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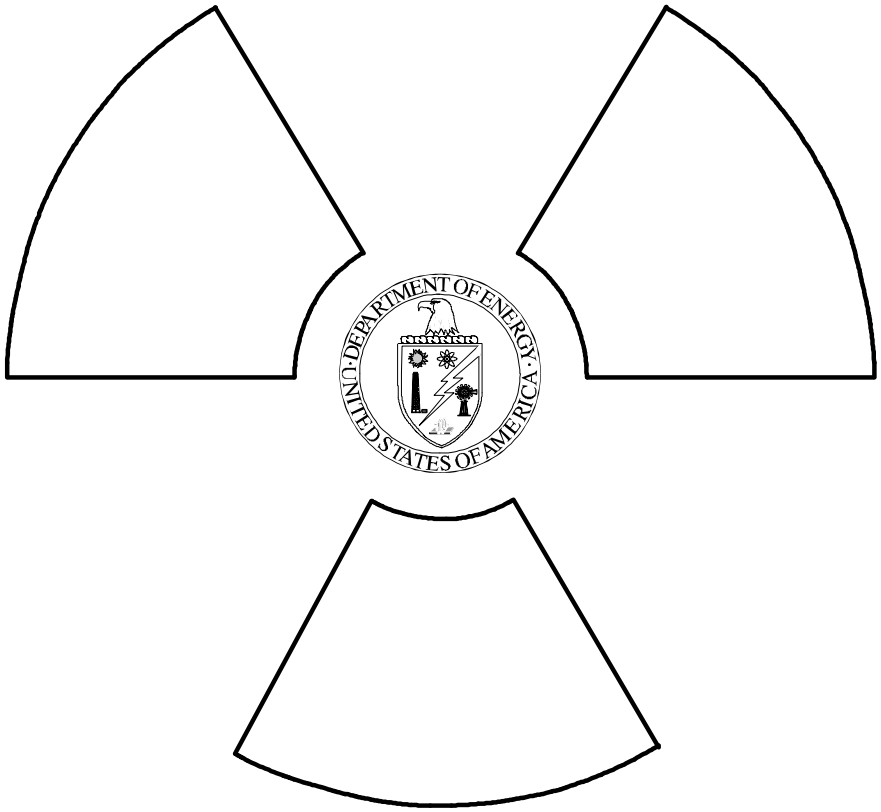
IMPLEMENTATION GUIDE

For Use With

Title 10, Code of Federal Regulations, Part 835
OCCUPATIONAL RADIATION PROTECTION



RADIATION SAFETY TRAINING

ASSISTANT SECRETARY for ENVIRONMENT, SAFETY and HEALTH

FINAL GUIDE - FOR UNLIMITED USE and DISTRIBUTION

U.S. Department of Energy
IMPLEMENTATION GUIDE

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RADIATION SAFETY TRAINING

I. PURPOSE AND APPLICABILITY

This Implementation Guide (IG) provides an acceptable methodology for establishing and operating a radiation safety training program that will comply with U.S. Department of Energy (DOE) requirements specified in Title 10 of the Code of Federal Regulations (CFR), Part 835, Occupational Radiation Protection *(DOE, 1993a*; hereinafter referred to as 10 CFR 835*)*. For completeness, this IG also identifies applicable requirements and recommendations contained in DOE Order 5480.11, as amended, Radiation Protection for Occupational Workers *(DOE, 1992a)*; DOE Order 5480.18A, Accreditation of Performance-Based Training for Category A Reactors and Nuclear Facilities *(DOE, 1991a)*; DOE Order 5480.20, Personnel Selection, Qualification, Training, and Staffing Requirements at DOE Reactor and Non-Reactor Nuclear Facilities *(DOE, 1991b)*; DOE's Radiological Control Manual *(DOE, 1994*; hereinafter referred to as the RCM (with the associated numbers denoting the article numbers)); and secondary documents (American National Standards Institute (ANSI) Standards, etc.) invoked by the above documents. This IG also addresses guidance found in the DOE Training Accreditation Program Manuals, TAP 1 and TAP 2 *(DOE, 1991c)*. Appendix A of this IG is a cross reference of applicable sections of 10 CFR 835, this IG, and the RCM.

This IG amplifies the regulatory requirements of 10 CFR 835, which are enforceable under the provisions of Sections 223(c) and 234A of the Atomic Energy Act of 1954, as amended *(AEC, 1954)*. The requirements and recommendations of the other DOE documents are enforceable through contractual or administrative means.

Except for requirements mandated by a regulation, a contract, or by administrative means, the provisions in this guide are DOE's views on acceptable methods of program implementation and are not mandatory. Conformance with this guide will, however, create an inference of compliance with the related requirements. Alternate methods that are demonstrated to provide an equivalent or better level of protection are acceptable. Contractors are encouraged to go beyond the minimum requirements and to pursue excellence in their programs.

The word "shall" is used in this IG to designate requirements from regulations, DOE Orders, the RCM, and secondary documents. The requirements of 10 CFR 835

are mandatory except to the extent an exemption has been granted pursuant to 10 CFR 820, Procedural Rules for DOE Nuclear Activities *(DOE, 1993b)* and are identified by a bolded and underlined "**shall.**" Requirements taken from DOE Orders and the RCM are mandatory to the extent they are invoked by a contract or through administrative means.

Those facilities not subject to the requirements of 10 CFR 835 should substitute the corresponding DOE 5480.11 requirements.

This IG is applicable to all DOE activities involving occupational exposure to ionizing radiation of DOE employees and/or DOE-contractor/subcontractor employees.

II. DEFINITIONS

airborne radioactivity area: Any area where the measured concentration of airborne radioactivity, above natural background, exceeds or is likely to exceed 10 percent of the derived air concentration (DAC) values listed in appendix A or appendix C of 10 CFR 835.

challenge examination: An examination on standardized core course materials designed to establish the capabilities of a worker with respect to radiation safety and provide an exception to the required training. Challenge examinations should be based on the objectives stated for the training program, and are an approved form of proficiency testing.

contamination area: Any area where contamination levels are greater than the values specified in appendix D of 10 CFR 835, but less than or equal to 100 times those levels.

controlled area: Any area to which access is managed in order to protect individuals from exposure to radiation and/or radioactive material. Individuals who enter only the controlled area without entering radiological areas are not expected to receive a total effective dose equivalent of more than 100 mrem (0.001 sievert) in a year.

disqualification: The loss of formal qualification for radiological control technicians (RCTs), or the process of designating radiological workers (RWs) as needing additional training prior to task assignment because of one or more of the following: insufficient or unsatisfactory performance of proficiency requirements, lapse of periodic requalification (for RCTs) or retraining (for radiological workers) requirements, or serious job-performance deficiencies resulting in unsafe radiological conditions.

escort: An individual, with the prerequisite training necessary for unescorted access to the area(s) where the escort activities will be performed, who is authorized to escort individuals who lack the prerequisite training necessary for unescorted access to the areas to be visited.

exemption: A release from select DOE Orders pertaining to personnel training and qualification. Exemption also refers to the release of an individual from portions of a training program through prior experience, education, and/or proficiency testing.

facility: A facility includes systems, buildings, utilities, and related activities whose use is directed to a common purpose at a single location. Examples include: accelerators, storage areas, test loops, nuclear reactors, radioactive waste disposal systems and burial grounds, testing laboratories, research laboratories, and

accommodations for analytical examinations of components. Also includes: pipelines, ponds, impoundments, landfills and the like, and motor vehicles, rolling stock, and aircraft.

general employee: Any individual who is either a DOE or DOE contractor employee; an employee of a subcontractor to a DOE contractor; or a visitor who performs work for or in conjunction with DOE or utilizes DOE facilities.

high contamination area: Any area where contamination levels are greater than 100 times the values specified in appendix D of 10 CFR 835.

high radiation area: Any area, accessible to individuals, in which radiation levels could result in an individual receiving a deep dose equivalent in excess of 0.1 rem (0.001 sievert) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

oral examination board: A group of individuals selected to administer an oral proficiency examination to RCTs and RCT supervisors for the purpose of evaluating their proficiency in routine and emergency conditions.

performance-based training (PBT): A systematic program of instruction designed around job tasks and the related knowledge and skills required for competent job performance. Also referred to as "Systematic Approach to Training," "Competency-Based Training," "Instructional System Design," and other names.

practical factor: The portion of a training or qualification program utilizing on-the-job or practical knowledge skills. Practical factors are the required attributes of this hands-on type of training.

qualification: The combination of an individual's physical attributes and technical, academic, and practical knowledge and skills developed through training, education, and on-the-job performance.

qualification standard: The explicit performance requirements for minimum proficiency in technical, academic, and site-specific knowledge and practical skills used in determining satisfactory completion of training programs. The qualification standard is used to qualify RCTs at DOE facilities.

radiation area: Any area accessible to individuals in which radiation levels could result in an individual receiving a deep dose equivalent in excess of 0.005 rem (0.05 mSv) in 1 hour at 30 centimeters from the source or from any surface that the radiation penetrates.

radiological area: Any area within a controlled area which must be posted as a "radiation area," "high radiation area," "very high radiation area," "contamination area," "high contamination area," or "airborne radioactivity area" in accordance with 10 CFR 835.603.

radiological buffer area (RBA): An intermediate area established to prevent the spread of radioactive contamination and to protect personnel from radiation exposure. The area surrounds or is contiguous with Contamination Areas, High Contamination Areas, Airborne Radioactivity Areas, Radiation Areas, High Radiation Areas, or Very High Radiation Areas.

radiological control technician (RCT): Any DOE or DOE contractor employee who performs qualitative and quantitative radiological evaluations to prescribe and implement protective measures for general employees. This includes assigned operators, radiation protection technicians, or technicians with any other title who actually perform these tasks.

radiological worker: A general employee whose job assignment involves operation of radiation producing devices or working with radioactive materials, or who is likely to be routinely occupationally exposed above 0.1 rem (0.001 sievert) per year total effective dose equivalent.

refresher training: Periodic, usually annual, training for radiological workers to provide current safety information on significant changes to radiation protection policies and procedures, to apprise them of changes in facility conditions, or to enhance worker cognizance of infrequently encountered radiological safety matters.

requalification: The process of reviewing, updating, and improving the level of knowledge for the renewal of a position qualification. It should highlight and review the initial qualification program and include a) subject matter not reinforced by frequent use; b) changes in facility conditions, procedures, or operating experience; and c) applicable accidents or poor practices pertaining to safe radiological controls. Requalification is necessary for the RCT position.

retraining: A process of reviewing, developing, and improving the knowledge base for required training. Retraining does not encompass a formal position qualification, but has similar elements and methods.

shall: Within the context of this Guide, the word "shall" is used only to designate requirements from 10 CFR 835, the RCM, DOE Orders, and secondary documents invoked by them.

should and may: Within the context of this Guide, the words "should" and "may" are used to represent optional program recommendations and allowable alternatives, respectively. Deviations generally require no specific approval or justification; however, exceptions or deviations to "should" provisions referenced directly from the RCM require specific justification and approval in accordance with Article 113.3 of that manual (i.e. RCM 113.3).

site: An area managed by DOE where access can be limited from any reason. The site boundary encompasses Controlled Areas.

very high radiation area: Any area accessible to individuals in which radiation levels could result in an individual receiving an absorbed dose in excess of 500 rads (5 grays) in one hour at 1 meter from a radiation source or from any surface that the radiation penetrates.

III. DISCUSSION

This IG can be used to identify applicable DOE regulations and DOE's requirements for the development of radiation safety training programs, and provides guidance for their implementation. Training departments and training administrators can use the information contained herein for suitably upgrading or evaluating their radiation safety training programs. This guide also provides clarification of the intent of DOE's initiative for the

standardization of radiation safety training programs.

While there are significant differences in the missions of various DOE and DOE-contractor facilities, and thus significant differences in the content of radiation safety training programs necessary for adequate protection of employees, the basics of radiation safety for DOE contractor programs can be taught using standardized core courses. Standardized core training programs preclude confusion about the training necessary for safe conduct of radiological work. This IG is based on the use of standardized core courses for instructing workers on generic aspects of radiation protection.

Several federal agencies have embraced the training system known by various names such as Systematic Approach to Training, Performance-Based Training, etc. Performance-based training is an approach to training designed around the actual job-performance tasks, knowledge, and skills required of the student. A performance-based training approach that evaluates the necessary facility and site knowledge that a worker needs for safe job performance, in conjunction with standardized core requirements for teaching the fundamentals of radiation safety, improves the overall quality of radiological work performance at DOE facilities.

Different levels of radiation safety training are used for ensuring the safe and efficient conduct of work at DOE facilities. Training courses, such as Radiological Worker I and II, take into account different levels of risk associated with various job functions and duty locations, and these courses are used to teach workers accordingly. Training should be commensurate with the level of potential radiological hazards, and should take note of economic, social, technical, and practical concerns. Specific training **shall** be provided to general employees, radiological workers, and RCTs (10 CFR 835.901-903 and RCM 612).

Two levels of radiological worker training have been developed for DOE. These two levels are based on the inherent radiological risks associated with: a) exposure to ionizing radiation; and b) actual work in radiological areas with radioactive materials and contamination. The intent is to increase the level of instruction provided to all workers, and to ensure a competent worker whose job assignments may include access to, and work assignments in, radiological areas. Radiological Worker I core and site specific training is designed to provide adequate, commensurate training for workers requiring unescorted entry into a Radiological Buffer Area or Radiation Area. This training provides in-depth information on risks of occupational radiation exposure. They are prohibited from unescorted entry into Contamination and High Contamination Areas, High or Very High Radiation Areas, or Airborne Radioactivity Areas. Radiological Worker II training is required before access can be authorized to all radiological areas, and is designed for workers whose job assignment includes use of or work on radioactive materials and/or in contaminated areas.

RCTs require core training and a high degree of training for the specific types and levels of hazards present at various DOE nuclear facilities. The level of training for the qualification of RCTs should always be commensurate with the specific hazards associated with the performance of their duties. Site-specific RCT training should be commensurate with the full spectrum of facility radiological concerns, and should

address proper actions for emergency situations.

Visitors to DOE facilities receive an orientation by the facility organization responsible for training in radiation safety protection that is specific to the facility visited. This orientation provides a basic overview of the facility radiation protection program and applicable facility procedures. The orientation should be commensurate with the areas being visited, the hazards within those areas, and the activities expected to be conducted. Visitor orientation is required prior to unescorted entry into Controlled Areas.

Other guidance is necessary to implement the training requirements of Category A reactors (see DOE Order 5480.18A), and Category B reactors and DOE non-reactor nuclear facilities (see DOE Order 5480.18A and DOE Order 5480.20). Facilities under the requirements of DOE 5480.18A require training programs with formal accreditation. These programs apply to RCTs, subcontracted (vendor) RCTs, and certain radiological support personnel. Training programs developed at these facilities shall meet the requirements for performance-based training and accreditation according to the accreditation order timetable (DOE 5480.18A).

This IG specifies both generic radiation safety training criteria and training criteria that are deemed specific for each DOE or DOE-contractor nuclear facility. It is the policy of the DOE to accept the completion of generic core training from the DOE-approved or -accredited training program as sufficient evidence that retraining in core subjects is not required when a worker is transferred to or temporarily works at another DOE facility—provided that the satisfactory completion of training was within the previous two years. Training in facility-specific radiation safety criteria, such as suggested in Appendix B of this guide, and site-specific topics, as identified in DOE training program management manuals, **shall** be completed prior to fulfilling specified duties (Subpart J of 10 CFR 835 and RCM 612 & 621).

IV. IMPLEMENTATION GUIDANCE

Implementation of DOE radiation safety training programs should include the development of course materials from the standardized DOE core training materials, the identification and inclusion of site- and facility-specific instruction, and an evaluation of other DOE requirements found in DOE Orders for accreditation of training programs. Qualification standards, training evaluations, and the provisions for maintaining training records are also required elements of a satisfactory training program for radiation safety. Instruction is to be provided to DOE and DOE-contractor general employees, visitors, RWs, RCTs and supervisors. Emergency response personnel should receive special radiation safety training commensurate with potential emergency response functions. Training should address both normal and abnormal situations in radiation safety.

A. General Information

All workers at DOE facilities require some form of training or familiarization with radiation safety matters if they have any potential to receive occupational exposure to radiation. General Employee Radiation Safety Training, which is referred to as General Employee Radiological Training (GERT) in the RCM, is recommended for all employees.

Many facilities currently operating in the DOE system will benefit from standardized, upgraded training programs without requiring compliance with DOE 5480.18A. Radiological workers at Category A reactors and at high-hazard and select moderate-hazard non-reactor nuclear facilities, whose job descriptions designate them as operations, maintenance, and technical support personnel, shall have the radiation safety aspects of their training incorporated into a structured Training Accreditation Program and Plan (DOE 5480.18A). The DOE Training Accreditation Plan Program Manuals, TAP 1 and TAP 2, provide functional descriptions of personnel requiring accredited training. The list of DOE facilities requiring a formal accredited training program for their operating organization personnel is found in Attachments 1 and 2 of DOE 5480.18A. This IG assists in prescribing the proper radiation safety training content that meets the requirements of 10 CFR 835 and the RCM for radiation safety training programs, and follows the various guidance developed for DOE on accredited training programs. The RCM requirements for training are intended for incorporation into the Accreditation Plan at those facilities. DOE has recommended that operators of radiation safety training programs that are not included in the specific nuclear safety training Orders should consider the elements of performance-based training (PBT) in their approach (DOE/EH-0258T-1, General Employee Radiological Training and Radiological Worker Training - Program Management Manual *(DOE, 1992b)* and DOE/EH-0262T-1, Radiological Control Technician Training - Program Management Manual *(DOE, 1992c)*).

1. Standardized Core Courses

Core courses are developed for generic types of radiation safety training found at most DOE facilities. These core course materials have been developed by DOE and provided to contractors. Included are instructor's lesson plans, student guides, qualification standards, question banks, training certificates, and selected visual materials. Contractors' training programs shall provide all aspects of the core training (RCM 612).

The standardized core courses shall be expanded by the facility's organization responsible for training, or other cognizant organization, to include radiological controls specific to the type of facility (RCM 612). Although a PBT program is currently required only at DOE facilities under the requirements of DOE 5480.18A, all DOE facilities should, as much as practicable, use this approach in developing specific training (RCM 613.8). Accelerator, plutonium, uranium, and tritium operations facilities should amplify the training courses with additional site-specific information for adequate radiation safety at these installations (RCM 612 and RCM Chapter 6, Part 6). Suggested learning objectives and examples for these facilities are noted in Appendix B of this IG. DOE encourages use of its guides to good practices for these facilities in order to identify learning objectives that are appropriate for the particular facilities. (See the Supporting Documents Section of this IG for a listing of specific guides.)

Satisfactory completion of the DOE standardized core course at one DOE facility shall be recognized by all DOE sites as successful completion of core training (RCM 612.3). The RCM accepts successful completion of GERT, RWT, and RCT core training courses within the past two years as valid throughout the DOE complex (RCM 612.3). Qualification or training at one DOE facility or site is thus acceptable for core training requirements at other DOE facilities.

A wallet sized card or other certification that indicates the successful completion of DOE standardized core radiation safety training requirements should be provided to personnel. In order to be acceptable as proof of training at other DOE facilities, the certificate shall include the:

-- Individual's name;

-- date of training;

-- topics covered; and

-- name of certifying official (such as the instructor or examination evaluator)(10 CFR 835, Subpart J and RCM 612.3).

The notation of the course title (i.e., General Employee Radiation Safety Training, Radiological Worker I, Radiological Worker II, Radiological Control Technician) on the certificate is sufficient to indicate the specific topics covered, as listed in the DOE Training Program Manuals (DOE/EH-0258T-1 and 0262T-1, provided that the entire core course content was taught. However, site-specific aspects shall be completed for each facility and may be included with other site orientation training requirements (RCM 612.3). Site-specific training of General Employees, Radiological Workers, and qualification of RCTs should include formal classroom instruction and **shall** include written examinations (Subpart J of 10 CFR 835 and RCM 613.1).

2. Site-Specific Training

Site-specific training includes the necessary radiation safety and health information that is distinct to a particular DOE contractor or site and the type of facility being operated. Training should include contractor requirements and recommendations in radiation safety and emergency procedures. The RCM requires that site-specific instruction on radiation safety topics be included to supplement the DOE core course (RCM 612.3). 10 CFR 835, Subpart J emphasizes training in procedures specific to the facility where the individual is assigned. Site-specific training topics are identified in the DOE Training Program Manuals and through the site job/task analysis for facilities requiring accreditation of training programs (DOE/EH-0258T-1 and 0262T-1).

The ability to restrict worker access to certain areas in multiple-facility DOE sites is useful in limiting unwarranted training. If access to the facilities can be limited, workers may be trained for work at one type of facility but not for another, different facility (RCM 612.4). Access controls—such as lists of trained personnel or worker ID cards—determine authorized access to a particular facility; additional categories of facility-specific training, such as uranium or plutonium facility training, may thus be exempted. Radiological workers, technicians, and supervisors who may access multiple facility types should have completed each appropriate site-specific/ facility training segment for each facility type.

3. Minimum Training Requirements

The following are considered adequate training requirements for an acceptable basic radiation safety training program. These considerations and requirements (from specifically invoked DOE standards) are universal throughout the different categories of radiation safety training provided to employees.

a. Training Program Content

Radiation safety training programs should be of adequate content and

supplemented with periodic refresher training, as specified in Section IV.A.3.d, and continuing training so that safe conduct of radiological work is assured. The content of training programs is divided into three categories: standardized core course material, site-specific information, and practical training. DOE has specified the content of core course material, and has provided for supplementing this with additional training that each DOE facility identifies as necessary.

b. Examinations

Examinations are required for DOE radiation safety training programs. The examinations are used to demonstrate adequate completion of training or portions of the training program, such as RCT qualification. Examinations are required for GERT, Radiation Worker Training, RWT, RCT Qualification, and certain visitor radiological orientations. Examinations required for employees at nuclear facilities subject to DOE Order 5480.20 include General Employee Training (GET) examinations every two years. The GERT examination as required in the RCM, if included in its entirety, may be included in the required GET examination for nuclear facility safety. A DOE bank of test questions for the core training is available from DOE-EH for the purpose of developing core course examinations.

A minimum passing score for examinations shall be established (RCM 613.1a). The minimum passing grade for examinations should be at least 80%, where 100% is a perfect score, in order to assure that a minimum level of knowledge is attained. Practical factors are also used in evaluating skills training for Radiological Workers and RCT positions. Successful performance of practical factors **shall** be demonstrated prior to qualification or completion of training beyond the GERT level (10 CFR 835.902 & 903, and RCM 632.3, 633.2 & 642.1,).

Radiological control technicians shall also pass an oral examination, administered by an Oral Examination Board to determine the qualification of candidates (RCM 615). The Oral Examination Board evaluates responses to normal and emergency situations to ensure that adequate practical and theoretical skills have been learned.

For initial training, challenge examinations may be given to workers based on prior experience, education, and/or training. The radiation protection organization should determine appropriate criteria for allowing challenge examinations. Guidance is contained below in the discussions of each training program. With successful completion of the challenge examination, an exemption to the appropriate core training course or lesson is granted. The minimum passing score for challenge examinations should also be established at or above 80%.

Challenge examinations are to be designed to be comprehensive of the entire core training program for Radiological Worker I and II examinations, and comprehensive for each tested subject area for RCT examinations. DOE 5480.20 requires proficiency testing (i.e., challenge examinations) for any exemptions to training requirements of applicable positions at DOE nuclear facilities. Examinations should address learning objectives from each topic or subject area of the training in order to ensure that workers not benefiting from classroom instruction are qualified.

c. Remedial Actions

Personnel who do not pass all required examinations, qualification boards, or oral practical factors requirements should not be allowed to proceed with tasks involving exposure to radioactive materials or radiation until remedial actions have been completed. If GERT is not completed, personnel shall not be permitted unescorted access in facilities or areas where they may routinely encounter barriers, postings, or radioactive materials (RCM 621). Remedial actions for failure to pass a written examination, oral examination, or meet practical factors requirements should include remedial instruction/ retaking the examination, repeating the training program, or being restricted from job duties. Since challenge examinations are designed to provide credit toward required training, the remedial action would be to deny credit for that examination toward the required training. The choice of remedial action depends on the severity of the disqualification or determination of inadequate training. With more advanced qualifications, such as RCT training, it may be determined that not all candidates are able to meet the requirements. In this case, company policies should provide for the proper placement of individuals who are incapable of completing the training or qualification process.

d. Periodic Requalification

Requalification and retraining of workers is necessary for continued safe facility operations. DOE-accredited training programs for operating organization personnel (which may include RCTs and radiological workers) require a biennial cycle of continuing training. Other radiation safety training programs not under the requirements of DOE 5480.18A require requalification per 10 CFR 835 and the RCM. Retraining for GERT, RWT, and RCTs **shall** be accomplished within the two-year time period (10 CFR 835.901-903). DOE 5480.20, Chapter I, Section 12 addresses extension requirements for position qualifications.

A special radiation safety orientation shall be completed by visitors who may access Controlled Areas (RCM 622), and should be completed prior to each different site visit. A training upgrade to GERT training or radiological worker training should be considered for visitors making frequent or extended visits to DOE facilities. For frequent site visitors with radiological worker training, refresher training should be completed when the period of time between facility visits exceeds one year.

e. Radiation Safety Protection Instructor Qualifications

Instructors for radiation safety training should have a knowledge of the subject based on experience, formal instruction, and previous training. Qualifications of instructors for nuclear facilities are addressed in DOE Order 5480.20. Instructors at all nuclear facilities shall have demonstrated knowledge of instructional techniques through training or experience; and the manager of the organization responsible for radiation safety training shall verify that the instructors are competent for the subject area being taught (DOE 5480.20, Chapter II, 2(c)(8)). Instructors shall also have earned a high school diploma or its equivalent and have experience relevant to the material being presented (DOE 5480.20). The DOE Training Resources and Data Exchange (TRADE) provides continuing education courses to radiation safety trainers.

f. Training Effectiveness Evaluations

Training effectiveness evaluations are quality-assurance measures useful in determining that qualified workers have all the required knowledge and skills, and that they have retained and are applying these properly. Feedback is an important form of evaluation that encourages improvements and upgrades to the training programs. Comments from supervisors, instructors, and trainees can enhance course effectiveness. Other means of evaluating training programs are currently in place (such as industry and facility exchanges, instructor evaluations, and routine assessments); these are not addressed here.

Documented evaluations of the effectiveness of radiation safety training should be completed by surveys of current qualified workers. Such evaluations are based on observing workers who have completed the qualification and have had the opportunity to perform the job duties for several months. These evaluations should include discussions of appropriate radiation safety knowledge and on-the-job observations of practical skills and applications. In order to encourage candid responses about the effectiveness of the training, employees must be assured that these post-training surveys are not to be used as a system for disqualifying personnel or for identifying retraining requirements for individual workers.

The surveys should be performed by qualified technical personnel, supervisors of qualified workers, supervisors of training instructors, or senior instructors. Written tests may be included. Formal documentation of the results and conditions of the evaluations shall be kept by the organization responsible for training or its designee (DOE 5480.18A). The results of these evaluations may also serve as one input used to identify items for inclusion in the site radiation safety performance goals program (RCM 131 and 132).

g. Training Records and Documentation

Records of each individual's participation and performance in the qualification and retraining programs are required by 10 CFR 835.704. The handling and disposition of records in general is discussed in DOE Order 1324.2A, Records Disposition, *(DOE, 1988a)*. Training records and course documentation shall meet the requirements of RCM 725. Training records/course documentation shall be included in the facility/contractor radiological records management program (RCM 712). Course documentation includes current training program lesson plans, student guides, position qualification standards, requalification and retraining program content, practical and on-the-job performance measures, and Oral Examination Board procedures. ANSI N13.6, Practice for Occupational Radiation Exposure Records Systems *(ANSI, 1989)* also contains information on retention of training records. The organization responsible for training should keep all required records. Training records for subcontracted radiation safety training should reside in the custody of the originating contract organization (RCM 712).

B. General Employee Radiation Safety Training and Visitor Radiation Safety Orientation

1. DOE Regulations and Requirements

General Employee Radiation Safety Training (GERT) is required for general employees who enter Controlled Areas and may routinely encounter radiation safety barriers, postings, or radioactive materials

(RCM 621). All persons employed either full- or part-time in DOE reactor and non-reactor nuclear facilities shall be trained in the radiological health and safety program to an extent commensurate with their job duties (DOE 5480.20). Training **shall** be successfully completed prior to receiving occupational radiation exposure (10 CFR 835.901a and RCM 621).

The expected time for completion of GERT is approximately one hour (RCM 621.4). Some sites may find it appropriate to include GERT training with other required site-orientation training, such as GET training (DOE 5480.20). The examination should address the specified areas listed in section B.2 below.

GERT training is not a formal accredited training program and does not conform to the job-specific requirements for performance-based training. The DOE core GERT course is developed for all potential workers and visitors who may enter controlled areas at DOE facilities or encounter radiation protection boundaries or postings. Documentation of the receipt of GERT core course and the site-specific information included in the GERT at each DOE facility **shall** be maintained (10 CFR 835.704(a) and RCM 725 & 731). Retraining in GERT **shall** be completed by all general employees every two years and when there is a significant change to radiation protection policy and practices that affect general employees, to ensure that current guidance is provided and that any changes in radiological controls, regulations, or company policies are disseminated to the work force (10 CFR 835.901(b) and RCM 613.3). When changes to company or DOE programs are made, a decision shall be made whether GERT retraining will be provided earlier than would be required under the standard two-year cycle (RCM 613.3). The decision should be based on the practical effects of the change, and what implications there are for the work force. Small administrative changes or alterations of guidance information should not require a formal GERT retraining, but may be accomplished with use of notices to employees or an updated GERT handbook (see below).

A GERT handbook or GERT student guide shall be used for GERT training at each site (RCM 612.1). This handbook should be provided to employees for the purpose of initial and continuing training. It contains current information, both specific to the site and about general DOE radiation protection policies. The handbook is used to assist in keeping DOE workers informed of current radiation protection policies. A current version of the handbook should also be distributed to all GERT-trained workers on the alternate year when GERT retraining is not completed (RCM 613.3).

2. GERT Course Content

The core content of this training is provided in the DOE GERT program manuals (DOE/EH-0258T-1). This training represents the minimum requirement for standardized core course materials, and each contractor shall implement the standardized core course and augment it with site-specific aspects of radiation safety (RCM 621). The core content of GERT training for general employees is identified in the GERT program manual.

Site-specific aspects of GERT training should include the following:

-- Contractor policies on control of radiation exposure to the embryo/fetus;

-- contractor escort and visitor policies;

-- area access and egress requirements;

-- additional warning signs or barriers;

-- contractor protective clothing policies;

-- types of radiation and radioactivity encountered onsite;

-- alarm types and responses; and

-- facility radiation protection policies.

3. Visitors

Visitors who enter the controlled area shall complete a radiation safety orientation that provides an overview of the radiation protection program at the facility (RCM 622.1). The content of the orientation is listed in RCM 622.1. This content is similar to GERT training, although it may be an abbreviated form, or specific to the limited areas visited. For example, an escorted short-term visitor to a Category B reactor facility should be given an orientation that includes the facility description, the radiological health and safety program, the industrial safety/ hygiene program, and the security/ emergency plan programs (DOE 5480.20, Chapter I, para 7e). Actions to be taken during emergencies should be included in the orientation (RCM 622.1).

The radiation safety training for visitors may be given in the form of a videotape or handout to personnel for review prior to access to controlled areas of the site. A record of the orientation shall be maintained by the cognizant facility and visitor sign-in logs may be used as this record (RCM 622.3). Radiation safety training for visitors does not normally require an examination unless two conditions are met: (a) the facility being visited is a reactor facility or non-reactor nuclear facility as defined in DOE Order 5480.5, Safety of Nuclear Facilities *(DOE, 1986a)*, and (b) the visit will extend long-term, i.e., more than one to two weeks (DOE 5480.20 Chapter I, para 7e). Persons subject to these two conditions who do not pass this examination shall not be permitted access without a continuous escort (DOE 5480.20 Chapter I, para 7e).

Visitors, contracted and temporary personnel, and visiting dignitaries at DOE reactor and non-reactor nuclear facilities shall be under continuous escort while at the facility unless they have been trained in appropriate areas (DOE 5480.20 Chapter I, para 7e). Only in situations of extreme urgency (other than emergency situations under which routine requirements do not apply and with the approval of the facility radiation protection manager) are visitors or temporary personnel who have not completed radiation safety training to be allowed access to Controlled Areas. When visitors and other temporary personnel are under continuous escort, a brief statement of their responsibilities while under escort should be provided.

Visitors who require access to DOE facilities on a routine basis, and require access to radiological areas, should upgrade their knowledge of radiation protection and complete Radiological Worker I or II training.

C. Radiological Worker Training

1. General Information

The following section pertains to the development and implementation of radiation safety training for radiological workers. This guidance is applicable for Radiological Worker I, II, and Specialized Radiological Worker training courses.

a. DOE Regulations and Requirements

Training in fundamental and practical radiation protection is required for all

Radiological Workers by 10 CFR 835, DOE 5480.11, and the RCM. For the purposes of this document, a Radiation Worker as defined in DOE 5480.11 is identical to a radiological worker. Radiological Worker training is a necessary part of the overall safety program required for the work force at DOE and DOE contractor facilities. The overall scope of such training should be altered to meet the needs of each facility, but a minimum standard of radiation safety training is required in order to: (a) ensure a safe and efficient workforce that is aware of the consequences of occupational radiation exposure; (b) provide Radiological Workers the ability to assume the primary responsibility for their own radiation protection; (c) ensure that a consistent level of radiation safety training is being provided to the DOE workforce; and (d) encourage a consistent standard for monitoring and contamination control techniques to minimize exposure from radiation and/or radioactive materials. The training **shall** precede assignment as a Radiological Worker, or **shall** be concurrent with the assignment only if the worker is accompanied by and under the direct supervision of a trained Radiological Worker (10 CFR 835.902, DOE 5480.11, and RCM 631).

Content of the training program is divided into core training courses, which are found in the DOE Radiological Worker program manual, and site-specific topics for facilities, to be developed by each DOE facility. The core course shall be provided in its entirety (RCM 612). The DOE Office of Environment, Safety, and Health will periodically evaluate and upgrade the contents of the core course. The site-specific aspects taught in Radiological Worker training should use the PBT approach to determine appropriate content (RCM 613.8).

Supervisors of certain operating and support personnel at DOE reactor and non-reactor nuclear facilities require additional training of increased depth to reflect the added responsibility of the supervisor position. DOE 5480.20 discusses additional training requirements for supervisors at: (a) Category A reactors; (b) Category B reactors; and (c) non-reactor nuclear facilities. In addition, training of management personnel and supervisors on handling risk communication to workers should be implemented (RCM 124).

b. Special Requirements for Training Accreditation Programs

Facilities that come under the requirements of DOE Order 5480.18A should determine which training programs require accreditation by using the functional descriptions contained in the Training Accreditation Program Manual,TAP 1. Since positions such as maintenance technicians and technical staff could also be defined as radiological workers, depending on the specific duties, development of the formal accreditation program at these facilities should consider this fact and specific determinations must be made as to whom must follow the performance-based training approach in radiation protection instruction (DOE 5480.18A). The training programs described in this IG can be incorporated into these accredited training programs. It is intended that the radiation safety training areas presented here will be adequate for direct incorporation into the overall accredited training programs for these positions.

c. Challenge Examinations

Radiological workers may challenge the knowledge requirements of Radiological Worker I or Radiological Worker II training programs. In order to successfully qualify,

workers must pass examinations designed to be comprehensive for the learning objectives of all classroom topics and job-performance tasks. The challenge examinations may be more difficult or longer than regular class examinations, since classroom attendance provides learning comprehension that challenge examinations cannot. Challenge examinations should vary from tests used during classroom instruction. If a candidate is unsuccessful in one attempt at taking the challenge examination, the entire core Radiological Worker training program (I or II) shall be completed (RCM 631.3).

d. Refresher Training and Retraining

Refresher training shall be provided within one year of initial training, and subsequently every alternate year during which radiological worker retraining is not completed (RCM 613.4). Site-specific training and refresher training shall include changes in the requirements and updates from lessons learned from operations and maintenance experience and occurrences both at the site and across the DOE complex (RCM 613.5). Training in changes to the radiation protection program at the facility and lessons from operating or maintenance experience are important, because workers must know current radiation protection information for safe working conditions. Site-specific topics and DOE-wide information should be included in these reviews. Other topics that should be addressed in order to provide the radiological worker with a review of required skills and knowledge include the following:

-- Selected fundamental radiation protection topics at a depth equal to that of initial training;

-- new facilities and/or equipment, or modifications of equipment or facilities;

-- industry and facility operating experiences; and

-- identified deficiencies in radiological work noted by appraisals, safety assessments, or effectiveness evaluations.

Refresher training has no required length, but adequate time should be scheduled to allow a comprehensive presentation of the material. Refresher training may also be presented with other annual safety training requirements.

Every second year after initial training, retraining of radiological workers **shall** be completed (10 CFR 835.902, DOE 5480.11(9.o.2), and RCM 613.4). Retraining is a more in-depth review of knowledge than refresher training, and should include selected fundamentals of the initial training course with emphasis on seldom-used knowledge and skills. Retraining should include the initial core course material and be tailored to subjects for which trainee evaluations and experience or other evidence indicate that special emphasis and depth of coverage is needed. The retraining interval has been set to coincide with DOE 5480.18A requirements for accredited training programs, which include areas of radiological worker training. Retraining of radiological workers should include examinations similar in detail to initial qualification. Examinations should stress frequently used information, rather than infrequently used theoretical knowledge, and should test for retention of important site-specific information. To adequately evaluate worker skills on the job, and correct for poor radiological work practices that may develop, both written

and practical examinations should be administered.

e. Computer-Based Training

Alternatives to providing training in a classroom or lecture setting may be used, such as computer-based training (CBT). If the capability to update the information of the CBT is limited, additional current-topics training should be provided.

2. Radiological Worker I Training

Radiological Worker I training is designed to be completed by workers whose job assignments require routine access to Radiological Buffer Areas and Radiation Areas. Such training is required prior to entry into a Radiological Buffer Area without a qualified escort (RCM 632.1). Radiological Worker I training is also required for unescorted entry into Radioactive Material Areas containing sealed radioactive sources or radioactive material labeled and packaged in accordance with RCM Articles 412 and 413 (RCM 333.1).

Radiological Worker I training is not a prerequisite for Radiological Worker II training.

a. DOE Core Course Topics

The standardized core course lesson plan is found in the DOE GERT and RWT program management manual (DOE/EH-0258T-1).

b. Additional Site-Specific Topics

Training should include, but is not limited to, all topics listed in this section. The training **shall** emphasize procedures specific to the worker's job assignment and facility (10 CFR 835.902 and DOE 5480.11). Site-specific topics of instruction should include the following:

-- Sources of radiation at facility;

-- sources of radioactive materials or contamination at facility;

-- policies on protection of the embryo/fetus from radiation;

-- contractor radiation protection policies and procedures;

-- contractor radiation safety practices; and

-- proper response to radiological alarms and abnormal occurrences.

Practical factors for Radiological Worker I training should encompass, as a minimum, the following site-specific performance elements (RCM 632):

-- Entering and exiting a simulated Radiological Buffer area and a Radiation Area;

-- performance of self-monitoring for personnel contamination, if self-monitoring is used in the facility;

-- verification of proper monitoring equipment performance (instrument response and source check); and

-- abnormal occurrence procedures and responses to radiological alarms.

Practical-factors training should include an evaluation of the trainee in performing the above elements. An operational evaluation as per DOE 5480.20 (6.o) should include the above elements in the facility walk-through or simulation.

The length of the radiological worker qualification program for completion of classroom and practical training is expected to be approximately 8 hours (RCM 632.4). Greater or lesser length of training may be appropriate, depending on the expected hazards found and procedures used at each specific site. When Radiological Worker I training is incorporated into training programs at DOE nuclear facilities (DOE 5480.18A), the expected length of radiation safety and control training should be appropriate to the level of hazard expected during routine facility operations.

c. Supplemental Facility Training

Training for radiological workers whose job assignment involves work at a specified DOE facility type, such as an accelerator or uranium facility, should consider the additional training topics as described in the RCM 661-664. Appendix B of this IG also contains learning objectives that may be considered for incorporation.

d. Examinations

Radiological Worker I training **shall** include an examination at the completion of the course to test for comprehension (10 CFR 835.902 and RCM 613.1). The examination shall include DOE core course material (RCM 632.2) and should include site-specific aspects (RCM 632.3). Test questions from the DOE test bank should be used for the core course portion of the examination. Examinations should address both normal and abnormal situations in radiological protection. A minimum examination score of 80% should be established. Practical factors should also be tested, with satisfactory completion determined. Generally, practical factors may only be considered satisfactory if completed with no significant errors.

Trainees not passing the examination at the conclusion of the course should be retrained prior to being allowed to work in radiological areas, or they should be evaluated by standard contractor procedures for other non-radiological work.

Challenge examinations may be given for core course materials based on previous education and experience.

Each facility should evaluate the extent and complexity of their Radiological Worker I training and determine the cost benefit associated with offering challenge examinations. A facility may decide not to initiate a challenge examination program if it is not expected that challenge examinations would save significant time and money. Consideration should be given to projected failure rates and the amount of time spent developing and providing challenge examinations to individuals having to take the training upon failure of the challenge examination.

e. Restrictions for Radiological Worker I

Workers having completed Radiological Worker I training are qualified for conducting work in Radiological Buffer Areas and Radiation Areas. They should have an adequate comprehension of the risks and potential hazards of radiation exposure. Radiological Worker I workers are restricted from access into other radiological areas (such as Contamination Areas, Airborne Radioactivity Areas, High Radiation Areas, etc.), and are precluded from working with radioactive contamination or radioactive materials where there may be a possibility of the release of radioactivity. Unescorted worker access, for Radiological Worker I qualified individuals, to high or very high radiation areas is permitted upon successful

completion of the high/very high radiation area training module (RCM 632.5).

3. Radiological Worker II Training

Radiological Worker II training is required before unescorted access is allowed into High or Very High Radiation Areas, Contamination Areas, or Airborne Radioactivity Areas. It is also required prior to radiological work under conditions such as:

-- Working in contact with hot particles;

-- using radiological gloveboxes with high contamination levels;

-- working in certain anti-contamination clothing (cloth or plastic); and

-- working with respiratory protective equipment (for radiological purposes).

Radiological Worker II training is designed as a separate training program from Radiological Worker I training. Radiological Worker I training is not a prerequisite for Radiological Worker II training, since the Radiological Worker II training includes each topic contained in Radiological Worker I training, except that the material is covered in more detail. The expected time for completion of Radiological Worker II training should be approximately 16 hours, including both classroom and practical-factors training (RCM 633.3). Greater or lesser length of training may be appropriate, depending on the expected hazards and safety-related procedures found at the site. When Radiological Worker II training is incorporated into accredited training programs at DOE nuclear facilities, the expected length of radiation safety and control training should be appropriate for the level of hazard expected at the facility.

a. Core Training Content

Radiological Worker II training is designed to be completed by workers whose job assignments require routine access to all radiological areas, and work with radioactively contaminated materials and in areas with potential high radiological consequence such as Airborne Radioactivity Areas or High Contamination Areas. The standardized core course lesson plan is found in the DOE GERT and RWT program manuals.

b. Additional Site-Specific Topics

Radiological Worker II training **shall** also emphasize procedures specific to the worker's job assignment and facility(10 CFR 835.902 and RCM 633.1). Site-specific topics of instruction should include each of the following:

-- Sources of radiation at the facility;

-- sources of radioactive materials or contamination at the facility;

-- policies on protection of the embryo/fetus from radiation;

-- contractor radiation protection policies and procedures;

-- contractor radiological controls;

-- access and egress procedures for radiological areas;

-- abnormal occurrence procedures and radiological alarm response; and

-- operational and safety procedures associated with specific job assignments (e.g., gloveboxes, waste-handling equipment, etc.).

DOE Order 5480.20, Chapter I gives further guidance on required facility-specific subject training areas for selected positions. The training program should give due consideration to potential special training needs for selected positions, especially for non-routine aspects of work.

c. Site-Specific Practical Factors

Radiological Worker II training shall include the following site-specific practical training performance measures as a minimum (RCM 633.2):

-- Donning and removal of protective clothing;

-- entering and exiting a Radiological Buffer Area, Contamination Area, and High Radiation Area to perform a task;

-- anticipated response to simulated abnormal situations, such as
  - a spill of radioactive liquid
  - a high-radiation alarm
  - an airborne radioactivity alarm
  - a spread of surface contamination;

-- anticipated response to simulated or actual radiological alarms, such as
  - a criticality alarm
  - a self-monitor (frisker) alarm
  - an off-scale instrument reading;

-- performing self-monitoring for contamination; and

-- operational checks of radiation survey instruments.

d. Examinations

Radiological Worker II training **shall** include an examination at the completion of the theoretical and classroom material (10 CFR 835.902 and RCM 613.1) . The examination(s) should include both core-course material and site-specific aspects. Test questions from the DOE test bank should be used for the core course portion of the examination. Examinations and practical training evaluations should contain a representative cross-section of knowledge and skills presented in the training program, both general and site-specific. Examinations should address both normal and abnormal situations in radiation protection (RCM 613.2). A minimum passing score for examinations should be set at 80% or better. Further, the practical examination should only be considered satisfactory when there are no significant errors by the examinee.

Challenge examinations may be given for core course materials based on previous education and experience.

Trainees not passing the examination at the conclusion of the course should be retrained prior to being allowed to work in radiological areas, or they should be evaluated by standard contractor procedures for other non-radiological work.

4. Specialized Radiological Worker Training

RCM 634 provides for specialized training for nonroutine operations (suggested as occurring less than two times per year) or in work areas where the radiological conditions are subject to rapid or gross changes.

a. Purpose

The intent of this training is to provide competency in the performance of higher-risk procedures in which the consequence of faulty actions may be severe or life-threatening. Such training should be

provided for personnel who are involved with planning, preparing, and performing jobs that have the potential for high radiological consequences. Successful completion of Radiological Worker II training is a prerequisite for persons receiving this training.

b. Content

The content of specialized worker training is dependent on the work evolution or procedure being trained for. Because of the variety of possible subjects, the content and length of training cannot be regulated in a prescribed manner. Actual performance of the work action/evolution, from the initial work entry until the completion of documented work or work procedure, should be addressed. Use of each team member or respective trade workers should also be incorporated in the simulation. In order to assure timely and complete response to work requirements and radiation safety practices, it is critical that RCTs be involved in the performance of this training. Mock-up training using detailed models of systems or work locations may be used, and is recommended for work evolutions on reactor or component systems. Special ALARA considerations for high-exposure work evolutions, and the use of realistic contamination-containment devices, should be considered as proper aspects of specialized training.

c. Training Evaluation

An evaluation of the success of Specialized Radiological Worker Training should be performed at the conclusion of training. Only workers who can successfully demonstrate adequate performance of duties should be allowed to perform job functions. Records of personnel having completed Specialized Radiological Worker Training should be kept. This will help identify previously trained individuals for future, similar operations.

D. Radiological Control Technician Training

DOE RCTs are required to be qualified in the performance of all job functions. A formal qualification program has been developed by DOE for this purpose.

1. DOE Regulations and Requirements

It is recommended that RCT trainees have a minimum of a high school diploma or GED equivalent; additional minimum qualification requirements are found in DOE 5480.20 and RCM 642. DOE 5480.20, requires that RCTs at Category A reactors have a minimum of a high school diploma. An individual who has applicable prerequisite training or education may be given an exception from certain portions of the training program. The DOE Guide to Good Practices in Radiation Protection Training *(DOE, 1988b)* recommends this approach. Provisions for exceptions to RCT training are included in RCM 642.3. Certification of trainees as Radiation Protection Technologists by the National Registry of Radiation Protection Technologists (NRRPT) may be acceptable for exceptions from individual sections of the core academic training for initial qualification. These exceptions may include (at the discretion of the site) exceptions to challenge examinations based on review of the NRRPT training course lessons. The RCM also supports the pursuit of NRRPT certification by DOE and DOE-contractor RCTs.

Suitable previous experience such as college credit or operational experience may also be used to fulfill minimum qualifications at facilities not explicitly covered by DOE 5480.18A. Certain DOE-contractor

training programs for RCTs have incorporated a multiple-level qualification program.

RCT programs may have two or more qualification levels, each with a documented set of instructions and experience requirements. For these programs, reaching the next qualification level or grade is contingent upon completion of additional qualification standards, instruction, and practical training, and usually includes meeting a specific experience-level requirement. Job responsibilities for each qualification level should be well-documented. DOE and contractor facilities that utilize this type of system of advancing qualification should ensure that each individual is qualified and certified at the next level prior to allowing the assumption of duties.

Challenge examinations should be offered to suitably experienced individuals for the purpose of providing accelerated RCT qualification. The organization responsible for training should make a determination that, based on previous qualifications of a RCT, a candidate may challenge areas of the qualification by examination. Challenge examinations may be developed by each DOE facility to the extent appropriate for their training programs. Challenge examinations should only apply to the core academic areas of RCT instruction and may be administered to cover all learning objectives identified in the core academic training program.

DOE 5480.20 requires that, to provide exceptions to requirements of initial and continuing training programs, the operating organization (or separate organization responsible for training depending on facility-specific delegation of authority for training) establish procedures and criteria for administering and documenting proficiency testing. Challenge examinations should be used to help fulfill this requirement. Documentation should include the identification of the person, the subject of the exception, and a justification. Examinations are a requirement of proficiency testing. Exceptions to proficiency testing should be approved by the DOE contractor management.

Qualification standards are used to define the requirements for satisfactory RCT qualification. The signature of the instructor or manager of the organization responsible for technician training certifies the successful completion of each subject area. DOE qualification standards from the standardized core training program shall be used (RCM 614.2). Qualification standards for the core course material are found in the DOE RCT training program manual, and should be used as a model to develop site-specific standards. Additional qualification standards shall be developed by the facility for site-specific areas of instruction and practical training.

2. Requirements for Performance-Based Training Accreditation

Additional requirements for the development, implementation, design, and evaluation of DOE-accredited training programs for RCTs are found in DOE 5480.18A. Certain DOE reactor and non-reactor nuclear facilities are designated such that a Training Accreditation Program is required for positions, with RCTs being included according to the accreditation order timetable. RCTs shall have the radiological protection aspects of their training incorporated into a structured Accreditation Program and Plan (DOE 5480.18A). DOE has designed the RCT standardized core training to be incorporated directly into the performance-based training of technicians at these

facilities. DOE facilities that require accreditation should ensure that when the learning objectives and lesson plans/guides are completed, they include all the required training found in the DOE qualification standards.

Operational evaluations as required by DOE 5480.20 may incorporate the Phase II evaluations discussed in Section 3b of this IG. Operational evaluations are a requirement for certain DOE reactor and non-reactor nuclear facilities.

3. Initial Radiological Control Technician Training

The initial RCT training program is divided into two parts, termed Phase I and Phase II training.

a. Phase I Training

Phase I consists of academic training encompassing specific learning objectives. This classroom phase uses learning objectives from the standardized core training lessons developed by DOE-EH and additional site-specific learning objectives [see section D.3.a.(2)] developed by each DOE or contractor facility. Recommended classroom time for instruction on the Phase I core training lessons is 240 hours but can vary based on job-performance evaluations. This guideline is inclusive of examinations and test reviews. The time for completing the Phase I training program is dependent on the additional learning objectives developed for site-specific/performance-based training, and may vary widely depending on the hazard class of the facility.

Phase I training includes training from the DOE standard core course and additional site-specific and facility training.

(1) DOE Standardized Core Academic Training

The DOE standardized core curriculum for initial training and qualification of RCTs is found in the DOE RCT training plan manual (DOE/EH-0262T-1). It applies to RCT training programs at all DOE contractor sites. The training reflects the core topics identified in DOE 5480.11 and other current relevant guidance.

(2) Site Academic Training

Contractor sites **shall** add additional training topics for RCT qualification based on identified site-specific requirements (10 CFR 835.903 and RCM 612). The training elements should be identified using a performance-based training methodology from the DOE TAP 2 manual. Guidance on possible content of site-specific training elements can be found in various training references, such as American Society for Testing and Materials (ASTM) E-1168-87, Standard Guide for Radiological Protection Training for Nuclear Facility Workers *(ASTM, 1987)*. The DOE RCT training plan manual identifies learning objectives that may be considered site-specific.

In training RCTs, the depth of knowledge required for adequate job performance is such that much of the training program may be site-specific. This applies particularly to Phase I training in plant systems, communications, organizational responsibilities, procedures and records, tools and equipment, ALARA policies, and in radiological aspects of training such as material control, monitoring, and conduct of radiological work.

(3) Facility-type training

Certain types of DOE nuclear facilities have enough similarity between their missions that they could benefit from sharing certain non-site-specific, yet non-universal, kinds of training. The specific knowledge of radiological protection at these facilities differs from general radiation safety and, as such, is not found in the DOE core materials. Additional subjects for use at DOE contractor facilities with similar operating conditions, such as accelerator, plutonium, tritium, and uranium facilities, have been developed to meet this facility-type training. These topics are listed in RCM 661-664. Appendix B of this IG gives further information on the content and approach of this additional facility-type information.

b. Phase II Training

Phase II training consists of practical, on-the-job training (OJT) that provides the RCT trainee with adequate job-performance skills. As with Phase I training, it is comprised of the DOE core tasks and site-specific tasks, each defined by the qualification standard. Phase II training should encompass the routine, day-to-day functions of the RCT, such as radiological surveying, job coverage, exposure and contamination control, ALARA considerations, and other tasks identified through job/task analysis. It should also provide instruction on and evaluation of non-routine conditions, such as response to radiological alarms and contaminated personnel. After the completion of this training, an evaluation of trainee performance should be accomplished using job-performance measures. Job-performance measures are a tool developed within performance-based training to identify the knowledge and skills required to accomplish practical tasks. The DOE Training Accreditation Program Manual, TAP 2 contains detailed information on developing job performance measures for evaluation of practical training.

A list of suggested DOE core practical training tasks is found in the DOE training plan. The radiological control technician qualification standard contains the performance tasks for Phase II training, and should contain the standardized core tasks and additional site-specific tasks generated by performance-based task identification. Trainers may also utilize the learning objectives found in Appendix B of this IG for developing practical training tasks for uranium, plutonium, accelerator, or tritium operations facilities.

Radiological control technicians may require additional training in areas not associated with radiological protection. Qualification of RCTs in hazardous materials-handling or hazardous waste, first aid, CPR, etc. may enhance overall job performance. These additional qualifications may be presented separately from the DOE RCT qualification program, and are not part of the required DOE standardized training programs. An evaluation by line management of the organization responsible for training and the operating organization should be undertaken periodically to ensure that RCTs are not qualified for too many job functions, which might limit their performance in radiological surveillance. Each contractor is responsible for ensuring that any applicable additional qualifications specified by the contractor are justified and completed satisfactorily.

4. Radiological Control Technician Qualification

Training **shall** precede assignment as a qualified RCT, but work assignments may accompany the training program while under the supervision of a trained individual in order to allow for development of the necessary work skills required for qualification (10 CFR 835.903, DOE 5480.11(9.o.3), and RCM 641). Trainees should be supervised by a qualified RCT in the performance of job duties, and their work (e.g., surveys, postings, and job coverage) should be reviewed by qualified persons. Trainees may be qualified for certain tasks prior to completing RCT qualification and may independently perform specific tasks or job assignments for which they are qualified. The qualification standards are used to document the completion of training evaluations for specific tasks.

Qualification of RCTs requires the successful completion of the following steps:

-- Phase I training including all examinations, with a minimum passing score of 80% on the final qualifying examination, and participation in a post-exam review;

-- Phase II training Job Performance Measures, including the instructor's verification of satisfactory performance; and

-- an oral examination, with the examining board verifying the successful review of the RCT's performance.

a. Examinations

Examination recommendations given in the RCM do not designate a minimum passing score. A minimum passing score of 80% for the average of in-class examinations during the training program is recommended. DOE programmatic evaluations of training courses developed by DOE and contractor facilities will assist in determining that examinations for core training materials are adequate and comprehensive. The purpose of testing is to evaluate the retention of knowledge that an RCT will need during the performance of job duties rather than theoretical knowledge that is retained only short-term. Use of the DOE test bank for core examination questions will also assist in providing a consistent level of qualification. The final qualifying examination should have a minimum passing score of 80%.

The DOE bank of test questions for the core training is available from DOE-EH for the purpose of developing core course examinations. The qualification examination should have frequent rotation and revision in order to avoid compromise. For this reason, and also to serve as challenge examinations, several different examinations of similar difficulty should be developed by the organization responsible for training.

Challenge examinations should address each learning objective from the DOE core materials. Failure to achieve a satisfactory grade on a challenge examination will require that the pertinent training be completed. Failures of challenge examinations in multiple subject areas indicate that the trainee should complete the entire qualification program.

Challenge examinations for RCT trainees should be given for individual academic sections of Phase I or Phase II training, and an oral examination is mandatory. Instruction on the facility and site-specific knowledge necessary for comprehensive qualification will usually preclude offering a challenge examination for the entire training program. Exceptions to this may be determined if the individual trainee has previous RCT experience at the facility.

Evaluation of practical tasks from Phase II training occurs during the process of actual task performance as identified in the Job Performance Measures. Successful completion of Phase II training is verified by signature for each Job Performance Measure. Substitution of proficiency testing for practical training is acceptable subject to the review and approval of the radiation protection manager. Proficiency testing in lieu of practical training should only be approved for individuals with demonstrable knowledge and/or experience which clearly justifies not providing the practical training. Additionally, substitution of a test in lieu of performance of certain tasks may be necessary for purposes of meeting ALARA objectives.

b. Oral Examination Board

Qualification of RCTs requires the successful completion of an oral examination, given by an Oral Examination Board comprised of members designated by the radiation protection manager or the equivalent (RCM 615.1, 615.2, and 642.1). The board should consist of at least three persons with experience in radiation protection and should be drawn from the following: RCT supervisors; one or more staff members from support functions in radiation protection such as Radiological Engineering, Dosimetry, or Radiological Support; operations line management; and staff personnel, as applicable (RCM 615.3). The radiation protection manager or his/her equivalent shall designate the Board members and appoint a Chairperson (RCM 615.2). RCT instructors may attend in a non-voting capacity.

The purpose of the oral examination is to determine the response of the trainee to situations in radiation protection, both under normal operating conditions and during emergencies (RCM 615.4). The scenarios used for this purpose may consist of routine situations encountered at the facility and/or possible abnormal and emergency events. Questions asked by the Board should not be of a high degree of theoretical content, as would be administered during a written examination. Questions requiring calculations and multiple part answers should be limited to situations that would require such responses in the field.

The oral examination should be prepared in advance to include all specified areas that will be tested, and an outline should be prepared to determine if candidate responses are appropriate. The designated head of the board (as determined by the radiation protection manager or equivalent) should determine the success of the examination based on discussion and/or polling of the voting members. Failure of the oral examination by a RCT trainee requires remedial steps, such as review and discussion of answers that were deficient. Subsequent re-taking of the oral examination or possible disqualification based on repeated failure should adhere to contractor administrative policies.

5. Subcontractor Radiological Control Technician Qualification

Subcontractor RCTs are individuals who are not DOE or DOE contractor employees and normally have not completed the DOE RCT training program or the Accredited RPT training program for Category A Reactors and selected nuclear facilities. These subcontracted RCTs should have the same knowledge base and prerequisite qualifications as DOE facility technicians for the job tasks they will be performing (RCM 645.1). The RCM states that "subcontractors and subcontractor employees shall meet the same requirements and expectations and should have comparable training"

(RCM 125.9). The minimum training and qualification program for subcontracted RCTs is listed in RCM 645. For DOE facilities that must comply with DOE 5480.20, subcontractor and temporary personnel must be qualified for their duties by one of three methods: (a) a satisfactory result of an audit of subcontractor training records; (b) a previous verification by the organization responsible for training within the last two years that the subcontractor employee has the requisite qualifications; or (c) the successful completion of training considered pertinent to accomplish the assigned tasks.

Subcontractor and temporary RCTs should also be provided with other applicable training in the facility operations and safety procedures, such as fire protection programs, security programs, and hazardous materials training.

. Limited Radiological Control Technician Qualifications

Subcontractor RCTs may be authorized for a limited qualification not encompassing the entire DOE training program, based on written identification of the duties that he/she is authorized to perform. Limited qualifications may be beneficial by not requiring subcontractor RCTs to pass the extensive written and practical examinations and an oral examination for DOE RCT qualification. Subcontractor RCTs on-site for periods less than six months should pass written examinations and an oral evaluation given by the site radiation protection organization and based upon the subcontractor RCT's limited duties to be performed at the site. In these instances, the site must ensure that subcontractor RCTs only perform the limited duty job functions for which they have been qualified. Subcontractor RCTs onsite for periods greater than six months should successfully complete an oral examination. An evaluation of the length of time subcontractor technicians will be on-site should be completed prior to their arrival to determine if extensive training and oral examination should be required.

The use of qualified, experienced site RCTs to observe, mentor, and evaluate newly qualified or trainee RCTs is a reliable method of qualification. Attendance in continuing training sessions (see next section) should also be considered. Site RCT supervisors should also observe the on-the-job performance of subcontractor RCTs as a part of the training and qualification program (RCM 645.1).

6. Continuing Training for RCTs

Following qualification of RCTs and their supervisors, a two-year cycle of continuing training should begin. Continuing training is defined in the RCM (RCM 643.2). This continuing training is designed and implemented to enhance the proficiency of, and maintain an adequate knowledge base for, the technician. Upon completion of the two-year period of continuing training, requalification **shall** be completed (10 CFR 835.903 and RCM 643.2).

Continuing training should consist of radiation protection information that provides improvement in the retained knowledge and skills of the RCT (RCM 643.3). Infrequently used information and skills should be addressed, as should site-specific changes in procedures and requirements. Using the DOE performance-appraisal process to update current lessons from operating experiences and industry events is a potential source of continuing training topics. Case studies of past or recent poor work-practice experience provide an effective method to learn from other sites. The RCM requires "verification of

the effectiveness of training" and the effectiveness evaluation process can be used to identify appropriate changes in the training program. Certain topics for continuing training may be specified by DOE and shared among related DOE facilities. The use of the EG&G Idaho/DOE Safety Performance Measurement System (SPMS)/Occurrence Reporting and Processing System (ORPS) database is encouraged in developing useful topics for instruction.

Scheduling of continuing training should be in accordance with facility operating procedures, and should be conducted using an established schedule. Attendance should be mandatory for continued requalification and should be documented. Missed training sessions should be recovered promptly in order to address the time-sensitive nature of continuing training. Because DOE does not stipulate any formal classroom training for the biennial requalification of RCTs, continuing training is the primary means for ensuring adequate retention of knowledge.

Subcontracted RCTs should be given continuing training if their work contract extends for a period longer than six months, but may be encouraged to attend, regardless of their time at the facility (RCM 645.2).

7. Requalification of Radiological Control Technicians

RCT requalification is required every two years. Requalification requires completion of practical training, a comprehensive written examination, and a final oral examination. Requalification should stress more difficult and advanced radiological protection concepts and procedures as the RCT advances in experience and knowledge. More advanced training may be incorporated into a position advancement for senior-level technicians. The use of advancing levels of technician qualification may or may not be feasible, depending on the facility. Passing criteria for qualification should be the same as initial Phase I and Phase II training, although consideration may be given to the advanced nature of the student, and the possibility of an advanced level of technician rating.

8. Radiological Control Technician Supervisor Training

Direct or first-level supervisors of RCTs should be qualified in radiation safety training to a level appropriate to their assigned duties. Radiological Control Technician Supervisors shall be qualified as RCTs (RCM 644.1). Training may be less comprehensive for upper-level supervision or senior management than the initial RCT training, but should include training on management responsibilities for radiation safety, evaluations and assessment functions, and effective communication.

Managers and supervisors of RCTs should be trained to deal with the perceptions of workers concerning radiation risks (RCM 124). In order to be helpful to workers with anxiety about work involving radiation exposure, several topics are listed in the RCM for inclusion in management training. These topics include:

-- Guidance on handling personnel interactions;

-- emphasis on factual interchanges;

-- the fundamentals of risk communication; and

-- the importance of informing management of any abnormal occurrences.

Managers and first-line supervisors of RCTs at DOE reactor and non-reactor nuclear facilities shall receive training in supervisory skills and/or management training as appropriate to their job responsibilities (DOE 5480.20 Chap. I, par. 7i). This training need not be subject to examination as part of initial training, nor categorically repeated in their continuing training programs.

RCT supervisors should have a greater depth of knowledge than that expected of a technician. Completion of an oral examination, by appearance before the Oral Examination Board, shall be required for requalification of RCT supervisors (RCM 644.3), and should focus on the abilities to analyze radiological conditions and unusual situations, and supervise subordinates (RCM 644.4). The membership of the Oral Examination Board for RCT supervisors should not include other peer supervisors or subordinates (RCM 615.5).

E. Supervisor and Management Training

1. Operations Management and Supervisors

Supervisors and line management of personnel performing jobs that involve interaction with radiation and radioactive materials need training in the principles of radiation protection. A basic understanding of the concepts of radiation protection and the interactions between workers and the radiation protection organization is essential. Direct or first-level supervisors of radiological workers should also be radiological worker-qualified if any portion of their assignment requires them to train, direct, or replace their cognizant employees in job duties categorized by 10 CFR 835.2 as radiological workers. Other technical or supervisory management personnel should complete GERT training.

DOE Order 5480.19, Chapter I (C)(5), Conduct of Operations Requirements for DOE Facilities *(DOE, 1990)* requires formalized supervisory and management training as part of the operations requirements for DOE facilities. As managers and supervisors, they should perform independent verifications and progressive operations appraisals. These appraisals for environmental safety and health considerations and training functions are to be conducted in accordance with established operating criteria. Managers should be trained to conduct these types of inspections for safe conduct of radiation work.

2. Radiation Protection Management

Line managers in the radiation protection organization shall be trained in the principles of the RCM and other appropriate technical guidance (RCM 651). The training program should emphasize self-assessment and external evaluations in radiation safety, including performance indicators, root cause analysis, and occurrence reporting. Training in the RCM requirement for verification of the effectiveness of training should also be emphasized. If managers or supervisors are new employees, then this radiation safety training should be completed prior to formally assuming line supervisor and management responsibilities. Incumbent employees need not complete a formal training program, but should attend a continuing training program.

F. Other Radiation Safety Training

Several other job-function descriptions at DOE facilities have various degrees of

interaction with the radiation protection organization and radiation protection. Specific training for these individuals should be tailored to the degree of knowledge that is necessary for safe working conditions. The RCM discusses several categories of employees at DOE facilities that need radiation safety training.

1. Technical Support Personnel

Personnel involved with the planning, preparing, and performance of jobs with potential high radiological risk should be given training in ALARA principles and techniques (RCM 652). Previous experience in radiation protection program design is desirable. Proper design and engineering for these higher risk jobs will entail visits to the actual job site by those individuals involved in the design of the specific work tasks. Special consideration should be given to the use of mock-ups during the special training of the individual workers who will perform the actual work tasks. Completion of Radiological Worker Training (I or II) is recommended as a minimum for all technical support personnel. Additional training should be considered for personnel planning and preparing operations and procedures that require mock-up training or specialized radiological worker training (RCM 652).

2. Radiological Support Personnel

Radiological support personnel are defined in the RCM as including, but not limited to, dosimetry technicians, instrument technicians, medical personnel, records clerks, in vivo bioassay technicians, and laboratory personnel. They should have training using the DOE standardized core course topics selected to be appropriate to their job function (RCM 654.3). Selection of topics may be taken from radiological worker or RCT core materials and/or site-specific training topics developed at the facility. These staff should be provided with continuing training for the purpose of providing continuous improvement in knowledge and skills used in job performance (RCM 654.3).

3. Industrial Radiographers, Radiographer Assistants, and Operators of Radiation-Generating Devices

Regulations on the proper training of Industrial Radiographers, Radiographer Assistants, and Operators of Radiation-Generating Devices are found in 10 CFR 34.31, Personnel Radiation Safety Requirements for Radiographers and Radiographers' Assistants *(NRC, 1992)*. Guidance on training for radiography can be found in the NRC's Regulatory Guide 10.6, Guide for the Preparation of Applications for Use of Sealed Sources and Devices for Performing Industrial Radiography (Appendix C)*(NRC, 1984)*; the National Council on Radiation Protection's (NCRP) Report No. 61, Radiation Safety Training Criteria for Industrial Radiography *(NCRP, 1978)*; and NRC's Report NUREG/BR-0024, Working Safely in Gamma Radiography *(NRC, 1982)*. Because of the different nature of radiography training and its historical separation from worker radiation safety training, this material is not presented in this IG. Staff who will be entering radiography facilities or hired to perform radiography at a facility should attend radiological worker training to foster communications between these two differently-regulated programs dealing with the same hazard.

4. Emergency Response Personnel

DOE requires that emergency response and support personnel be provided with rapid access to the site and radiological areas at DOE facilities. Both onsite and offsite

personnel may require such access. Emergency workers such as firefighters, medical personnel, security personnel, and radiological support teams will need the ability to rapidly enter all radiological areas in the event of emergencies.

Special Radiological Worker training should be provided to these personnel (RCM 656.2). The training should be based on the facility training programs in place for radiological workers, and should include the necessary core and site-specific knowledge for rapid and safe response to radiological areas (RCM 656.3). Additional training may be necessary for fire fighters and other emergency personnel required to access radiological areas under hazardous conditions. Use of practical training in emergency equipment, communications, radiological evaluations, etc. should be considered.

Emergency response personnel should receive specialized training commensurate with the hazards and situations they are likely to encounter during an emergency (RCM 656.2).

The use of escorts in lieu of full and proper training for emergency response personnel is highly discouraged for ALARA and other considerations and should only be considered for special situations, i.e. two-man rule situations, etc..

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APPENDIX A

10 CFR 835, Implementation Guide, and DOE Radiological Control Manual Cross-Reference

10 CFR 835	Implementation Guide	Radiological Control Manual
835.704(a)	IV.A.3.g & IV.B.1	712, 725, & 731
835.901(a)	III, IV.A.3.d, & IV.B.1-2	611, 612, & 621
835.901(b)	IV.B.1	613.3
835.902	III	612
"	IV.A.1 & IV.A.2	612 & 613.8
"	IV.A.3.b	632.3, 633.2, & 642.1
"	IV.A.3.d	613.4
"	IV.C.1.a	631
"	IV.C.1.d	613.4
"	IV.C.2.b	632.3
"	IV.C.2.d	613.1
"	IV.C.3.b	633.1
"	IV.C.3.d	613.1 & 613.2
835.903	III	612
"	IV.A.1 & 2	612 & 613.8
"	IV.A.3.b	632.3, 633.2 & 642.1
"	IV.A.3.d	613.4
"	IV.D.3.a	612
"	IV.D.4	641
"	IV.D.6	643.2

Appendix B
Supplemental Facility-Type Learning Objectives

The following learning objectives have been developed from DOE Guides to Good Practices for consideration in site-specific topics for instruction at DOE facilities having operations involving the use of accelerators, plutonium, tritium, or uranium. They may be used to add to the DOE core course materials for operations at these types of facilities. The level of detail for these learning objectives is intended for RCT qualification, but a condensed version can be developed for radiological worker instruction.

I. ACCELERATOR FACILITIES

A. Radioactivation

-- Describe the major radioactive species and their decay modes for radioisotopes produced by activation. Be familiar with the relative hazards of various radionuclides.

-- Explain the processes by which components (targets, peripheral equipment, etc.) can become activated, and the monitoring that this would require.

-- Identify several components or materials that have a likelihood of becoming radioactive due to facility operations.

-- Describe the occurrence and relative hazards of gaseous radioactivation products that may occur at the facility, and the system(s) used to control/monitor them.

-- Determine the criteria by which suspect activated components can be released from positive control, and the restrictions that apply to this "free release" of material that may be potentially radioactive.

B. Radiological Surveys

-- Describe routine contamination surveys that must be accomplished due to radioactivation processes.

-- Explain how to accomplish the routine radiation surveys for all controlled areas, high-radiation areas, perimeter and shielded areas, and exclusion areas.

-- Explain the importance of special surveys needed for such things as target removal, beam geometry or power level changes, shielding alterations, or other operational changes.

-- Explain the concept of skyshine, and describe the surveys necessary to monitor it.

C. Component Source Terms

-- Describe the source term (electron, proton, etc.) and the major reactions (and radiations produced) that occur at the facility.

-- Diagram the possible beam paths and the radiation hazards associated with various areas while the beam is on.

-- Describe the primary residual radioactivity sources that occur at the facility due to beam activation, etc.

-- Describe the limiting radiation source (gamma, neutron, or other particle) for the major beam/target combinations.

D. Interlock and Warning Devices and Systems

-- Explain the function of the safety interlock system and the warning devices used to prevent inadvertent entries.

-- Describe the locations of scram switches and emergency exit mechanisms (if applicable).

-- Describe the procedures for periodic testing of interlock systems.

-- Describe the proper procedure for area searches prior to activation of the beam.

E. Access to Beams and Beam Containment

-- Explain the radiological and physical hazards associated with accelerator beam proximity, for both primary and secondary beams.

-- Explain the restrictions and the proper procedures used for primary and secondary beam access.

F. Special Instruments and Measurement Techniques

-- Explain the special problems of pulsed radiation with respect to instrument response and radiation detection.

-- Identify the proper radiation instruments that are needed for various uses at accelerator facilities.

-- Identify the performance limitations of various instrumentation at accelerators due to magnetic fields, rf, and high dose rates.

-- Describe proper instrument survey techniques and procedures for accelerator surveys

G. Biological Effects

-- Describe the potential biological effects (specific to accelerator beams) on the human body.

-- Identify symptoms of inadvertent exposure to accelerator beams.

II. PLUTONIUM FACILITIES

A. Properties of Plutonium

-- Explain the basic process of nuclear fission, the relative energy release, and the uses of plutonium (Pu) in weapons, nuclear fuel, and heat sources.

-- Discuss the isotopes of Pu commonly produced, used, or present as by-products at the facility. Describe properties of these isotopes, such as decay

mode(s), fissile or spontaneous fission properties, and alpha decay heat generation.

-- Explain the principle modes of production of Pu at the facility.

-- Identify the oxidation properties of Pu oxides and metal, and the pyrophoric properties of oxides. Be familiar with the engineered controls and safety procedures used to control the combustion of Pu oxides.

-- Identify biological properties of plutonium, including the modes of entry into the body, residence times in the body, distribution of Pu in the body, and relocation and excretion of Pu from the body.

-- Describe the chemical toxicity of Pu, and relate it to the radiological toxicity of Pu. Compare this to the toxicity of uranium and other cancer-promoting agents.

B. External Radiation Control

-- Explain the sources of neutron exposure from Pu materials, and the related neutron dose equivalent rates from kilogram quantities of Pu metal or large oxide arrays. Be familiar with glove-box procedures to reduce neutron exposure when working with Pu.

-- Explain the difference between high- and low-exposure plutonium.

-- Describe various shield types and materials used for reducing gamma and neutron exposure to Pu and byproduct materials (if applicable).

-- Explain other control measures that reduce personnel exposures in the workplace, such as housekeeping, inventory controls, remote handling, occupancy factors, etc.

-- Explain reasons for controlling plutonium dust levels in gloveboxes, on gloves, and in work areas for exposure reduction of the hands and forearms.

-- Describe the importance of the proper location for personnel dosimetry to be worn, how such location is determined, and the proper method of wearing personnel dosimetry.

-- Identify the potential for extremity radiation exposure at plutonium facilities, and the uses of extremity dosimetry. Describe the proper methods of wearing extremity dosimetry.

C. Internal Exposure Control

-- Describe the facility internal dosimetry program components, measurement capabilities, and monitoring frequencies.

-- Explain the difference between prospective and retrospective bioassay monitoring.

-- Describe the limitations of in vivo bioassay monitoring with respect

to plutonium internal depositions.

D. Containment and Glove-Box Operations

-- Identify the special containment devices used for plutonium operations.

-- Describe the proper methods of working in containment and glove-boxes while different Pu materials are present.

-- Describe techniques for changing gloves to prevent the spread of contamination.

-- Describe bag-out techniques and survey methods required during removal of items from cabinets through bag ports.

E. Special Instruments and Measurement Techniques

Describe the proper operation and function of all radiation detection instruments used in detection of Pu materials.

F. Personnel Protection

Explain the functions of special personnel protective equipment used for plutonium handling and remote operations.

G. Inventory Control and Accountability

Discuss the use of the special materials inventory program used at the facility (if applicable), including:

-- Method used for measurement;

-- Accuracy (measurement control);

-- Notification procedures for inventory corrections; and

-- Inventory accountability.

H. Criticality

Discuss criticality events:

-- Identify the indications and alarms associated with a criticality event.

-- Identify the initial protective actions to be taken by radiation protection and affected personnel if a criticality event occurs.

-- Identify basic instrumentation capable of detecting criticality events.

I. Biological Effects

J. Special Radiological Surveys and Techniques

III. TRITIUM FACILITIES

A. Chemical Properties

-- Describe the three common isotopes of hydrogen.

-- Identify the chemical reactions tritium will commonly undergo and the "isotope effects" that occur.

-- Explain the replacement ability of tritium with hydrogen

molecules and the diffusion potential that it has in materials.

-- Identify the chemical similarities of hydrogen, deuterium, and tritium.

B. Physical Properties

-- Describe the diffusion, permeability, and solubility properties of hydrogen in metals, glasses, plastics, etc.

-- Explain the ability of tritium to degrade various materials, such as oils, plastics, and glass.

-- Explain the effect of temperature on the diffusion properties of tritium in materials.

-- Identify the isotopic effects of tritium and how they are controlled.

-- Describe the decay scheme(s) of various tritiated compounds and how certain tritiated gases will build up pressure with nuclear decay.

C. Nuclear Properties

-- Describe the radioactive properties of tritium, including half-life, specific activity, and maximum and average beta emission energies.

-- Describe tritium beta particle ranges in common materials.

-- Demonstrate solution of tritium decay equations for activity determinations and conversion of activity to mass quantities.

D. Biological Effects

-- Describe the range and LET of tritium beta emissions in human tissues, and relate the solubility of tritiated compounds in tissue to this.

-- Describe specific sites of the human body where tritium uptake can occur as well as the methods to reduce or eliminate such exposures.

-- Describe the limiting organs of concern for the tritium compounds normally encountered at the facility, including any solvents, oils, and tritiated surfaces or solids encountered on a routine basis.

-- Describe the pathways into the body of tritiated compounds used in the facility and the metabolic pathways once a tritium intake has occurred, including organically bound portions and relative biological clearance times.

-- Explain the conversion of various tritium radiation exposures (e.g., skin or airborne contamination) to dose equivalent and committed dose equivalent.

-- Identify organically bound tritium compounds formed in the body, including both labile and non-labile organic compounds.

-- Describe how the chemical or isotopic form of tritium compounds can affect their biological or chemical mobility.

-- Contrast the relative biological hazards of tritium gas versus tritiated water or water vapor.

-- Explain any special precautions necessary (e.g., special protective clothing or bioassay frequency) when exposure of the skin to tritium is a potential pathway.

-- Describe areas where secondary containments are used, and the necessary reliability of these containment devices. Identify applications where secondary containment should be considered.

-- Describe the ventilation systems used in containments for control of contamination.

-- Identify uses of purged atmospheres in containments.

-- Describe the special methods necessary for decontamination of skin which has been contaminated with tritium, including tritiated water.

E. ALARA

-- Describe the ALARA program, including application of facility-specific procedures and protocols in meeting ALARA goals.

-- Identify specific uses of pre-job planning and training as effective ALARA tools.

F. Bioassay Program

-- Describe the frequency, type, and limitations of the bioassay program at the facility, including both routine and special types of bioassay sampling (e.g., accident samples, organic tritium sampling).

-- Explain the requirements of DOE Order 5480.11 and the RCM that specify when internal dose evaluation programs are required for radiation workers.

-- Describe the potential for cross-contamination and the method of reporting unusual levels of tritium in urine sampling results.

-- Describe the action levels for bioassay results and the dose commitments that correspond to these levels.

-- Describe different investigation levels (including derived investigation levels) for acute versus chronic tritium intakes.

G. Tritium Releases

-- Identify the potential for release of tritiated compounds from containment devices, and list several common past release incidents.

-- Identify current probabilities of intake for various scenarios of tritium accidental releases to the atmosphere or work area, and the resulting dose assessments of this exposure. (Probability of intake < 10^{-5} of material in process.)

-- Explain immersion in cloud of tritium gas (elemental tritium).

H. Effluent Recovery Systems

-- Explain the liquid effluent control and recovery systems in place for tritium wastes.

-- Describe the tritium monitoring equipment used for control of tritiated effluents, and include alarm levels, calibration and operational checks, and actions taken in case of alarms.

-- Explain gaseous effluent treatment systems.

I. Airborne Tritium Measurement

-- Explain the use of ionization chamber instruments (if applicable) for tritium air monitoring. Include the following characteristics:

- chamber volume and sensitivities
- method of tritium sampling
- converting current to concentration
- calibration procedures
- response times of instruments
- alarm set points (if applicable).

-- Describe the stack monitoring devices in use at the facility, the alarm levels and the methods of sampling.

-- Describe discrete sampling methods for tritium such as liquid-scintillation counting of desiccant-sampling tubes or bubbled samples.

-- Describe the process-monitoring instrumentation used at the facility. Include the following characteristics:

- type of measurement instrument
- detection level
- locations sampled
- alarm levels
- contamination interferences
- calibration procedures.

J. Airborne Tritium Control

-- Explain the facility ventilation systems used for controlling airborne tritium levels.

-- Describe methods of using local ventilation for contamination control during work procedures.

-- Identify the room air exchange rates for the facility.

-- Explain differential room pressure zones used for tritium control, and the techniques used to measure proper flow to zones.

-- Describe any alarms that may be used in conjunction with facility ventilation systems, and identify the proper response to them.

K. Respiratory Protection, Protective Clothing

-- Identify the respirators used at the facility for protection against tritium compounds. Include the following:

- methods of donning / wearing
- protection factors
- limitations (time, chemical depletion, etc.)
- training programs and qualification for use
- special protective devices such as an air-supplied suit or a self-contained breathing apparatus (SCBA).

L.. Inventory Control and Accountability

-- Explain the tritium inventory program used at the facility (if applicable). Include the following:

- method used for measurement
- accuracy (measurement control)
- notification procedures for inventory corrections.
- inventory accountability.

M. Sources of Tritium

IV. URANIUM FACILITIES

A. Properties of Uranium

-- Describe the isotopes of uranium in use at the facility, their natural occurrences, and the general concept of enrichment of uranium.

-- Identify the elements and decay chains of the uranium(^{238}U) and actinium (^{235}U) series and the relative quantities and associated hazards of the decay products at the facility.

-- Identify any transuranic or fission/activation product contamination that may be associated with the uranium process at the facility.

-- Describe the chemical toxicity effects of uranium, and demonstrate the use of formulae to determine the limiting toxicity factor (chemical or radiological).

-- Explain the pyrophoric properties of uranium and engineered controls in use to prevent fires and spontaneous combustion.

-- Identify the chemicals (e.g., HF, HNO_3, H_2) used in uranium processing at the facility and their associated hazards.

B. Special Sampling and Monitoring

-- Describe the various types of air monitoring and sampling that are used to control and measure

airborne radioactivity at the plant.

-- Identify the common types of airborne radioactivity that may occur at the facility and methods to reduce the potential of exposure.

C. External Exposure Control

-- Identify the hazards of beta radiation associated with uranium metal processing and specific methods of beta dose reduction.

-- Explain the limitations of radiation instrument response when dealing with various beta/gamma radiation fields or contaminated areas; demonstrate how to apply instrument corrections based on knowledge of radiation quality.

-- Describe specific uses of beta radiation shielding employed at the facility and the relative shielding ability of various materials used.

-- Describe use of safety glasses for eye protection from beta radiation.

-- Discuss use of heavy leather gloves in reducing extremity exposures.

D. ALARA

-- Review the ALARA concept as it applies to the internal and external radiation hazards of uranium, and cite practical examples of applying it at the facility.

E. Biological Effects

F. Criticality Safety

Discuss criticality events:

-- Identify the indications and alarms associated with a criticality event.

-- Identify the initial protective actions to be taken by radiation protection and affected personnel if a criticality event occurs.

-- Identify basic instrumentation capable of detecting criticality events.

G. Special Instruments and Measurement Techniques

H. Internal Exposure Control

UNITED STATES
DEPARTMENT OF ENERGY

Office of Health Physics and Industrial Hygiene (EH-41, 270 CC/GTN)
Washington DC 20585

REQUEST FOR CHANGES TO IMPLEMENTATION GUIDE ON RADIATION SAFETY TRAINING

(Use Multiple Pages as Necessary)

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Description of Change Request:

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Suggested Specific Word Changes:

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For EH-41 Use Only:
EH-411 Technical Staff Contact: Pete O'Connell, (301) 903-5641
EH-411 Guidance Program Contact: David M. Rohrer, (301) 903-3658