level liquid waste.

Bldg. 7001

The Shipping and Receiving Area operated by Finance and Materials Division handles both incoming and outgoing shipments of radioisotopes.

7000 Area

This area, primarily operated by Plant and Equipment Division, contains general maintenance and storage areas. It also includes the Salvage Yard.

Bldg. 7019

This building is used by the Laboratory Protection Division for storage.

Bldg. 7025

Operations Division prepares tritium targets in this building.

Bldgs. 7567 and 7669

These buildings house a pumping station and storage tanks for liquid waste from HFIR.

Storage Area 5

This is used by Operations Division for transuranic waste storage and fissile waste storage.

Storage Area 6

This area is dedicated to solid waste burial.

7600 Area

This area houses the Fuel Recycle Division and its work on the fuel recovery process.

Bldg. 7819

This is used by Operations Division for storage of contaminated equipment.

Bldg. 7830

This building contains the sampling station for mid-level liquid waste used by Operations Division.

Bldg. 7860

The Operations Division Hydrofracture Facility is located in this building.

Bldg. 7863

This is used by Operations Division for storage of contaminated equipment.

Bldg. 7831

Solid Waste compacting is done by Operations Division.

Bldg. 7853

This building is used by Operations Division for mid-level liquid waste disposal.

NERP

The National Environmental Research Park (NERP) is used by the Environmental Sciences Division and others for ecological monitoring and experimentation.

A SUMMARY OF THE ACTIVITIES MONITORED BY THE RADIATION AND SAFETY SURVEYS DEPARTMENT

A SUMMARY OF THE ACTIVITIES MONITORED BY THE
RADIATION AND SAFETY SURVEYS DEPARTMENT

COMPLEX	BUILDING	DIVISIONS	ACTIVITY
South Central	4500N	Chemical Technology Analytical Chemistry Chemistry	Nuclear waste management Radionuclide analysis Neutron Diffraction
	4501	Chemical Technology Metal & Ceramics	Fission product studies Microsphere studies
	4505	Chemical Technology	^{3}H sorption studies
	4507	Chemical Technology	Stand-by status
	4508	Chemical Technology	^{235}U studies
Central	3028	Operations	Manipulator cells
	3029	Operations	High-level beta-gamma work
	3030	Operations	High-level beta-gamma work
	3031	Operations	High-level beta-gamma work
	3032	Operations	Low-level alpha work
	3033	Operations	Purifying & packaging Kr and ^{3}H gases
	3033 Annex	Operations	Preparation of transuranic targets
	3038	Operations	Uranium isotope study
	3047	Operations	High-level alpha, beta-gamma work
East	4500S	Eight Divisions	Tracer-level general research
	5500	Physics Metals & Ceramics	Low energy physics Damaged reactor components study
	6000	ORAU	Production of short-lived nuclei
	6010	Engineering Physics	Shielding requirement neutron investigations
	6025	Engineering Physics	Computer facilities
	5505	Chemistry	Transuranic studies

A SUMMARY OF THE ACTIVITIES MONITORED BY THE
RADIATION AND SAFETY SURVEYS DEPARTMENT (Continued)

COMPLEX	BUILDING	DIVISIONS	ACTIVITY
Southwest	3026-C	Metal & Ceramics Health & Safety Research	Radiation damage of metals Production of medical isotopes
	3500	Instrumentation & Controls	Irradiation components from reactors
	3503	Chemical Technology	Microsphere production
	3504	Environmental Science	Analysis of environmental samples for radioactivity
	3508	Chemical Technology	Mixed oxide dissolution studies Electrochemical oxidation studies Solvent extraction studios
	3517	Operations	Source fabrication of ^{90}Sr and ^{137}Cs
	3525 & 3026D	Operations	Destructive and non-destructive testing of reactor components
	3592	Chemical Technology	Coal conversion studies
Northwest	1503, 1504, 1505, 1506	Environmental Sciences	Uptake, elimination and tracer studies in plants, animals, soil, and water
	2000	Quality Assurance and Inspection	Quality inspection using x-ray, Ir-192 and Co-60 sources.
	2011	Analytical Chemistry	Activation analysis of Na, Cs, K and Li
		Metals and Ceramics	Stress rupture test of metal
	2024	Solid State	Radioactive waste isolation
	2026	Analytical Chemistry	Analysis of highly radioactive samples
	3017	Chemical Technology	Cementitious waste form development studies

A SUMMARY OF THE ACTIVITIES MONITORED BY THE
RADIATION AND SAFETY SURVEYS DEPARTMENT (Continued)

COMPLEX	BUILDING	DIVISIONS	ACTIVITY
Northwest (Continued)	3019	Chemical Technology	Cell 1 - storage of Kg quantities of Th-oxide pellets
			Cell 2 - storage of UO_2 - ThO_2 Microspheres
			Cells 3 & 4 - Storage of 1100 kg of uranium.
			Cells 5, 6, & 7 - Dissolution of ^{233}U solids. Solvent extraction-ion exchange purification of U-233.
			$^{239}PuO_2$-$^{238}UO_3$ milrosphere production
	3074	Plant & Equipment	Decontamination and repair of master slave manipulators.
	3100	Chemical Technology	^{233}U, ^{235}U and Pu storage sampling and repackaging.
Melton Valley	7702	Operations	Shielding design studies
	7709	Health & Safety Research	Reactor radiation biology Radiation dosimetry
	7900	Operations	^{252}Cf production neutron activation studies
	7920	Chemical Technology	Purification of ^{252}Cf transuranium source fabrication
	7930	Metal & Ceramics	Purification of ^{252}Cf ^{248}Cm recovery
	7500	Engineering Technology	Simulated fuel melt-down studies

A SUMMARY OF THE ACTIVITIES MONITORED BY THE
RADIATION AND SAFETY SURVEYS DEPARTMENT (Continued)

COMPLEX	BUILDING	DIVISIONS	ACTIVITY
North Central	3001	National Park Service	Graphite reactor
	3003	Solid State	Accelerators used in material effects studies
	3005	Operations	Reactor (decommissioned)
	3010	Operations	BSR: low temperature irradiation
	3012	Metals & Ceramics	Uranium fuel fabrication
	3025	Solid State Operations	X-ray diffraction studies ^{60}Co irradiation facilities
	3027	Laboratory Protection	Storage of SNM
	3042	Operations	Reactor research
	3044	Plant & Equipment	Repair of "hot" equipment
	3127	Laboratory Protection	Storage of nuclear materials and precious metals
Area Surveys	2007	Environmental and Occupational Safety	Calibration of monitoring equipment
	2523	Operations	Decontamination laundry facilities
	2531	Operations	Evaporation of mid-level liquid waste
	2537	Operations	Evaporation and condensation of mid-level liquid waste
	3518	Operations	Pumping system between retention pound and treatment plant
	3544	Operations	Low-level liquid treatment plant
	Tank Farm	Operations	Sludge removal project
	Retention Ponds	Operations	Storage of low-level liquid waste
	7001	Finance and Materials	Shipping and receiving
	7000 Area	Plant & Equipment	General maintenance and storage

A SUMMARY OF THE ACTIVITIES MONITORED BY THE
RADIATION AND SAFETY SURVEYS DEPARTMENT (Continued)

COMPLEX	BUILDING	DIVISIONS	ACTIVITY
Area Surveys (Continued)	7019	Operations	General storage
	7025	Operations	Tritium target preparation
	7567 & 7569	Operations	Pumping station and storage tanks for liquid waste from HFIR
	Storage Area 5	Operations	Transuranic waste storage fissile waste storage
	Storage Area 6	Operations	Solid waste burial
	7600 Area	Fuel Recycle	Fuel recovery process
	7819	Operations	Storage of contaminated equipment
	7830	Operations	Sampling station for mid-level liquid waste
	7860	Operations	Hydrofracturing
	7863	Operations	Storage of contaminated equipment
	7831	Operations	Solid waste compacting
	7853	Operations	Mid-level liquid waste disposal
Y-12 Operations	9201-2	Fusion Energy	Fusion energy research
	9204-3	Chemical Technology	Electromagnetic separation of isotopes
	9207	Biology	Ionizing radiation studies at the molecular and cellular levels
	9211 & 9220	Biology	Chemical and radiation studies on the *mammalian* systems cancer-virus studies
	9210	Biology	Genetic and teratogenic effects of low dose ionizing radiation
	9224	Biology	Mutagenic effects of chemicals and radiation on animal life
Shift Survey	ORNL	All Divisions	All of the above

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