Effective Date: 05/22/06

WP 12-5
Revision 10

Waste Isolation Pilot Plant Radiation Safety Manual

Cognizant Section: Radiation Safety and Emergency Management

Approved by: Don Harward

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS vi

1.0 EXCELLENCE IN RADIOLOGICAL CONTROL 1
1.1 Waste Isolation Pilot Plant Radiation Safety Manual 1
1.1.1 Radiological Control Policy 1
1.1.2 Manual Applicability and Control 2
1.1.3 Compliance 3
1.1.4 WIPP Radiation Safety Manual 3
1.1.5 Application of Provisions 4
1.1.6 Users Groups 4
1.1.7 The "As Low As Reasonably Achievable" Process 4
1.1.8 Integrated Safety Management 4
1.2 Leadership in Radiological Control 6
1.2.1 Senior Management Commitment 6
1.2.2 Worker Attitude 7
1.2.3 Worker Responsibilities 8
1.2.4 Radiation and Risk Communications 8
1.2.5 Conduct of Radiological Operations 8
1.2.6 Improving Worker Awareness of Radiological Conditions 9
1.2.7 Critiques 10
1.2.8 Facility Modifications and Radiological Design Considerations 10
1.3 Improving Radiological Performance 10
1.3.1 Radiological Performance Goals 10
1.3.2 Management of Radiological Control Goals and Performance Indicators 10
1.3.3 Radiological Control Performance Reports 11
1.3.4 Assessments 11
1.3.5 Workplace Awareness 12
1.3.6 Internal Exposures 12
1.3.7 Neutron Exposures 13
1.3.8 ALARA Committee 13
1.4 WTS Radiological Control Organization 13
1.4.1 Radiological Control Organization 13
1.4.2 RS&EM Manager Qualifications 15
1.4.3 Radiological Control Organization Functions and Staffing 15
1.4.4 Relationship Between Radiological Control Technicians and Workers 15
1.4.5 Marginal Radiological Control Performance 15

2.0 RADIOLOGICAL STANDARDS 16
2.1 Administrative Control Levels and Dose Limits 16
2.1.1 Administrative Control Level 16
2.1.2 Lifetime Control Level 16
2.1.3 Occupational Dose Limits 17
2.1.4 Member of the Public Dose Limit 21

2.1.5 Embryo/Fetus Dose Controls 21
2.1.6 Special Control Levels 21
2.2 Contamination Control and Control Levels 22
2.2.1 Personnel Contamination Control 22
2.3 Contamination Control Levels 24
2.3.1 Airborne Radioactivity Control Levels 24
2.3.2 Posting Requirements 24

3.0 CONDUCT OF RADIOLOGICAL WORK 24
3.1 Planning Radiological Work 24
3.1.1 General 24
3.1.2 Planning for Maintenance, Operations, and Modifications 25
3.1.3 Infrequent or First-Time Activities 26
3.1.4 Temporary Shielding 26
3.1.5 Technical Work Documents 26
3.1.6 Control of Internal Exposure 26
3.2 Work Preparation 27
3.2.1 Radiological Work Permits 27
3.2.2 Use of Radiological Work Permits 27
3.2.3 Radiological Work Permit Preparation 27
3.2.4 ALARA Job Reviews and Pre-Job Briefings 28
3.2.5 Use of Personal Protective Equipment and Clothing 28
3.3 Access Control 28
3.4 Contamination Control 29
3.4.1 Controlling the Spread of Contamination 29
3.4.2 Monitoring for Personnel Contamination 29
3.5 Radiological Work Controls 29
3.5.1 Requirements 29
3.5.2 Work Conduct and Practices 29
3.5.3 Logs and Communications 29
3.5.4 Review of Work in Progress 29
3.5.5 Stop Radiological Work Authority 30
3.5.6 Response to Abnormal Situations 30
3.5.7 Controls for Bench Top Work, Laboratory Fume Hoods, Sample Stations, and Glove Boxes 30
3.6 Evaluation of Performance 31
3.6.1 Conduct of Critiques 31
3.6.2 Post-Job ALARA Reviews 32
3.6.3 Lessons Learned 32
3.7 Special Applications 32
3.7.1 Plutonium Operations 32
3.8 Design and Control 33
3.8.1 Radiological Design Criteria 33
3.8.2 Control Procedures 34

4.0 RADIOACTIVE MATERIALS 34
4.1 Radioactive Material Identification, Storage, and Control 34

4.1.1 General . . . 34
4.1.2 Radioactive Material Labeling . . . 35
4.1.3 Radioactive Material Packaging . . . 35
4.1.4 Radioactive Material Storage . . . 36
4.2 Release and Transportation of Radioactive Material . . . 36
4.2.1 Release to Controlled Areas . . . 36
4.2.2 Release to Uncontrolled Areas . . . 36
4.2.3 Transportation of Radioactive Material . . . 37
4.3 Radioactive Source Controls . . . 37
4.4 Solid Radioactive Waste Management . . . 38
4.4.1 Requirements . . . 38
4.4.2 Waste Minimization . . . 38
4.4.3 Mixed Waste . . . 39
4.5 Control of Radioactive Liquids and Airborne Radioactivity . . . 39
4.5.1 Minimization and Control of Radioactive Liquid Wastes . . . 39
4.5.2 Control of Radioactive Drains . . . 39
4.5.3 Control of Airborne Radioactivity . . . 39
4.6 Support Activities . . . 40
4.6.1 Personal Protective Equipment and Protective Clothing . . . 40
4.6.2 Decontamination . . . 40
4.6.3 Vacuum Cleaners and Portable Air-Handling Equipment . . . 41

5.0 RADIOLOGICAL HEALTH SUPPORT OPERATIONS . . . 41
5.1 External Dosimetry . . . 41
5.1.1 Requirements . . . 41
5.1.2 Technical Requirements for External Dosimetry . . . 41
5.1.3 Electronic Dosimeters . . . 42
5.1.4 Personnel Area Monitoring Dosimeters . . . 42
5.1.5 Nuclear Accident Dosimeters . . . 42
5.2 Internal Dosimetry . . . 42
5.2.1 Requirements . . . 42
5.2.2 Technical Requirements for Internal Dosimetry . . . 43
5.2.3 Technical Requirements for Dose Assessment . . . 43
5.3 Respiratory Protection Program . . . 44
5.3.1 Requirements . . . 44
5.3.2 Medical Assessment . . . 45
5.3.3 Use of Respiratory Protection . . . 45
5.3.4 Heat Stress . . . 45
5.4 Handling Radiologically Contaminated Personnel . . . 46
5.4.1 Skin Contamination . . . 46
5.4.2 Contaminated Wounds . . . 46
5.4.3 Handling Individuals Exposed to Airborne Radioactivity . . . 47
5.5 Radiological Monitoring and Surveys . . . 47
5.5.1 Requirements . . . 47
5.5.2 Radiation Exposure Monitoring . . . 48
5.5.3 Area Radiation Monitors . . . 48
5.5.4 Contamination Surveys . . . 48

5.5.5 Airborne Radioactivity Monitoring 48
5.6 Instrumentation and Calibration 49
5.6.1 Standardization 49
5.6.2 Inspection, Calibration, and Performance Tests 49
5.6.3 Maintenance 49
5.6.4 Calibration Facilities 50

6.0 WIPP RADIOLOGICAL SAFETY TRAINING PROGRAM 50
6.1 Changes and Revisions 50
6.2 Organizational Relationships and Responsibilities 50
6.2.1 RS&EM Manager 51
6.2.2 Technical Training Manager 51
6.2.3 Line Managers 51
6.2.4 Radiological Control Manager 52
6.2.5 Radiological Control Technician Superintendent 52
6.2.6 Technical Training Coordination 52
6.2.7 Radiological Control Technician Job Performance Measures Evaluators/On-the-Job Trainers 53
6.2.8 Radiological Control Technicians 53
6.2.9 Radiological Worker II 54
6.2.10 Radiological Worker I 54
6.2.11 Emergency Response Personnel 54
6.2.12 Technical Support Personnel 55
6.2.13 Other Radiological Control Personnel 55
6.2.14 Radiological ALARA Committee Members 55
6.2.15 Radiographers and Radiation-Generating Device Operators . . 56
6.2.16 General Employees 56
6.3 Radiological Safety Training Requirements 56
6.4 General Employee Training 57
6.5 Radiological Orientation for Visitors 57
6.6 Radiological Worker Training 58
6.7 Radiological Worker I 59
6.8 Radiological Worker II 59
6.9 Specialized Radiological Worker Training 59
6.10 Radiological Control Technician Training and Qualification Program Elements 60
6.10.1 Detailed Knowledge 60
6.10.2 Temporary Radiological Control Technician Personnel 61
6.10.3 Emergency Action Training 61
6.10.4 Training Records 61

7.0 RADIOLOGICAL RECORDS 62
7.1 Requirements 62
7.1.1 Purpose 62
7.1.2 Record-Keeping Standards 62
7.2 Employee Records 63
7.2.1 Employment History 63

7.2.2 Personnel Radiological Records 63
7.2.3 Other Personnel Radiological Records 65
7.2.4 Medical Records 66
7.2.5 Radiological Training and Qualification Records 66
7.3 Visitors 67
7.3.1 Record Requirements 67
7.3.2 Reports 68
7.4 Radiological Control Procedures 68
7.4.1 Policies, Procedures and Radiological Work Permits 68
7.4.2 ALARA Program Records 68
7.4.3 Quality Assurance Records 68
7.5 Radiological Monitoring 69
7.5.1 Area Monitoring Records 69
7.5.2 Radiation Monitoring 69
7.5.3 Airborne Radioactivity Monitoring 70
7.5.4 Contamination Monitoring 70
7.5.5 Sealed Radioactive Source Leak Tests and Inventories 71
7.5.6 Personnel Area Monitoring Dosimetry Results 71
7.6 Instrumentation and Calibration Records 71
7.6.1 Calibration and Operational Checks 71
7.6.2 Special Calibration Records 71
7.7 Records Management 72
7.8 Radiological Reporting 72
7.8.1 Reports to Individuals 72
7.8.2 Annual Radiation Report 72

8.0 REFERENCES 72

APPENDIX - GLOSSARY 75

ACRONYMS AND ABBREVIATIONS

ALARA	as low as reasonably achievable
ALI	annual limit on intake
ANSI	American National Standards Institute
ASME	American Standards for Mechanical Engineering
CAM	continuous air monitor
CBFO	Carlsbad Field Office
CEDE	committed effective dose equivalent
CFR	*Code of Federal Regulations*
cm	centimeters
CMRO	central monitoring room operator
DAC	derived air concentration
DOE	U.S. Department of Energy
DOELAP	DOE Laboratory Accreditation Program (for dosimetry)
DOT	U.S. Department of Transportation
dpm	disintegration per minute
GET	General Employee Training
HEPA	high-efficiency particulate air (filter)
ICRP	International Commission on Radiological Protection
ISM	Integrated Safety Management
JPM	job performance measure
JPME	job performance measure evaluator
MP	management policy
mrem	millirem
NCRP	National Council on Radiation Protection and Measurements
NIST	National Institute of Science and Technology
OJT	on-the-job training
ORPS	Occurrence Report and Processing System
PC	protective clothing
PCB	polychlorinated biphenyl
PPE	personal protective equipment
ppm	parts per million
RADCON	Radiological Control
RBA	radiological buffer area
RCM	Radiological Control Manager

RCT	Radiological Control Technician
rem	roentgen equivalent man
RH	remote-handled
RIDS	Records Inventory and Disposition Schedule
RMA	Radioactive Material Area
RPP	radiation protection program
RS&EM	Radiation Safety & Emergency Management
RWP	radiological work permit
TEDE	total effective dose equivalent
TLD	thermoluminescent dosimeter
TRU	transuranic
WH	Waste Handling
WIPP	Waste Isolation Pilot Plant
WTS	Washington TRU Solutions LLC

1.0 EXCELLENCE IN RADIOLOGICAL CONTROL[1]

1.1 Waste Isolation Pilot Plant Radiation Safety Manual

1.1.1 Radiological Control Policy

A key element of the Radiation Protection Guidance to the Federal Agencies for Occupational Exposure, and a fundamental principle underlying this manual, is:

> *There should not be any occupational exposure of workers to ionizing radiation without the expectation of an overall benefit from the activity causing the exposure.*

The Waste Isolation Pilot Plant (WIPP) is firmly committed to having a radiological control program of the highest quality. This applies to those WIPP activities which manage radiation and radioactive materials, and which may potentially result in radiation exposure to workers, the public, and the environment.

It is the policy of Washington TRU Solutions LLC (WTS) to provide a safe environment for its employees, employees of other companies, and the public visiting WIPP.

It is WTS's continuing policy to:

- Provide safe and healthful working conditions by controlling exposure to ionizing radiation and radiological contamination to a level that is as low as reasonably achievable (ALARA).
- Install, maintain, and operate WIPP, within the context of ALARA, in accordance with recognized and accepted radiation safety standards, as applicable to WIPP.
- Comply with all applicable environmental and occupational health and safety regulations, including exposure to ionizing radiation.
- Maintain appropriate records of activities that involve exposure to ionizing radiation and radiological contamination.

The WIPP Radiological Control Policy shown below is intended to guide the actions of every person involved in radiological work throughout the facility.

WIPP RADIOLOGICAL CONTROL POLICY

ALARA

Personnel radiation exposure is to be maintained ALARA.

Radiation exposure of the work force and public is to be controlled such that radiation exposures are well below regulatory limits and there is no radiation exposure without commensurate benefit.

OWNERSHIP

Each person involved in radiological work is expected to demonstrate responsibility and accountability through an informed, disciplined, and cautious attitude toward radiation and radioactivity.

EXCELLENCE

Excellent performance is evident when radiation exposures are maintained well below regulatory limits, contamination is minimal, radioactivity is well controlled, and radiological spills or uncontrolled releases are prevented.

Continuing improvement is essential to excellence in radiological control.

1.1.2 Manual Applicability and Control

| The U.S. Department of Energy (DOE) has established basic standards for occupational radiation protection in Title 10 *Code of Federal Regulations* (CFR) Part 835, "Occupational Radiation Protection." Section 835.101 of 10 CFR Part 835 requires affected DOE activities to be conducted in compliance with a documented radiation protection program (RPP) that addresses each requirement of that regulation. Here at WIPP the RPP is maintained by the Radiation Safety and Emergency Management section. The DOE G 441.1, a series of Guides, provide guidance for developing and implementing an RPP sufficient to ensure compliance with 10 CFR Part 835. DOE-STD-1098-99, *DOE Standard Radiological Control*, is primarily directed toward line managers in meeting their responsibilities for implementing occupational radiation protection programs. The DOE G 441.1, a series of Guides, are primarily directed toward radiological control organization professionals who are responsible for developing programs that will ensure regulatory compliance. The Guides, therefore, tend to provide flexibility for the use of professional judgment and are more technical and general in nature than DOE-STD-1098-99.

The Radiological Control Program discussed in this manual goes beyond the scope of, and includes more details than, the documented RPP required by 10 CFR Part 835. To ensure implementation of a comprehensive and coherent radiological control program

that exceeds basic requirements and provides a substantial safety margin, this manual implements the provisions of DOE-STD-1098-99 to the extent appropriate to facility hazards and operations, consistent with the DOE's Integrated Safety Management (ISM) Program. Should any conflicts arise between this manual and the documented RPP, the requirements of the documented RPP should take precedence. Such conflicts should be resolved expeditiously.

This manual is not a substitute for regulations; it is intended to be consistent with all relevant statutory and regulatory requirements and shall be revised whenever necessary to ensure such consistency.

The Radiation Safety and Emergency Management Manager (RS&EM Manager) shall be the final authority for interpretation of this manual at WIPP.

This manual is a living document. WTS intends to review and update provisions on a periodic basis to incorporate lessons learned and suggestions for improvement. The RS&EM Manager is responsible for this task. Recommendations to correct or improve this manual are encouraged and should be communicated to the radiological control organization.

1.1.3 Compliance

The word "shall" identifies those elements and requirements that WTS considers mandatory. This manual demonstrates compliance with many articles of 10 CFR Part 835. Those requirements are indicated by a parenthetical reference to 10 CFR Part 835 (e.g., [see §835.XXX]).

The word "should" means that the evaluated provision supports compliance with a basic requirement. The use of "should" recognizes that (1) there may be site- or facility-specific attributes that warrant special treatment; (2) the safety benefit derived from implementation of the provision may not in all cases be commensurate with the associated detriments (e.g., financial cost, worker discomfort, schedule impacts); and (3) literal compliance with the provision may not achieve the desired level of radiological control performance.

1.1.4 WIPP Radiation Safety Manual

Management policies, requirements, expectations, and objectives for the site Radiological Control Program should be clearly and unambiguously stated.

All personnel who perform work at WIPP, including subcontractors and DOE employees, shall comply with this manual.

This manual is written, updated, reviewed, and maintained in accordance with applicable WIPP approved procedures.

1.1.5 Application of Provisions

The Radiological Control Program was developed and designed to be commensurate with the existing and potential radiological hazards at the facility.

1.1.6 Users Groups

The radiological control group participates in users groups and currently has membership on the DOE Health Physics Instrument Committee and the Air Monitoring Users Group. As members, personnel attend meetings, present information, exchange ideas, and perform research.

1.1.7 The "As Low As Reasonably Achievable" Process

Title 10 CFR Part 835 requires WIPP to develop and implement plans and measures to maintain occupational radiation exposures ALARA. The ALARA program is developed and implemented in WP 12-2, WIPP ALARA Program Manual (see 10 CFR §835.101 and §835.1001). As applied to occupational radiation exposure, the ALARA process does not require that exposures to radiological hazards be minimized without further consideration, but that such exposures be optimized, taking into account both the benefits arising out of the activity and the detriments arising from the resultant radiation exposures and the controls to be implemented. Further guidance is available in Radiological Control Position Papers.

An effective ALARA process includes effective consideration, planning, and implementation of both physical design features (including engineering controls) and administrative controls to balance the risks of occupational radiation exposure against the benefits arising out of the authorized activity. Lessons learned are documented, institutionalized, and considered in planning and executing subsequent activities to further the goals of the ALARA process and to provide optimal employee protection.

While most or all of the provisions of this manual support the ALARA process, the provisions of Section 3.0 are specifically directed toward the planning and execution of work, physical design features and administrative controls, and efforts to implement work controls commensurate with the radiological hazards.

1.1.8 Integrated Safety Management

The DOE requires its contractors to develop and implement an ISM system that integrates safety (including radiological safety) into management and work practices at all levels (see DOE P 450.4, Safety Management System Policy, and its associated guidance documents). WTS intends for the provisions of this manual to be consistent with, and to complement implementation of, ISM. This manual supports ISM by providing a system of radiological controls that can be implemented on a sitewide basis and tailored to meet WIPP-specific needs. This manual also provides direction for increasing worker involvement in identification and implementation of appropriate

controls. Like the ALARA process, an effective ISM system emphasizes the development and implementation of controls that are commensurate with the hazards associated with any specified activity.

Under ISM, both DOE and WTS line managers are charged with responsibility for integrating safety measures into all facets of work planning and execution. Line managers should use this manual as a guide to integrating radiological control measures into work planning and execution.

This manual supports the ISM guiding principles as follows:

- Line Management Responsibility - This manual clearly indicates that line management is responsible for ensuring adequate implementation of the Radiological Control Program.

- Clear Roles and Responsibilities - This manual establishes clear roles and responsibilities for DOE and WTS line management for the Radiological Control Program.

- Competence Commensurate with Responsibilities - This manual provides requirements for providing classroom and on-the-job training so that individuals may gain and maintain the appropriate competence.

- Identification of Safety Standards and Requirements - This manual provides cross-references to other DOE, federal agency, scientific, and consensus standards that are important to developing and implementing an effective and comprehensive radiological control program.

- Hazard Controls Tailored to Work Being Performed - This manual provides requirements for implementing a program that establishes radiological controls that are commensurate with the hazards and that provides flexibility for consideration of other hazards (e.g., industrial safety, industrial hygiene, environmental hazards).

The concepts of Balanced Priorities and Operations Authorization are outside the scope of this manual.

Both ISM and ALARA processes require hazard controls to be tailored to the work being performed. In addition to establishing basic radiological safety standards that must be observed, 10 CFR Part 835 establishes requirements that provide significant flexibility so that individual activities may implement compliance measures in a manner that is commensurate with specific hazards and work activities.

1.2 Leadership in Radiological Control

Superior, consistent performance is achieved when qualified personnel use approved procedures and management actively monitors the workplace and assesses ongoing activities. Such ongoing activities include, but are not limited to, operations, remediation, laboratory work, research and development, and cleanup. Constant review and informed interest by senior management are required to achieve a superior radiological control program. Management leads by example; what management does speaks louder than what management says. Management at all levels should emphasize the need for high standards for radiological control through direct communication, instruction, and inspection of the work space. The DOE Carlsbad Field Office (CBFO) Manager and the WTS General Manager should have a basic knowledge of radiation and its effects and radiological control requirements, and should also be familiar with the current radiological performance record. Key principles common in a successful, well-managed radiological control program are provided in this section.

1.2.1 Senior Management Commitment

Senior managers should establish high standards for radiological control performance and frequently communicate these standards and management expectations to the work force.

Senior managers should state in writing their firm commitment to a radiological control program of the highest quality. Management commitment and support are demonstrated by allocating sufficient resources, including personnel and training, to ensure that workers are qualified for their assigned duties.

Managers should ensure that orientation, training, and indoctrination reinforce rules and guidelines for each worker to minimize radiation exposure and control radiological conditions.

Managers should hold workers and their supervisors accountable for radiological control performance. Relevant knowledge and performance should be assessed as a specific part of each person's performance evaluation. This assessment should not be limited to those who perform radiological work, since many other workers have an impact on the Radiological Control Program.

Senior managers should solicit feedback from their radiological control professionals, line management, and workers on radiological control performance.

Senior managers should adopt and promote a positive attitude toward radiological control that encourages initiatives to identify concerns at an early stage, to prevent conditions from deteriorating, and to promote doing the right job correctly the first time.

Prevention of the spread of radioactivity is less costly than remediation. Management should be willing to accept changes that will improve radiological control and should foster this mind-set throughout the organization.

The authority and responsibility to establish a comprehensive and effective radiological safety training program should be assigned to line managers and their subordinates. Training, in most cases, should be provided by the WIPP training organization, but the responsibility for quality and effectiveness rests with line management.

Senior managers should be alert to opportunities for minimizing the generation of radioactive waste and discharges to the environment, controlling contamination at its source, and reducing radiation exposure to workers and the public.

Reporting a problem to a superior does not absolve the manager from fixing or mitigating a situation promptly.

1.2.2 Worker Attitude

Control of worker radiation exposure can be achieved only if all individuals involved in radiological activities have an understanding of, and the proper respect for, radiological hazards. Each worker should receive training to assist them in understanding that proper radiological control is an integral part of their daily duties. Employees are responsible for knowing and strictly following the control measures for minimizing radiation exposures applicable to each job. Employees who work in an unsafe manner or violate rules or procedures that could jeopardize their health and safety or the health and safety of others are subject to appropriate disciplinary action.

In addition, employees are trained to immediately notify the Central Monitoring Room Operator (CMRO) of conditions or situations where a loss of radiological control has occurred or is likely to occur. The CMRO then makes the appropriate notifications, including management, and there are immediate actions to correct the situation or place the area in a safe configuration.

The training program should support efforts to improve the attitude of the work force. Training instructors are knowledgeable about the work environment and those aspects of radiological control that are important to developing a better attitude and perspective.

The attitude that constant improvement in radiological work needs to be developed. This includes development and fostering the cooperation between the work force and the radiological control organization. Workers are encouraged not to look upon radiological controls as hurdles or restrictions to be bypassed.

Radiological control personnel are encouraged to be helpful in showing workers how to follow the rules. This spirit of cooperation is developed without subverting the control
| functions of the Radiological Control Technicians (RCTs). A situation in which radiological controls are left solely to the radiological control organization is unacceptable.

To maintain the success and efficiency of the Radiological Control Program, it is imperative that individuals involved with radiological operations accept and exercise their responsibility for knowing and complying with radiological control requirements and good practices established under this program.

1.2.3 Worker Responsibilities

Personnel should receive training to assist them in recognizing that their actions directly affect contamination control, personnel radiation exposure, and the overall radiological environment associated with their work.

1.2.4 Radiation and Risk Communications

Due to the continuing concerns of many people related to low radiation exposure and health impacts, managers should be trained to deal with the perception concerning radiation risks. This training is provided by the Technical Training group. Managers | and supervisors should be sensitive to the fact that workers have to understand the fundamentals of radiation, its risks, and their role in controlling exposure. It is not sufficient to rely solely on regulatory limits for establishing or defining acceptable work practices and work environments. If workers have questions, management is encouraged to utilize the radiological control organization for assistance.

Some individuals, such as those who have had uptakes of radionuclides, may be concerned about future doses. Such instances warrant special attention on the part of the manager. The manager should ensure that adequate and correct information is | given to such individuals regarding personal exposure. Counseling by the RS&EM | Manager with such individuals is the preferred way to consider relevant factors. In some cases, special control levels (Section 2.1.6) should be applied.

1.2.5 Conduct of Radiological Operations

This manual is consistent with the provisions of DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities*. The concepts of all chapters of DOE O 5480.19 apply to the conduct of radiological control activities. All applicable requirements of DOE O 5480.19 are identified and implemented by WIPP approved documents.

Managers whose personnel are involved in radiological work are expected to be involved in the planning, scheduling, and conduct of radiological work. Assurance of adequate radiological safety should not be compromised to achieve production, remediation, or research objectives. The assurance of radiological safety should take precedence over the rate of transuranic (TRU) waste processing for disposal.

| Line managers and supervisors should be technically knowledgeable and inquisitive and should ask questions of the work force concerning radiological work details to verify worker comprehension. They are expected to monitor work and periodically to observe personnel at work and to identify good radiological work practices and radiological

deficiencies and concerns. Frequent inspections and walk-throughs, including off-hours and weekends (where appropriate), are essential to reinforce the conveyance of management expectations to the work force.

| Managers, supervisors, and workers are involved in the development of accurate, clear, written procedures for performing radiological work. If, during the use of procedures, a written requirement cannot be followed responsibly, personnel should be trained to stop work, notify management and get a procedure change. This is accomplished following applicable WIPP approved procedures.

| Managers and supervisors shall encourage the work force to identify radiological control deficiencies and concerns. Prompt action is to be taken to address and eliminate identified issues and prevent recurrence. Training, indoctrination, and procedure review are useful in addressing these issues.

| Managers and supervisors should establish working conditions that encourage improved radiological control. This includes temperature, humidity, and lighting, as well as the more difficult considerations of accessibility. Work conditions should be considered in planning work.

Cleanliness and good housekeeping are essential. A good radiological control program cannot exist in a sloppy, dirty workplace. Cleaning up after operations should be automatic for each person. It is not reasonable to expect radiological control to be separated from the work environment; they go together.

Subcontractors and subcontracted employees are treated the same as facility staff in the area of radiological matters, shall have comparable radiation safety training (see 10 CFR §835.901), and are expected to meet the same requirements and expectations.

1.2.6 Improving Worker Awareness of Radiological Conditions

In performing assigned duties within radiological areas, workers should be familiar with the area radiological conditions and be aware of the possibility that unforseen changes may occur. Although the conduct of radiological surveys is viewed as a traditional role of RCTs, experience has shown that properly trained and qualified workers are capable of performing supplemental surveys in the course of work. This process results in exposure savings and improved contamination control.

Specific examples of surveys that may be effectively performed by workers and result in exposure reductions include self-monitoring of dose rates during High-Radiation Area entries. The performance of legal record surveys, such as release surveys, shall remain the responsibility of the radiological control organization.

1.2.7 Critiques

It is WTS's desire and expectation, based on concern for the safety and well-being of workers and the general public, that radiological work practices are continually scrutinized and questioned so that opportunities for improvement can be identified, assessed, and applied. This scrutiny and questioning of the Radiological Control Program should be conducted constructively so that the site benefits as a whole. Radiological controls should not be viewed as "road blocks" to productivity, but rather as enhancements to overall effectiveness.

A formal critique process should be established to obtain pertinent facts following an unusual radiological situation or at the satisfactory conclusion of a new or unusual operation involving radiological controls. This process complements the Occurrence Reporting and Processing System (ORPS).

Work force participation should be encouraged. Critiques are a management tool and should not be used to fix blame.

1.2.8 Facility Modifications and Radiological Design Considerations

Radiological control performance is affected by human performance and engineered design features. This manual primarily addresses the way individuals operate the existing WIPP facility. General design criteria for new facilities and major modifications to existing facilities are provided in 10 CFR Part 835 and DOE O 420.1A, *Facility Safety*. During the design of new facilities or modifications of existing facilities, the design, or modification and selection, of material shall include features that facilitate operations, maintenance, decontamination, and decommissioning (see §835.1002[d]). Additional design criteria are provided in Section 3.8.1. Facility modification radiological/ALARA design reviews are conducted in accordance with WP 12-2.

1.3 Improving Radiological Performance

1.3.1 Radiological Performance Goals

| Goals are intended as a measure of, and a motivation for, improvement, not an end in themselves. Goals are not to be viewed narrowly as numerical values, but as tools to assist management in focusing their priorities and attention. Radiological performance goals are developed and approved by the ALARA committee as ALARA goals.

1.3.2 Management of Radiological Control Goals and Performance Indicators

The performance indicators are developed by the ALARA Committee and should be measurable, achievable, auditable, challenging, and meaningful in promoting improvement. The tracking and measuring of ALARA Program performance is detailed in WP 12-2.

1.3.3 Radiological Control Performance Reports

The results of the radiological ALARA performance indicators are provided in the Annual ALARA Report. The information is also provided to the Quality Assurance Department for their periodic WTS Performance Assessment Reports.

1.3.4 Assessments

"Assessment," as used in this manual, refers to the process of providing independent feedback to senior line managers to indicate the adequacy of the Radiological Control Program.

Inspections, audits, reviews, investigations, and self-assessments are part of the numerous checks and balances needed in a good radiological control program. Internal audits of the WIPP Radiological Control Program shall be conducted such that, over a 36-month period, all functional elements are assessed (see §835.102). The audit period may be extended 30 days to accommodate scheduling needs (see §835.3[e]). The audits should address program performance, applicability, content, and implementation. These should be performed by the Quality Assurance Department, or other organizations having requisite knowledge to adequately assess radiological control activities.

Identification of the functional elements of the program depends upon many site- or facility-specific factors. Based upon the contents of 10 CFR Part 835, the following functional elements should be considered for inclusion in the assessment program:

- Personnel dosimetry and dose assessment
- Portable and fixed instrumentation
- Contamination control
- Radiological monitoring (area and item monitoring)
- ALARA program
- Accident and emergency dose controls
- Radioactive material control, including sealed radioactive source control and material release
- Entry controls
- Training
- Posting and labeling

- Records and reports
- Radiological design and administrative controls

1.3.5 Workplace Awareness

Management initiatives to facilitate the expression of concerns on the part of the work force, to address such concerns, and to solve them are strongly encouraged to ensure the proper respect for, and understanding of, radiation.

This process is conducted through applicable WIPP approved procedures. Radiological Control Program deficiencies, such as procedure violations, are reported by the RS&EM Manager on a WIPP Form, which is managed by the quality assurance process.

1.3.6 Internal Exposures

Control and prevention of internal exposure, particularly from long-lived radionuclides in the workplace, present special challenges to WIPP's Radiological Control Program and warrant particular attention. Factors requiring management attention include the following:

- Workers may be exposed to unanticipated levels of elevated airborne radioactivity. The time required to collect representative airborne radioactivity samples and to determine the airborne concentration of radionuclides may contribute to worker intakes of radioactivity.
- If controls fail, uptakes of radionuclides can occur in a short time.
- The continued exposure of workers to airborne radioactivity over extended periods of time can create worker concerns.
- Doses from some internal radionuclides are difficult to measure. Although some radionuclides, such as cesium and tritium, can be readily measured at levels that produce only a few millirem (mrem), some long-lived radionuclides, like plutonium, require years for accurate measurements of hundreds of mrem.
- Medical intervention, such as the administration of blocking and chelating agents, to mitigate internal deposition may add risks by introducing additional chemicals into the body.
- Sampling of body excretions and whole-body or organ-counting techniques encourage worker perceptions of internal exposure significance.

- Administration of internal dose assessment is costly in dollars and worker time. Control and analysis of samples are also more complicated and time-consuming than the elements of external dosimetry.

- Use of respiratory protection devices imposes additional physical stresses upon participating workers.

The hierarchy of controls required to control internal exposures is provided in Section 3.1.6.

1.3.7 Neutron Exposures

Neutron exposures have the following characteristics that require attention:

- The specific biological effects of neutrons are not as well understood as the effects of gamma exposure.

- Neutron dose equivalent is more difficult to assess than gamma dose equivalent.

1.3.8 ALARA Committee

The ALARA process of managing radiation exposures is a fundamental requirement of every radiological control program. An ALARA committee provides a useful forum for reviewing radiological control plans and performance and focusing management resources on radiological control issues.

An ALARA committee has been established at WIPP and should be maintained. The WIPP ALARA Committee membership should include managers and workers from the line, the technical support organization, and the radiological control organization.

The WIPP ALARA Committee should make recommendations to management to improve progress toward minimizing radiation exposure and radiological releases. The committee should evaluate items such as construction and design of facilities and systems, planned major modifications or work activities, and experimental test plans for exposure, waste, and release controls.

The responsibilities of the WTS ALARA Committee are described in WP 12-2.

1.4 WTS Radiological Control Organization

1.4.1 Radiological Control Organization

Radiological control personnel shall monitor adherence to this manual and be available to the facility line manager for radiological support to the work force. To function

effectively in this capacity, they should receive their day-to-day priorities from facility managers.

The RS&EM Manager heads the radiation safety organization and is responsible for, and should establish, a high-quality radiological control program. The Radiological Engineers and dosimetry staff report directly to the RS&EM Manager within the Safety and Health Department. The Radiological Control Manager, RCTs, RCT Superintendent, and RCT Engineer report through the Operations Department. See Figure 1-1 for a visual representation of the WTS radiological control organizational relationship.

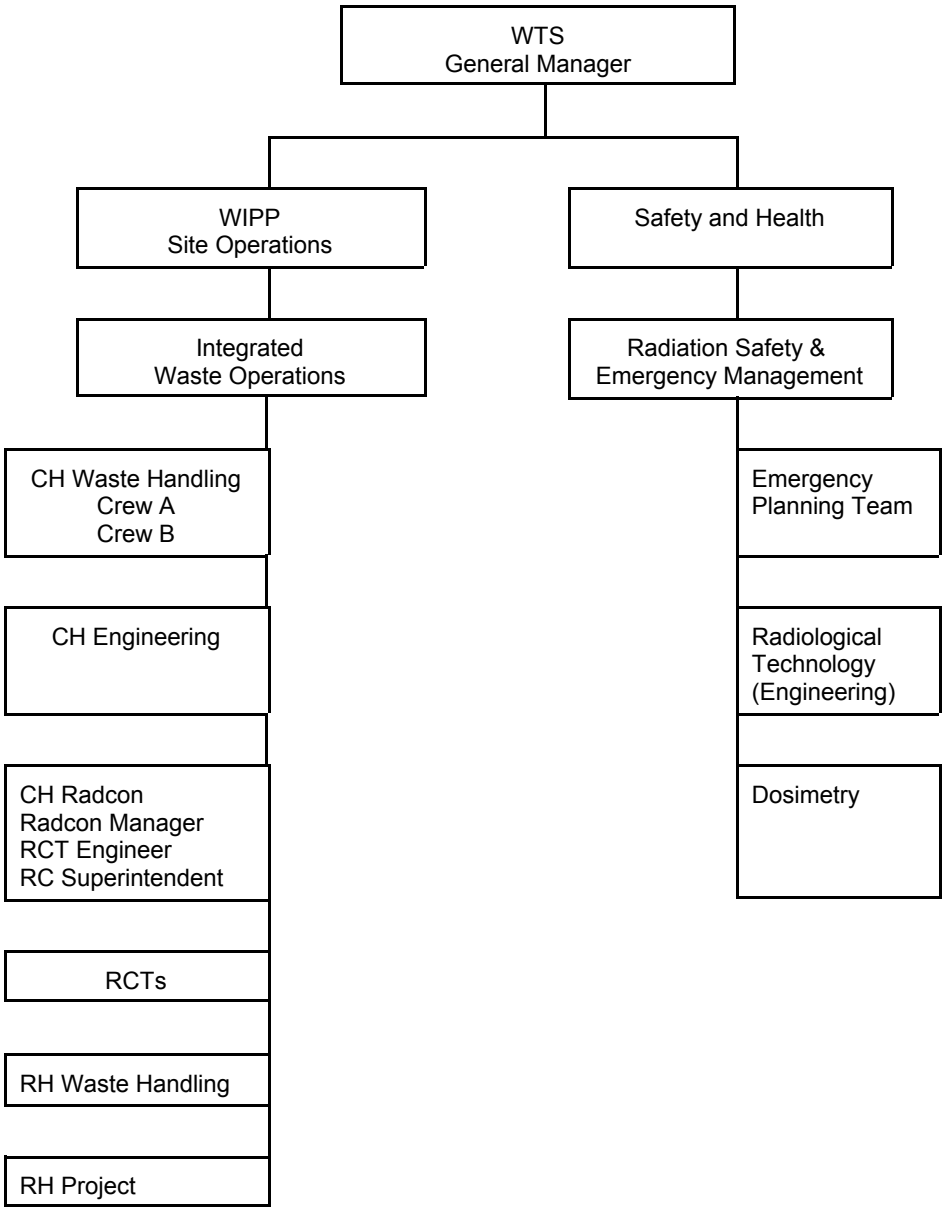

Figure 1-1, WTS Radiological Control Organizational Relationship

1.4.2 RS&EM Manager Qualifications

The RS&EM Manager should be an experienced radiological control professional and should be familiar with the design features and operations of WIPP that effect radiological hazards. The RS&EM Manager should have the technical competence and experience to establish radiological control programs and the supervisory capability to direct the implementation and maintenance of radiological control programs.

The RS&EM Manager should have a minimum of a bachelor's degree or the equivalent in science or engineering, including some formal training in radiological control. Certification by the American Board of Health Physics provides equivalency to the above. The RS&EM Manager should have at least three years of professional experience in applied radiological control work. Advanced academic degrees can count as one year of experience where course work related to radiological control is involved.

1.4.3 Radiological Control Organization Functions and Staffing

Radiological support personnel provide radiological control and radiological engineering, dosimetry, bioassay, independent oversight, instrumentation, and calibration functions. Training and education provisions for these individuals are established in Section 6.2.12.

1.4.4 Relationship Between Radiological Control Technicians and Workers

Radiological control technicians and their managers/superintendents perform the functions of assisting and guiding workers in the radiological aspects of the job. During Radiological Worker training a goal is to have personnel recognize questionable or deteriorating radiological conditions and seek advice from RCTs and their managers/ superintendents.

All workers at WIPP have the responsibility and authority to stop work.

The actions or presence of radiological control personnel does not absolve the workers of their responsibility for properly conducting radiological aspects of the job.

1.4.5 Marginal Radiological Control Performance

When radiological control performance is less than adequate, consideration should be given to strengthening line management and the radiological control organization to provide adequate radiological control.

If the work force does not have the required level of sensitivity for radiological work practices, additional management attention is needed to assure the proper outcome. Line management should be held accountable for implementation of the Radiological Control Program. Corrective actions that should be considered include:

- More direct line management in the workplace
- Curtailment of work schedules
- Deferral of work
- Addition of extra radiological control personnel
- Conduct of additional training

When the workers and supervisors achieve the proper level of radiological performance, the ongoing need for the corrective actions instituted above should be reevaluated.

2.0 RADIOLOGICAL STANDARDS

2.1 Administrative Control Levels and Dose Limits

To accomplish WIPP's objective of maintaining individual doses well below regulatory limits, challenging numerical administrative control levels should be established below the regulatory limits to administratively control and help reduce individual and collective radiation dose. These control levels should be multitiered, with increasing levels of authority required to approve higher administrative control levels.

Unless otherwise indicated, administrative, lifetime, and special control levels and dose limits are stated in terms of the sum of the doses received from internal and external sources.

2.1.1 Administrative Control Level

A DOE administrative control level of 2,000 mrem per year per person is established for all DOE activities (see Table 2-1). Approval by the appropriate Secretarial Officer or designee shall be required prior to allowing a person to exceed 2,000 mrem in a year.

An annual facility administrative control level of 1,000 mrem is established at WIPP. Other administrative control levels are defined in Table 2-1.

No individual shall be allowed to exceed the WIPP administrative control levels without
| prior written approval of the RS&EM Manager and the WTS General Manager.
Requests to exceed administrative control levels should be initiated by the affected employee's immediate supervisor in the form of a memorandum. The memorandum should state the individual's name, social security number, up-to-date accumulated thermoluminescent dosimeter (TLD) dose, estimated dose of the concerned exposure period, and justifications for the request. The memorandum should be submitted to the
| RS&EM Manager and the WTS General Manager for approval.

2.1.2 Lifetime Control Level

Efforts are made to control each individual's lifetime occupational dose below a lifetime control level of N roentgen equivalent man (rem) where N is the age of the individual in

| years. Section 2.1.6 discusses special control levels for radiological workers who may
| have lifetime doses exceeding N rem.

To ensure compliance with the lifetime control level, efforts should be made to determine the lifetime occupational dose of individuals expected to receive more than one rem in a year. The lifetime occupational dose is determined by summing all occupational internal and external doses received during the individual's lifetime.

The internal contribution to the lifetime occupational dose from intakes prior to January 1, 1989, may be calculated in terms of either cumulative annual effective dose equivalent or committed effective dose equivalent. The committed effective dose equivalent should be used to the extent that adequate data are available to calculate doses in these terms.

2.1.3 Occupational Dose Limits

Occupational dose limits from 10 CFR Part 835 are provided in Table 2-1 and shall not be exceeded (see §835.202[a][1]-[4]). All occupational dose received during the current year, except the dose resulting from planned special exposures and emergency exposures, shall be included when demonstrating compliance with Table 2-1 limits (see §835.202[b] and 702[d]). If formal records of an individual's prior occupational dose during the year cannot be obtained, a written estimate signed by the individual may be accepted (see §835.702[d]).

If personnel receive a dose over the limits stated in 10 CFR §835.202, except in accordance with 10 CFR §835.204, the DOE field organization shall be notified once the conditions under which the dose was received have been corrected (see §835.1301[c]). Operations will resume in the area only after DOE approval is received (see §835.1301[d]).

Emergency exposure limits are not planned special exposure limits. In extremely rare cases, emergency exposure to radiation may be necessary to rescue personnel or to protect major property. Emergency exposures may be authorized in accordance with the provisions contained in 10 CFR Part 835. These doses are in addition to, and accounted for separately from, the doses received under the limits in Table 2-1. The dose limits for personnel performing these operations are listed below. Guidelines for emergency exposures are provided in Table 2-4. Persons receiving emergency exposures must be Radiological Worker I trained, or equivalent, and must receive a briefing on the known or anticipated hazards, before the exposure (see §835.1302[d]).

The occupational dose limits provided in Table 2-1 apply to all general employees. However, general employees who have not completed at least Radiological Worker-I training are not permitted unescorted access to any radiological area (see §835.901[b]), Radioactive Material Area (RMA), or Radiological Buffer Area (RBA).

Table 2-1. Summary of Occupational Dose Limits and DOE and WIPP Administrative Control Levels

Type of Exposure	Occupational Dose Limit	DOE Admin Control Level	WIPP Admin Control Level
General Employee: Whole Body (internal + external) (TEDE) (see §835.202[a][1]) (see also DOE/WIPP-95-2065, 7.1.4.1.1)[3]	5 rem/year	2 rem/year	1 rem/year
General Employee: Lens of the Eye (external) (see §835.202[a][3])[4]	15 rem/year	N/A	3 rem/year
General Employee: Skin and extremities (external shallow dose) (see §835.202[a][4])[5]	50 rem/year	N/A	10 rem/year
General Employee: Any organ or tissue (other than lens of eye) (internal + external) (see §835.202[a][2])[1]	50 rem/year	N/A	10 rem/year
Declared Pregnant Worker: Embryo/Fetus (internal + external) (see §835.206[a])	0.5 rem/gestation period	N/A	N/A
Minors: Whole body (internal + external) (TEDE) (see §835.207)[3]	0.1 rem/year	N/A	N/A
Minors: Lens of the eye, skin, and extremities (see §835.207)[4]	10% of General Employee limits	N/A	N/A

Notes:

1. The annual limit of dose to "any organ or tissue" is based on the committed dose equivalent to that organ or tissue resulting from internally deposited radionuclides over a 50-year period after intake plus any deep dose equivalent to that organ from external exposures during the year (see §835.202[a][2]).

2. Exposures due to background radiation, as a patient undergoing therapeutic and diagnostic medical procedures, and participation as a subject in medical research programs shall not be included in either personnel radiation dose records or assessment of dose against the limits in this table (see §835.202[c]).

3. Whole body dose total effective dose equivalent (TEDE) = effective dose equivalent from external exposures + committed effective dose equivalent from internal exposures (see §835.2[a]).

4. Lens of the eye dose equivalent = dose equivalent from external exposure determined at a tissue depth of 0.3 cm (centimeters) (see §835.2[a]).

5. Shallow dose equivalent = dose equivalent from external exposure determined at a tissue depth of 0.007 cm (see §835.2[a]).

Table 2-2. Weighting Factors for Organs and Tissues

Organs or Tissues	Weighting Factor
Gonads	0.25
Breasts	0.15
Red bone marrow	0.12
Lungs	0.12
Thyroid	0.03
Bone surfaces	0.03
Remainder	0.30
Whole Body	1.00

Notes: Weighting factors as defined in International Commission on Radiological Protection (ICRP) Publication 26, "Recommendations of the International Commission on Radiological Protection," and National Council on Radiation Protection and Measurements (NCRP) Report 91, "Recommendations on Limits for Exposure to Ionizing Radiation," are used to convert organ or tissue dose equivalent to effective dose equivalent for the whole body. The effective dose equivalent is obtained by multiplying the organ dose by the weighting factor. For example, a 5 rem dose to the thyroid would be multiplied by the weighting factor 0.03 to yield a contribution of 0.15 rem to the total effective dose equivalent.

"Remainder" means the five other organs or tissues with the highest dose (e.g., liver, kidney, spleen, thymus, adrenal, pancreas, stomach, small intestine and upper large intestine). The weighting factor of 0.3 results from 0.06 for each of the five remainder organs (see §835.2[b], Weighting factor, Note 1).

For the case of uniform external irradiation of the whole body, a weighting factor equal to 1 may be used in the determination of the effective dose equivalent (see §835.2[b], Weighting factor, Note 2).

Nonuniform exposures of the skin from X-rays, beta radiation, and radioactive materials on the skin, including hot particles, shall be assessed and recorded as specified in the table below:

Table 2-3. Nonuniform Exposure of the Skin[1]

Area of Skin Irradiated	Method of Averaging, Adding to Other Doses Received, and Recording Nonuniform Skin Dose
$\geq$ 100 cm^2 (see §835.205[b][1])	• Averaged over the 100 cm^2 of skin receiving the maximum dose • Added to any uniform dose equivalent also received by the skin • Recorded as the annual extremity or skin (shallow) dose equivalent (H)
$\geq$ 10 cm^2 and < 100 cm^2 (see §835.205[b][2])	• Averaged over the 1 cm^2 of skin receiving the maximum dose (D), reduced by the fraction (f), which is the irradiated area in cm^2 divided by 100 cm^2 (i.e., H=fD); however, f $\geq$ 0.1 • Added to any uniform dose equivalent also received by the skin recorded as the annual extremity or skin (shallow) dose equivalent
< 10 cm^2 (see §835.205[b][3])	• Averaged over the 1 cm^2 of skin receiving the maximum dose • Not added to any other dose equivalent, extremity, or (skin) shallow dose equivalent recorded for the annual dose equivalent • Recorded in a person's radiation dose record as a special entry[1]

[1] Recording of shallow dose equivalents resulting from nonuniform exposure of the skin is not required if the resulting dose is less than 1 rem (see §835.702[b]).

Table 2-4. Guidelines for Control of Emergency Exposures

DOSE LIMIT (Total Effective Dose Equivalent)	ACTIVITY PERFORMED	CONDITIONS
5 rem	All	None
10 rem	Protecting major property	Only on a voluntary basis where lower dose limit not practicable
25 rem	Lifesaving or protection of large populations	Only on a voluntary basis where lower dose limit not practicable
>25 rem*	Lifesaving or protection of large populations	Only on a voluntary basis to personnel fully aware of the risks involved

* In this situation, the dose limit shall not exceed 100 rem.

Notes: The lens of the eye dose limit is three times the listed values.

The shallow dose limit to the skin of the whole body or the extremities is ten times the listed values.

2.1.4 Member of the Public Dose Limit

Members of the public permitted access to the Controlled Areas with an escort at WIPP shall be limited to an annual radiation dose of 100 mrem from the sum of doses received from internal and external radiation sources (see §835.208).

2.1.5 Embryo/Fetus Dose Controls

After a female radiological worker voluntarily notifies her manager in writing that she is pregnant, for the purposes of fetal/embryo dose protection, she is considered a declared pregnant radiological worker. This declaration may be revoked, in writing, at any time by the declared pregnant radiological worker (see §835.2[a], Declared Pregnant Worker).

WTS shall provide the option of a mutually agreeable assignment of work tasks, without loss of pay or promotional opportunity, such that further occupational radiation exposure is unlikely.

For a declared pregnant worker who chooses to continue work involving occupational exposure:

- The dose limit for the embryo/fetus from conception to birth (entire gestation period) as a result of the occupational exposure of the declared pregnant worker is 500 mrem (see §835.206[a]). The dose to the embryo/fetus is equal to the sum of doses received from external sources, sources inside the mother, and sources inside the embryo/fetus.

- Measures shall be taken to avoid substantial variation above the uniform exposure rate necessary to meet the 500 mrem limit for the gestation period (see §835.206[b]). Efforts should be made to avoid exceeding 50 mrem per quarter to the pregnant radiological worker.

If the dose to the embryo/fetus is determined to have already exceeded 500 mrem when a worker declares her pregnancy, the worker shall not be assigned to tasks where additional occupational radiation exposure is likely during the remainder of the gestation period.

WIPP declared pregnant radiological worker policy is described in, and implemented by, approved WIPP documents (see §835.206[c]).

2.1.6 Special Control Levels

Certain situations require lower individualized exposure control levels as recommended by the RS&EM Manager and medical officials. The RS&EM Manager should obtain advice from other managers and professionals in other disciplines such as human

| resources and legal in establishing special control levels. The RS&EM Manager may wish to establish these special control levels using a radiological health advisory group.

A special control level for annual occupational exposure is established for each radiological worker with a lifetime occupational dose exceeding N rem, where N is the age of the individual in years. The special control level allows the individual's lifetime occupational dose to approach and, if practicable, fall below N rem during ensuing years as additional occupational exposure is received.

WIPP has special control levels for an individual that is undergoing radiation therapy. Radiological workers expecting or who have received radiopharmaceutical treatment are requested to notify the Radiological Control Manager and dosimetry group as required by WIPP procedure.

Special control levels on an individual dose should not be implemented in a manner that interferes with that individual's right to work. If reasonable efforts to implement the
| special control level below WIPP's administrative control level per year threatens to
| restrict the individual's right to work or are otherwise unsuccessful, the RS&EM
| Manager and the WTS General Manager will authorize any doses in excess of the special control level, but not exceed regulatory dose limits.

2.2 Contamination Control and Control Levels

Control of radioactive contamination is achieved by using engineering controls and worker performance to contain contamination at the source, reducing existing areas of contamination, and promptly decontaminating areas that become contaminated. A summary of contamination values is shown on Table 2.5.

2.2.1 Personnel Contamination Control

Section 3.4.2 provides personnel contamination monitoring requirements and guidance. This guidance is not relevant to individuals exiting areas containing only radionuclides, such as tritium, that cannot be detected using hand-held or automatic frisking equipment.

Personnel found with detectable contamination on their skin or personal clothing, other than natural background radioactivity, should be decontaminated promptly as possible, using techniques described in applicable WIPP controlled procedures.

Table 2-5. Summary of Contamination Values

Radionuclide (See Note 1)	Removable (Dpm/100 Cm^2) (See Note 2)	Total (Fixed + Removable) (Dpm/100 Cm^2) (See Note 3)
U-natural, U-235, U-238, and associated decay products	1,000 alpha	5,000 alpha
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-135, I-129	20	100[8]
Th-nat, Th-232, Sr-90[6], Ra-223, Ra-224, U-232, I-126, I-131, I-133	200	1,000
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above[4]. Includes mixed fission products containing Sr-90[7].	1,000 beta-gamma	5,000 beta-gamma
Tritium and tritiated compounds[5]	10,000	N/A

Notes:

1. Except as noted in footnote 5 below, the values in this table apply to radioactive contamination deposited on, but not incorporated into, the interior of the contaminated item. Where contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for the alpha- and beta-gamma-emitting nuclides apply independently (see 10 CFR Part 835, App. D, note 1).

2. The amount of removable radioactive material per 100 cm^2 of surface area should be determined by swiping the area with dry filter or soft absorbent paper while applying moderate pressure and then assessing the amount of radioactive material on the swipe with an appropriate instrument of known efficiency. (Note: the use of dry material may not be appropriate for tritium). For objects with a surface area less than 100 cm^2, the entire surface should be swiped, and the activity per unit area should be based on the actual surface area. It is not necessary to use swiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual contamination levels are below the values for removable contamination (see 10 CFR Part 835, App. D, note 4).

3. The levels may be averaged over 1 square meter provided that the maximum activity in any area of 100 cm^2 is less than three times the values in this table (see 10 CFR Part 835, App. D, note 3).

4. This category of radionuclides includes mixed fission products, including the Sr-90 which is present in them. It does not apply to Sr-90 that has been separated from the other fission products or mixtures where the Sr-90 has been enriched (see 10 CFR Part 835, App. D, note 5).

5. Tritium contamination may diffuse into the volume of matrix of materials. Evaluation of surface contamination shall consider the extent to which such contamination may migrate to the surface in order to ensure the surface radioactivity value provided in this table is not exceeded. Once this contamination migrates to the surface, it may be removable, not fixed; therefore, a "Total" value does not apply (see 10 CFR Part 835, App. D, note 6).

6. These values should be applied to total Sr-90/Y-90 activity resulting from processes involving the separation or purification of Sr-90.

7. These values should be applied to total Sr-90/Y-90 activity resulting from the presence of Sr-90 in mixed fission products.

8. Value taken from DOE memorandum from Raymond F. Pelletier on Application of DOE O 5400.5 requirements for release and control of property containing residual radioactive material.

2.3 Contamination Control Levels

A surface is considered contaminated if either the removable or total surface contamination is detected above the levels in Table 2-5. Controls shall be implemented for these surfaces commensurate with the nature of the contaminant and level of contamination (see §835.1102[b]). Appropriate postings and controls are established in applicable WIPP approved procedures.

Surfaces exceeding the values of Table 2-5 for total contamination may be covered with a fixative coating to prevent the spread of contamination. However, reasonable efforts should be made to decontaminate an area before a coating is applied. A fixative coating should not be applied without the approval of the RS&EM Manager.

2.3.1 Airborne Radioactivity Control Levels

Use of engineering and administrative controls to reduce the potential for internal exposure should be evaluated before allowing individuals, with or without respiratory protection, to enter areas with airborne radioactivity.

Occupied areas with airborne concentrations of radioactivity that are greater than or potentially greater than 30 percent of a derived air concentration (DAC) shall be posted as specified in applicable WIPP approved procedures. For most radionuclides, air containing 30 percent of a DAC results in a CEDE (committed effective dose equivalent) of approximately 30 mrem if inhaled continuously for one working week without respiratory protection. Values of DACs are provided in 10 CFR Part 835.

2.3.2 Posting Requirements

Radiological postings are intended to alert individuals to the presence of radiation and radioactive materials and to aid them in controlling exposures and preventing the spread of contamination.

3.0 CONDUCT OF RADIOLOGICAL WORK

3.1 Planning Radiological Work

3.1.1 General

DOE regulations for occupational radiation protection require written authorization to control access to and work in radiological areas (see §835.501[d]). The level of detail included in such authorizations is dependent upon facility hazards and the nature of the work force. Technical requirements for the conduct of work, including construction, modifications, operations, maintenance, and decommissioning, should incorporate radiological criteria to ensure safety and maintain radiation exposures ALARA. In general, efforts to reduce individual dose should not be allowed to cause a concurrent increase in collective dose.

The primary methods used to maintain exposures ALARA shall be facility and equipment design features (see §835.1001[a]). Performance of certain activities, such as maintenance and modifications, may render permanently installed physical design features inadequate. In such instances, a special subset of design features, often referred to as engineering controls (e.g., temporary shielding, containment devices, and filtered ventilation systems) should be used, as appropriate, to control individual exposures. Design criteria are discussed in Section 3.8 of this manual.

When physical design features, including engineering controls, are impractical or inadequate, they shall be augmented by administrative controls (see §835.1001[a] and [b]). To accomplish this, the design and planning processes should incorporate radiological considerations in the early planning stages.

To ensure adequate protection of the work force, planning for radiological work should also include consideration of all other workplace hazards (e.g., industrial hygiene and safety, fire safety, electrical safety), consistent with the principles of ISM as discussed in Section 1.1.8.

3.1.2 Planning for Maintenance, Operations, and Modifications

For routine tasks, such as surveillance, tours, and minor nonradiological maintenance, performance of the review and documentation of identified radiological protection requirements may be conducted as part of the radiological work permit (RWP) process (see Section 3.2.1).

Trigger levels for WIPP activities that require formal radiological review are detailed in WP 12-2.

Radiological control requirements identified as part of the above formal radiological optimization techniques, such as cost-benefit analyses, represent a fundamental part of design analysis and work review. For review of minor work activities with low associated doses, a cost-benefit evaluation is an intrinsic part of the engineering review process and a detailed evaluation is not necessary. For review and planning of major tasks involving higher collective dose expenditures, a detailed and documented evaluation should be performed.

The above radiological review should be conducted by the WIPP Radiological ALARA Committee as prescribed by WP 12-2.

The radiological control organization may impose radiological requirements, in addition to those contained in WP 12-2, when such additional requirements are necessary to ensure the safety of employees, visitors, or members of the general public, or to protect the environment or facility.

3.1.3 Infrequent or First-Time Activities

Infrequent or first-time activities receive an ALARA review as directed by WP 12-2.

3.1.4 Temporary Shielding

The installation, use, and removal of temporary shielding are controlled by applicable WIPP approved procedures. The procedure provides for determining the appropriate amount of shielding, labeling, evaluation of additional weight of the shielding, periodic evaluation inspection, and survey of the shielding.

3.1.5 Technical Work Documents

Technical work documents, such as procedures, work packages, or job or research plans, are used to control hands-on work with radioactive materials. Technical work documents are not required for incidental or routine work activities that involve a low potential of worker exposure or workplace contamination.

Technical work documents used to control radiological work activities should be reviewed and approved by the radiological control organization, preferably the RCT Superintendent, or a Radiological Engineer. This review will determine whether an RWP is needed.

Review of technical work documents should also ensure that the appropriate radiological cautionary steps are incorporated into technical work documents. There are two types of radiological cautionary steps: radiological control (RADCON) hold point and RADCON action step. These are further defined in WP 10-2, Maintenance Operations Instruction Manual.

3.1.6 Control of Internal Exposure

The primary methods used to maintain individual internal doses ALARA shall be physical design features, such as confinement, ventilation, and remote handling (see §835.1001[a]). The design objective shall be under normal conditions, to avoid releases of radioactive material to the workplace atmosphere. The objective, under all conditions, shall be to control inhalation of radioactive material to levels that are ALARA (see §835.1002[c]).

Administrative controls, including access restrictions and the use of specific work practices designed to control airborne radioactivity, shall be used as the secondary method to maintain internal doses ALARA (see §835.1001[b]).

When engineering and administrative controls have been applied and the potential for airborne radioactivity still exists, respiratory protection should be used to limit internal exposures.

The selection of respiratory protection equipment should include consideration of worker safety, comfort, and efficiency. The use of positive pressure respiratory protection devices are recommended wherever practicable to alleviate fatigue and increase comfort.

The following controls are applicable to activities authorized in accordance with the above:

- Stay time controls to limit intake should be established for the entry.
- Evaluation of workplace airborne radioactivity levels should be provided through the use of continuous air monitors (CAMs) or air samplers with expedited assessment and analysis results.

3.2 Work Preparation

3.2.1 Radiological Work Permits

The RWP is an administrative mechanism used to establish radiological controls for intended work activities. The RWP informs workers of area radiological conditions and entry requirements and provides a mechanism to relate worker exposure to specific work activities. RWPs are written and used in accordance with applicable WIPP approved procedures.

3.2.2 Use of Radiological Work Permits

General RWPs are used for entry and repetitive work in areas with known and stable low-hazard radiological conditions. General RWPs may be used to control routine or repetitive activities, such as tours and inspections or minor work activities, in areas with well-characterized and stable radiological conditions. General RWPs should not be approved for periods longer than one year.

Job-specific RWPs are used for more complex work and for entry into higher hazard areas. Job-specific RWPs should be used to control nonroutine operations or work in areas with changing radiological conditions. The job-specific RWP should remain in effect only for the duration of the job.

3.2.3 Radiological Work Permit Preparation

The responsibility for ensuring adequate planning and control of work activities resides with line management. The lead work group responsible for the planned activity or for the area should initiate the preparation of the RWP.

The RWP process involves the use of radiological surveys and anticipated radiological conditions. The dosimetry and protective equipment requirements are identified on the RWP. The RWP is approved by the Radiological Control Manager and specific job supervisor.

3.2.4 ALARA Job Reviews and Pre-Job Briefings

An ALARA job review of RWPs will be conducted if the trigger values of WP 12-2 are reached or exceeded.

A pre-job briefing may be required by either the ALARA job reviewer or the approver of the RWP. Both the ALARA job review and the pre-job briefing will be maintained as specified by the Records Inventory and Disposition Schedule (RIDS).

3.2.5 Use of Personal Protective Equipment and Clothing

Individuals shall wear protective clothing (PC) during work in Contamination and High-Contamination Areas (see §835.1102[e]).

General guidelines for PC selection and use are provided in applicable WIPP approved procedures.

Appropriate instructions for donning and removing PC should be posted at the dress-out areas and step-off pad(s) for the affected work areas. In addition to posted instructions for donning and removing PC, RCTs should be available, when necessary, to provide guidance in the donning and removal process, thereby minimizing the potential for personnel contamination.

The use of personal protective equipment (PPE) or clothing (includes respiratory protection) beyond that authorized by the radiological control organization or other cognizant safety authorities detracts from work performance and is contrary to ALARA principles and waste minimization practice. Such use should not be authorized.

For radiological control purposes, company-issued clothing that is not specifically intended to protect individuals from contamination hazards, such as coveralls and shoes, should be considered the same as personal clothing. Company-issued clothing should not be used for radiological control purposes. Company-issued clothing, when available, should be worn under PC in lieu of personal clothing.

Personnel wearing PC should avoid actions that could result in personnel contamination, such as touching their bare skin, face, nose, mouth, hair, personal clothing, or eyeglasses with sleeves or gloves. Eyeglass restraints should be used if coveralls or gloves are worn.

3.3 Access Control

Access control requirements shall be established and implemented to minimize the exposure of radiation and radioactive contamination to personnel. WIPP access control is established and implemented by applicable WIPP approved procedures.

3.4 Contamination Control

3.4.1 Controlling the Spread of Contamination

Controls should be implemented as necessary to prevent the spread of contamination outside of radiological areas under normal operating conditions (see §835.1102[a]). The extent of these controls is dependent upon the type and level of contamination present and the activities in and around the area. Applicable WIPP approved procedures further defines the processes employed to control the spread of contamination.

3.4.2 Monitoring for Personnel Contamination

Individuals shall be monitored as appropriate for the presence of contamination when exiting Contamination, High-Contamination, and Airborne Radioactivity Areas (see §835.1102[d]). Individuals should perform a whole body frisk in accordance with applicable WIPP controlled procedures.

3.5 Radiological Work Controls

3.5.1 Requirements

Radiological work activities shall be conducted as specified by the controlling written authorization (see §835.501[d]). The applicable WIPP approved procedures detail the process for RWPs.

3.5.2 Work Conduct and Practices

Contamination levels caused by ongoing work should be monitored and maintained ALARA. Work should be curtailed and decontamination performed at preestablished levels, taking into account worker exposure or potential internal exposure.

3.5.3 Logs and Communications

Radiological control personnel maintain a logbook to document radiological occurrences, status of work activities, and other relevant information. Oncoming RCTs are expected to review the log and receive a turnover briefing from the personnel they are relieving.

3.5.4 Review of Work in Progress

As part of their normal review, both radiological control and work supervisors should periodically review ongoing jobs to ensure prescribed radiological controls are being implemented.

The RWP process includes a periodic review of the RWP and in the final review pre-job dose estimates are compared to digital dosimeter readings, if available.

3.5.5 Stop Radiological Work Authority

All workers at WIPP have stop work authority. This is detailed in Management Policy (MP) 1.2, Work Suspension and Stop-Work Direction.

Management will resolve the concerns prior to resuming operations or initiate actions to correct the condition using existing procedures.

3.5.6 Response to Abnormal Situations

Responses to abnormal situations are addressed in the applicable WIPP controlled procedures.

WP 12-9, WIPP Emergency Management Program, and applicable WIPP controlled procedures specify how radiological emergencies at WIPP will be handled. The RS&EM Manager supports the emergency management organization that plans and conducts exercises to demonstrate WIPP's ability to control all types of emergencies associated with the operation of the plant.

Radiological Emergency Assistance Center/Training Site emergency medical support is available through the DOE as part of a national support plan. This medical support is equivalent to that used in the commercial nuclear industry and at other DOE sites that are not large enough to justify a full-time medical staff. The names of the local medical support personnel and affiliated organizations available to WIPP for radiological support through memorandums of understanding are available at the Health Services Administrator's (site nurse) office.

3.5.7 Controls for Bench Top Work, Laboratory Fume Hoods, Sample Stations, and Glove Boxes

The following provisions are applicable to radiological work that has the potential to generate radioactive contamination in localized bench top areas, laboratory fume hoods, sample stations, and glove box operations located in areas that are otherwise contamination-free.

- Provisions for RWPs.
- PC should, at a minimum, include laboratory coats and gloves. Gloves should be secured at the wrist as necessary.
- Shoe covers should be considered based on the potential for floor contamination.
- Workers should periodically monitor their hands during work.
- Upon completion of work prior to leaving the area, workers shall monitor those areas of their body that are potentially contaminated (see §835.1102[d]). At a

minimum, this includes hands, arms, and front portions of the body. A whole body frisk is recommended.

- If there is a potential for splashing or airborne radioactivity, such as when taking pressurized samples, additional controls such as rubber aprons, face shields, full PCs, or respiratory protection should be instituted.
- Glove boxes should be inspected for integrity and operability prior to use.
- Glove boxes should be marked with, or survey measurements should be posted to identify, whole body and extremity dose rates.

An RWP should be issued to control radiological work in localized bench top areas, laboratory fume hoods, sample stations, and glove boxes.

3.6 Evaluation of Performance

During the conduct of radiological work and the handling of radioactive materials, abnormal events may occur that could indicate a weakness or area of programmatic breakdown of radiological controls. Prompt, consistent gathering of facts related to such events is required to satisfy reporting and investigation requirements and to formulate corrective actions to prevent recurrence. In addition, successful performance or completion of unique activities should be evaluated to identify and incorporate appropriate lessons learned.

Analysis of the facts should reveal areas where improvements can be made or where methods can be identified to prevent the recurrence of undesired results.

3.6.1 Conduct of Critiques

Management can conduct critiques of events and/or processes. Critiques are meetings of the individuals knowledgeable about an event (either a success or an abnormal event) to document a chronological listing of the facts. The purpose of the critique is not to assign blame, but to establish and record the facts.

Critiques should be conducted for successes and abnormal events and used for future plans of action if applicable.

Critique leaders should be trained in the required elements of the critique process and the appropriate methods of conducting and controlling the critique.

Critique meetings should be conducted as soon as practicable after the event or situation is stabilized, or after a successful evolution is completed. Critiques of abnormal events should preferably be conducted before involved personnel leave for the day.

At a minimum, the general critique process should include the following elements:

- Formal meetings, chaired by a critique leader
- Attendance by all members of the work force who can contribute
- Critique attendance records
- Minutes, recorded and signed by the critique leader and all contributors
- Pertinent personal statements from individuals involved in the event, signed and attached to the meeting minutes
- A listing of the facts in chronological order
- Supporting materials, including documents, records, photographs, parts, and logs, maintained by the critique leader

Evaluation of complex evolutions or events may require multiple critiques.

3.6.2 Post-Job ALARA Reviews

Post-job ALARA reviews are required if a pre-job ALARA review was done. The review includes differences in expected dose and actual dose, and total dose and individual dose, as applicable. In addition, the ALARA job review will document lessons learned and a determination of whether corrective actions are necessary.

3.6.3 Lessons Learned

Lessons learned are available from post-job reviews and reports of past radiological events on-site and at other facilities. The radiological control organization, in conjunction with line management, should evaluate lessons learned, provide prompt distribution, and incorporate the lessons into the WIPP Radiological Control Program, the radiological safety training program, and related operations.

3.7 Special Applications

3.7.1 Plutonium Operations

Low levels of plutonium in the body are difficult to measure and biological removal processes are slow. For these reasons, the primary emphasis shall be placed on engineered features to contain transuranics and to prevent airborne and surface contamination (see §835.1001[a]).

3.8 Design and Control

3.8.1 Radiological Design Criteria

The following design objectives are applicable during the design of new facilities and modifications of existing facilities. Additional design criteria are provided in DOE O 420.1A.

For areas of continuous occupancy (2,000 hours per year), the design objective shall be to maintain the average exposure level ALARA and below 0.5 mrem per hour. If occupancy is not continuous, the design objective shall be to maintain doses ALARA and below 20 percent of the occupational dose limits provided in Table 2-1 (see §835.1002[b]). The DOE recommends that design criteria be established to limit individual worker doses below 0.25 mrem per hour (500 mrem per year).

For control of airborne radioactivity, the design objective shall be to avoid releases to the work place atmosphere under normal conditions and, under any conditions, to control inhalation by workers to levels that are ALARA. Confinement and ventilation shall normally be used (see §835.1002[c]).

In justifying facility design and physical controls, optimization methods shall be used (see §835.1002[a]).

Support facilities should be provided for donning and removal of PC and for personnel monitoring, when required.

A neutron quality factor of 20 for conditions of unknown spectra (or doubling of the neutron quality factor associated with known neutron energies) should be used for design purposes only. Design analyses based on these neutron quality factors are intended to estimate the additional construction cost resulting from neutron quality factor increases. The results of these analyses should be used to ascertain the economic feasibility of incorporating such modifications in final design. This quality factor is not to be used for determination of individual dose equivalents.

Existing facility designs that have office space and lunchrooms or eating areas within radiological areas, RMAs, and RBAs require priority attention. Generally:

- Locating restrooms, drinking fountains, showers and similar facilities and devices are strongly discouraged within these areas.

- Locating office spaces within these areas is strongly discouraged; to the extent that such space is essential to support radiological work, steps should be taken to preclude unnecessary occupancy.

Facilities being designed or considered for design should be evaluated with the 10 CFR Part 835 requirements, ALARA design review during the design. The ALARA committee determines what level of review and involvement is required.

3.8.2 Control Procedures

Administrative control and procedural requirements shall be developed and implemented as necessary to supplement facility design features, particularly when the design of existing facilities is not in accordance with current standards (see §835.1001[b]). Administrative control procedures include access control measures, RWPs, and technical work documents as discussed in this manual.

Written procedures shall be developed as necessary to ensure compliance with the provisions of this manual that are derived from 10 CFR Part 835 (see §835.104). These procedures shall be commensurate with the radiological hazards created by the activity and the education, training, and skills of the individuals who are exposed to these hazards (see §835.104).

Written authorizations, including specific radiation protection measures, shall be required to control entry into and work within radiological areas (see §835.501[d]). These authorizations may include RWPs, technical work documents, administrative procedures, and other administrative controls.

The combination of design features and administrative control procedures shall be sufficient to ensure that, during routine operation, the Table 2-1 occupational dose limits for general employees are met and to ensure doses are ALARA (see §835.1003[a]).

4.0 RADIOACTIVE MATERIALS

4.1 Radioactive Material Identification, Storage, and Control

Radioactive material includes activated material, sealed and unsealed sources, and materials that emit radiation. For the purposes of this manual, radioactive material also includes any material, equipment, or system component determined to be contaminated or suspected of being contaminated. Items located in known or suspected Contamination, High-Contamination, or Airborne Radioactivity Areas, and having the potential to become contaminated, are considered radioactive material.

4.1.1 General

Materials in Contamination, High-Contamination, or Airborne Radioactivity Areas shall be considered contaminated until surveyed and released (see §835.1101[a]). Any equipment or system component removed from a process that may have had contact with radioactive material should be considered contaminated until disassembled to the extent required to perform an adequate survey, surveyed, and shown to be at levels less than or equal to the Table 2-5 values.

Except for sealed and unsealed sources, radioactive material located within radiological areas does not require specific labeling or packaging if sufficient information is provided

to allow individuals to take appropriate protective actions (see §835.606[a]). The information may be provided by means of postings, pre-job briefings, training, or other appropriate means.

4.1.2 Radioactive Material Labeling

Title 10 CFR Part 835 requires labeling of individual containers of radioactive material and radioactive items except under certain specified conditions in which existing postings and control measures provide adequate warning (see §835.605 and §835.606[a]).

Required labels shall include the standard radiological warning trefoil and the words "Caution" or "Danger" and "Radioactive Material" (see §835.605). The "Danger" heading should be used when an individual exposed to, using, or handling the material could receive a dose equivalent exceeding any applicable administrative control level in one hour. The radiation warning trefoil shall be black or magenta and imposed upon a yellow background (see §835.601[a]). Magenta is the preferred color for the trefoil and the lettering, (see American National Standards Institute (ANSI) N2.1 for symbol design).

Required labels shall also provide sufficient information to permit individuals handling, using, or working in the vicinity of the labeled material to take appropriate actions to control exposures (see §835.605).

If a label is applied to packaged radioactive material, the label should be applied to the outside of the package or be visible through the package.

4.1.3 Radioactive Material Packaging

Radioactive material that is outside Contamination, High-Contamination, or Airborne Radioactivity Areas and is confirmed or suspected of having removable radioactive contamination levels greater than Table 2-5 values, should be securely wrapped in yellow plastic or placed in a closed container.

Radioactive material with sharp edges or projections should be taped or additionally protected to ensure package integrity.

Radioactive material with removable or potentially removable contamination levels in excess of 100 times Table 2-5 values should have additional packaging controls such as double-wrapping or the use of plastic bags inside containers.

Plastic wrapping material with radiological control markings and labeling (or plastic wrapping materials emblazoned with yellow markings) should be used for packaging radioactive material and should not be used for nonradiological purposes.

4.1.4 Radioactive Material Storage

Radioactive material shall be used, handled, and stored in an RMA or other area posted in accordance with applicable WIPP approved procedures (see §835.2[a] and §835.603).

Decontamination or disposal of radioactive material is the preferred alternative to long-term storage.

Storage of nonradioactive material in an RMA is discouraged.

Outdoor storage of radioactive material is discouraged. In cases where outdoor storage is necessary, the integrity of containers used should be ensured to prevent degradation from weathering and subsequent release of radioactive material.

Radioactive material should be stored in a manner that reduces combustible loading. The use of cardboard containers for storage is discouraged.

Flammable or combustible materials should not be stored adjacent to RMA.

Fire protection measures, such as smoke detectors, water sprinklers and fire extinguishers, should be considered when establishing an RMA.

4.2 Release and Transportation of Radioactive Material

4.2.1 Release to Controlled Areas

Materials/items that may be contaminated are released in accordance with DOE O 5400.5, *Radiation Protection of the Public and the Environment*, since there are no further surveys required for release to the public or environment.

4.2.2 Release to Uncontrolled Areas

Materials/items/waste that may be contaminated are released in accordance with the methods and limits specified in DOE O 5400.5.

Material not immediately released after being surveyed shall be controlled to prevent contamination while awaiting release.

Radiological labeling shall be removed from, or defaced on, material prior to release for unrestricted use.

| Waste Stream Profiles are reviewed by the RS&EM Manager to ensure that waste described may be released as nonradioactive in accordance with the criteria of DOE O
| 5400.5. Environmental Compliance informs the RS&EM Manager when a Waste Stream Profile is added or changed.

WIPP Laboratories handles radioactive materials which can result in generating wastes that could exceed DOE O 5400.5 criteria. The WIPP Laboratories waste management procedure specifies under what conditions and operations waste that could exceed release criteria are generated. Waste generated in this process may be radioactive. Changes to the WIPP Laboratories waste management procedure are reviewed by the | RS&EM Manager or designee, to ensure that controls on potentially contaminated materials are not compromised.

Wastes that do not require a Waste Stream Profile can be generated by work on-site. | The RS&EM Manager, or designee, reviews work orders and determines if generated wastes could exceed DOE O 5400.5 criteria. If it appears that the wastes could exceed the release criteria, then it cannot be released until further evaluation is conducted in accordance with Radiological Technology procedures.

| Government property is sometimes released by the site for sale. The RS&EM Manager or designee, reviews the list provided by Property Management of items to be transferred off-site as surplus equipment/material. The materials/items are release if process knowledge indicates that they will be less than the requirements of DOE O 5400.5.

4.2.3 Transportation of Radioactive Material

Title 49 CFR §§ 171 through 180, "Hazardous Materials Regulations" establish requirements for inspecting and surveying packages, containers, and transport conveyances prior to transport via the public transportation system.

Title 10 CFR §835.1(b)(4) excludes radioactive material transportation activities that are performed in accordance with the applicable transportation requirements | (e.g., U.S. Department of Transportation [DOT] or DOE requirements) from the requirements of 10 CFR Part 835. However, radioactive material transportation (as defined in 10 CFR Part 835) does not include preparation of materials for shipment, packaging and labeling, or performance of radiological monitoring required for occupational radiation protection. These activities are conducted using applicable WIPP approved procedures.

Table 2-5 removable contamination values are more limiting than 49 CFR requirements and should be used as controlling limits for on-site and off-site transportation when using a conveyance that is owned by the DOE.

4.3 Radioactive Source Controls

Sources identified in 10 CFR Part 835, Appendix E, are leak-tested and inventoried semiannually (see §835.1202[a]). Source leak tests shall be capable of detecting radioactive material leaking equal to or exceeding 0.005 microcuries (see 10 CFR §835.1202[b]). Requirements for control of sealed and unsealed sources are found in applicable WIPP controlled procedures.

4.4 Solid Radioactive Waste Management

4.4.1 Requirements

DOE O 435.1, *Radioactive Waste Management*, describes how solid radioactive waste is treated, packaged, stored, transported, and disposed.

Radiological operations generating radioactive waste shall be designed and developed to promote minimization and permit segregation, monitoring, treatment, storage, and disposal (DOE O 435.1).

Radioactive waste minimization goals and practices shall be developed and implemented (DOE O 435.1).

Requirements for solid radioactive waste management are found in applicable WIPP controlled procedures.

4.4.2 Waste Minimization

A radioactive waste minimization program shall be in effect to reduce the generation of radioactive waste and spread of contamination (see DOE O 435.1). The following practices should be evaluated and instituted as appropriate to support waste minimization:

- Restrict material entering RBAs and other areas surrounding radiological areas to that needed for the performance of work.
- Restrict quantities of hazardous materials, such as paints, solvents, chemicals, cleaners, and fuels, entering RBAs and other areas surrounding radiological areas and implement measures to prevent inadvertent radioactive contamination of these materials.
- Substitute recyclable or burnable items in place of disposable ones and reuse equipment, chemicals, solvents, and cleaners when practical.
- Select consumable materials such as protective coverings and clothing that are compatible with waste-processing systems, volume reduction, and waste form acceptance criteria.
- Reserve an assortment of tools primarily for use in Contamination, High-Contamination, or Airborne Radioactivity Areas. Tools should be maintained in a designated storage or distribution area or a tool crib established for contaminated tools. Controls should be established for tool issuance and use.
- Survey potentially contaminated material from radiological areas to separate uncontaminated from contaminated materials.

- Segregate known uncontaminated from potentially contaminated waste.
- Segregate reusable items, such as tools, at the step-off pad.
- Minimize the number and size of RMAs.
- Emphasize training in waste reduction philosophies, techniques, and improved methods.

4.4.3 Mixed Waste

Mixed waste refers to waste that is regulated as both a hazardous waste under the Resource Conservation and Recovery Act, and radioactive waste under the Atomic Energy Act. Wastes containing greater than 50 parts per million (ppm) polychlorinated
| biphenyls (PCBs) may also be regulated under the Toxic Substance Control Act. Requirements for control and minimization of mixed waste are found in applicable WIPP controlled procedures.

Technical and administrative controls should be established to minimize the volume of mixed waste generated and the amount of radioactivity in such waste. Volume reduction methods include process optimization, materials substitution, and new technology development.

Materials suspected of being mixed waste should be identified and segregated as soon as practical in the generating process to avoid combining mixed waste with other waste forms.

4.5 Control of Radioactive Liquids and Airborne Radioactivity

4.5.1 Minimization and Control of Radioactive Liquid Wastes

DOE O 435.1 provides criteria for minimizing the generation of radioactive liquid waste.

4.5.2 Control of Radioactive Drains

| WIPP does not have radioactive drain systems. If a radioactive drain system is required, it will be designed to meet the applicable requirements.

4.5.3 Control of Airborne Radioactivity

Processes and activities with the potential for producing airborne radioactivity should be evaluated to include engineering controls to limit releases whenever appropriate. The requirements of 40 CFR Part 61, "National Emission Standards for Hazardous Air Pollutants" and 40 CFR Part 191, "Environmental Radiation Protection Standards for
| Management and Disposal of Spent Nuclear Fuel, High-Level, and Transuranic
| Radioactive Wastes" should be included in this evaluation as applicable.

The radiological control organization should be notified when engineering controls that prevent worker exposure to airborne radioactivity, such as barriers, glove boxes, and glove bags, are compromised. An evaluation should be made of continuing operations with compromised engineering controls. The use of respiratory protection to continue activities under these conditions is discouraged. Implementation of short-term engineering modifications that provide a commensurate level of worker protection is the preferred alternative.

Preventive maintenance and surveillance procedures should be established to ensure that equipment controls are maintained in an operable condition for containment of airborne radioactivity.

4.6 Support Activities

4.6.1 Personal Protective Equipment and Protective Clothing

Except for disposable, single use items, PC designated for radiological control use should be identified specifically by color, symbol, or appropriate labeling.

PC designated for radiological control use should not be used for nonradiological work.

PPE and PC should not be stored with personal street clothing.

At WIPP all PPE used in contamination events shall be disposed of as radioactive
| waste, unless otherwise authorized by the RS&EM Manager.

Personal protective equipment and PC shall be inspected prior to use. Clothing should be free of tears, separated seams, deterioration, and damage, or should be repaired in a manner that provides the original level of protection.

4.6.2 Decontamination

RWPs or technical work documents should include provisions to control contamination at the source to minimize the amount of decontamination needed.

Work preplanning should include consideration of the handling, temporary storage, and decontamination of materials, tools, and equipment.

Decontamination activities should be controlled to prevent the spread of contamination.

Water and steam are the preferred decontamination agents. Other cleaning agents should be selected based upon their effectiveness, hazardous properties, amount of waste generated, and ease of disposal.

Efforts should be made to reduce the level of contamination and the number and size of contaminated areas that cannot be eliminated.

The Radiological Control Manager and the manager for waste handling (WH) should be responsible for directing decontamination efforts.

4.6.3 Vacuum Cleaners and Portable Air-Handling Equipment

Improper use of vacuum cleaners and portable air-handling equipment may result in the generation of airborne radioactivity, loose surface contamination or high dose rates. Vacuum cleaners and portable air-handling equipment used in areas to control removable surface contamination or airborne radioactivity (except areas where only tritium is present) should be equipped with high-efficiency particulate air (HEPA) filters. If the material to be vacuumed is wet enough to preclude resuspension, then HEPA filters are not necessary. Vacuums used to collect radioactive materials should not contain any other waste materials prior to use. HEPA filters and recovered particles that are contaminated with radionuclides will be managed as radioactive waste (DOE O 435.1).

HEPA filters used in vacuum cleaners and portable air-handling equipment should meet the applicable efficiency and construction requirements for the devices in which they are installed.

Appropriate standards for system design, construction, maintenance, and testing are provided in American Standards for Mechanical Engineering (ASME) N509, "Nuclear Power Plant Air-Cleaning Units and Component," and ASME N510, "Testing of Nuclear Air Treatment Systems" and ASME AG-1, "Code on Nuclear Air and Gas Treatment." Several of the DOE 3020 series Technical Standards (e.g., DOE-STD-3020, 3022, 3025, and 3026) provide additional information applicable to HEPA-filtered systems.

The use of vacuum cleaners and portable air-handling equipment for radiological work will be conducted using applicable WIPP approved procedures.

5.0 RADIOLOGICAL HEALTH SUPPORT OPERATIONS

5.1 External Dosimetry

5.1.1 Requirements

The WTS external dosimetry program is established and implemented by WP 12-3, WIPP Dosimetry Program.

5.1.2 Technical Requirements for External Dosimetry

External dosimetry programs shall be adequate to demonstrate compliance with the Table 2-1 limits (see 10 CFR §835.402[b]). External dosimetry programs implemented shall be:

- Accredited by the DOE Laboratory Accreditation Program (DOELAP) for Personnel Dosimetry (see §835.402[b][1]); or

- Excepted from accreditation by the DOELAP Program (see §835.402[b][1]); or
- Otherwise approved by the Assistant Secretary for Environment, Safety and Health (see §835.402[b][2]).

DOE-STD-1095-95, *DOE Standard Department of Energy Laboratory Accreditation Program for Personnel Dosimetry Systems*, specifies the requirements for accreditation of personnel external dosimetry monitoring programs by DOELAP. A technical basis document has been developed and is maintained for the external dosimetry program (see WP 12-3).

5.1.3 Electronic Dosimeters

Work authorized by an RWP shall be stopped when supplemental dosimeters alarm. Work will resume in accordance with WIPP procedures and protocol.

Higher-than-expected readings should be investigated by the radiological control organization to document the cause of the irregularity. Timely processing of the wearer's TLD should be required by Dosimetry, unless available information indicates minimal possibility of a significant dose being received. Workers shall be restricted from radiological work until their compliance with dose limits is verified.

5.1.4 Personnel Area Monitoring Dosimeters

Establishment and maintenance of a comprehensive area monitoring program can minimize the number of areas requiring the issuance of personnel dosimeters and can demonstrate that doses outside radiological areas are negligible. WP 12-3 further explains the area monitoring dosimeter program at WIPP.

5.1.5 Nuclear Accident Dosimeters

There are no nuclear accident dosimeters in use at the WIPP facility.

5.2 Internal Dosimetry

The internal dosimetry program is established and implemented by WP 12-3.

5.2.1 Requirements

The following individuals shall participate in an internal dosimetry program:

- Radiological workers who are likely to receive a committed effective dose equivalent of 100 mrem or more from all radionuclide intakes in a year (see §835.402[c][1]).

- Declared pregnant workers likely to receive intakes resulting in a dose equivalent to the embryo/fetus of 50 mrem or more during the gestation period (see §835.402[c][2]).

- Occupationally exposed minors likely to receive a committed effective dose equivalent in excess of 50 mrem from all radionuclide intakes in a year (see §835.402[c][3]).

- Members of the public who enter a controlled area and are likely to receive an intake resulting in a committed effective dose equivalent exceeding 50 mrem in a year (see §835.402[c][4]).

5.2.2 Technical Requirements for Internal Dosimetry

All bioassay programs implemented to demonstrate compliance with Section 5.2.1 above shall be:

- Accredited by the DOE Laboratory Accreditation Program for Bioassay Programs (see §835.402[d][1]); or

- Excepted from accreditation by the DOELAP Program (see §835.402[d][1]); or

- Otherwise approved by the Assistant Secretary for Environment, Safety and Health (see §835.402[d][2]).

5.2.3 Technical Requirements for Dose Assessment

Interpretations of bioassay results and subsequent dose assessments should include the following:

- Characteristics of the radionuclide, such as chemical and physical form

- Bioassay results and the individual's previous exposure history

- Exposure information, such as route of intake and time and duration of exposure

- Biological models used for dosimetry of radionuclides

- Models to estimate intake or deposition and to assess dose

- Intradepartmental coordination between the radiological control organization and the medical organization for doses that may require medical intervention

The estimation of internal dose shall be based on bioassay data rather than air concentration values unless:

- Bioassay data are unavailable or inadequate; or
- Internal dose estimates based on air concentration values are demonstrated to be as or more accurate (see §835.209[b])

5.3 Respiratory Protection Program

Respiratory protection equipment includes respirators with particulate or gas-filtering cartridges, supplied air respirators, self-contained breathing apparatus, and airline supplied-air suits and hoods. The use of respirators is controlled by Industrial Safety.

5.3.1 Requirements

Use of respiratory protection shall be reduced to the minimum practicable by implementing engineering controls and work practices to contain radioactivity at the source (see 29 CFR §1910.134).

Title 29 CFR §1910.134 establishes requirements for respiratory protection program that are applicable to most DOE facilities. ANSI Z88.2, "Practices for Respiratory Protection," provides acceptable detailed guidance for implementation of the respiratory protection program and associated training of personnel.

Respirators shall be issued only to individuals who are trained, fitted, and medically qualified to wear the specific type of respirator. Training and qualification testing shall be performed annually (see 29 CFR §1910.134 and ANSI Z88.2).

Respiratory protection should be used when one or more of the conditions listed below are present. When any of these conditions are anticipated in a planned activity, the requirements for respiratory protection shall be incorporated in an RWP or operating procedure. If, in the judgment of radiological control personnel, any of these conditions arise during an activity, work shall be stopped until a new RWP is issued and adequate respiratory protection is provided.

- Working in an area with removable contamination levels > 100 times the Table 2-5 values
- When performing operations that may cause or are known to have caused airborne concentrations greater than 30 percent of a DAC and where engineering controls are inadequate or nonexistent

If mixed exposures to airborne radioactive and chemically hazardous materials are anticipated, the Industrial Safety and Hygiene organization shall be consulted relative to the need for combination cartridge respirators or a higher degree of respiratory protection.

Only self-contained breathing apparatus may be used in toxic or oxygen-deficient atmospheres. Due to the nature of the work at WIPP, it is expected that these conditions will be very unlikely. However, if these conditions present themselves, a major investigation shall be conducted and consideration will be given to using engineering controls to replace respirators.

Protection factors will be applied whenever personal respirators are used to limit the intake of radioactive materials in accordance with applicable WIPP controlled procedures.

5.3.2 Medical Assessment

Each prospective respirator wearer shall have a medical assessment prior to being fit-tested. The medical assessment shall determine if an employee's medical condition precludes the use of respirators and should follow the guidance in ANSI Z88.2 on frequency and content of the examination (see 29 CFR §1910.134 and ANSI Z88.2). The ability of an employee to accommodate the additional stress placed on the body when working in a respirator is part of this assessment.

5.3.3 Use of Respiratory Protection

The use of respiratory protection devices can impair worker mobility and vision and cause worker discomfort and stress. For these reasons, the issue and use of respiratory protective devices must be controlled.

Individuals using respiratory protection shall:

- Perform fit checks of close-fitting respirators to ensure a proper seal before entering areas requiring respirator use.
- Be clean-shaven in the area of fit, if applicable.
- Use corrective lenses, if needed, that are approved for use with respirators.
- Be trained to leave the work area when experiencing respirator failure.
- Be trained to remove their respirators to avoid life-threatening situations when exiting an area after respirator failure (see 29 CFR §1910.134 and ANSI Z88.2).

5.3.4 Heat Stress

Heat stress may result from working in areas of high heat, humidity, and radiant heat; working in PC; and using respirators, particularly where other protective equipment is required. Industrial Safety is available to assist if heat is a problem.

5.4 Handling Radiologically Contaminated Personnel

5.4.1 Skin Contamination

Survey techniques to determine the extent of skin contamination are found in applicable WIPP controlled procedures. Personnel are trained to notify the RCT if contamination is found. Once the contamination is determined on the individual, the decontamination is performed in accordance with applicable WIPP approved procedures. This procedure also identifies how to determine and record dose assessments of skin exposures.

5.4.2 Contaminated Wounds

Emergency medical care should be administered immediately for injuries involving radioactive materials in accordance with NCRP Report 65, "Management of Persons Accidentally Contaminated with Radionuclides." Medical treatment of injuries takes precedence over radiological considerations.

The site nurse or Emergency Services Technicians should be notified if there are any wounds in the vicinity of contamination on a person's body. WIPP has memorandums of understanding with the nearest emergency care medical facilities that specify treatment for contaminated, injured personnel. These hospitals are equipped with the proper treatment facilities to handle contaminated injured patients. The medical staffs at the facilities have received specialized training with respect to the handling of wounds contaminated with radioactive materials.

The treatment of contaminated injuries should include the following:

- Treatment of contaminated wounds by medically qualified personnel
- Monitoring of wounds and associated bandages for contamination, including alpha emitters if applicable
- Identification of the radionuclides involved, if possible
- Medical determination of the need for therapeutic intervention such as blocking or chelating agents
- Initiation of appropriate bioassay monitoring
- Determination of need for work restrictions

An injured individual should be counseled promptly on the medical and radiological implications resulting from contaminated wounds that result in internal doses greater than 2 percent of the Table 2-1 limits. The counseling should be performed by senior radiological control and medical professionals.

If an employee's skin is broken while working in a posted radiological area, a prompt radiological survey by RCT is required. If the skin is broken while working with radioactive materials, the employee should have the skin break surveyed by the RCT. Workers are instructed to report all incidents which cause injuries in the work place. During this process a report is filed and management notified. The RS&EM Manager and the Radiological Control Manager should determine if additional follow-up action is required and should contact Dosimetry, if necessary.

Employees who have open wounds should not enter Contamination Areas without approval from their immediate supervisor and the Radiological Control Manager. The employee's supervisor (with concurrence of the Radiological Control Manager) should ensure that protection afforded the wound or skin break is adequate for the nature of work to be performed. Bandages or other wound coverings should be administered by on-site medical personnel.

5.4.3 Handling Individuals Exposed to Airborne Radioactivity

Potential intakes of radioactive material are indicated when personnel without respiratory protection are exposed to airborne radioactivity, when the DAC is greater than the capability of the respirator to provide an adequate protection, or when respiratory protection has been compromised. Personnel with potential intakes of radioactive materials can have bioassay analysis performed and/or have their exposures to airborne radioactivity tracked (DAC-hour tracking).

5.5 Radiological Monitoring and Surveys

5.5.1 Requirements

Workplace monitoring provides a basis for posting and labeling, development of RWPs and other work authorizations, implementation of ALARA measures, issuance of individual monitoring devices, and verification of the efficacy of design measures and engineering controls.

Radiological monitoring of radiation exposure levels, contamination, and airborne radioactivity shall be conducted to:

- Characterize workplace conditions and detect changes in those conditions (see §835.401[a][2] and [3]).
- Verify the effectiveness of physical design features and engineering and process controls (see §835.401[a][5]).
- Demonstrate regulatory compliance (see §835.401[a][1]).
- Detect the gradual buildup of radioactive material in the workplace (see §835.401[a][4]).

- Identify and control potential sources of personnel exposure (see §835.401[a][6]).

- Determine exposure rates during each entry to a High or Very-High-Radiation Area (see §835.502[a][1]).

- Allow release of materials/items/waste for unrestricted use to the public and environment.

Monitoring shall be performed only by individuals who have the appropriate education, training, and skills (see §835.103). The instruments used shall be (see §835.401[b]):

- Periodically maintained and calibrated
- Appropriate for the types, levels, and energies of radiation to be detected
- Appropriate for existing environmental conditions
- Routinely tested for operability

5.5.2 Radiation Exposure Monitoring

Radiation monitoring is conducted using applicable WIPP approved procedures. This includes a schedule of what areas are surveyed and the frequency. The surveys are performed using equipment that is operability checked within 24 hours of use.

5.5.3 Area Radiation Monitors

Area radiation monitors are installed in the Remote Handled (RH) Area. They are currently being used for demonstration purposes. The monitors will be in operation when the RH area is opened to WH.

5.5.4 Contamination Surveys

In addition to the requirements of Section 5.5.1, routine contamination monitoring programs should be established to ensure that surveys are performed at a frequency that is consistent with the existing and potential hazards and activities planned in the area. Contamination surveys are performed using applicable WIPP approved procedures. The procedure defines a schedule of the areas surveyed and the frequency.

5.5.5 Airborne Radioactivity Monitoring

In addition to the requirements of Section 5.5.1, air monitoring programs should be established to ensure that airborne radioactivity monitoring is performed at a frequency that is consistent with the existing and potential hazards and activities planned in the area. Selection of air monitoring and sampling equipment should be based on the specific job being monitored. Air monitoring equipment includes portable and fixed air sampling equipment and continuous air monitors.

Air sampling equipment shall be used where a radiological worker is likely to receive an annual exposure of 40 or more DAC-hours (see §835.403[a][1]). This intake generally represents a CEDE to an individual of approximately 100 mrem. Samples shall also be taken as necessary to characterize the hazard in areas where respiratory protection devices have been prescribed for protection against airborne radionuclides (see §835.403[a][2]). Air samples should be adequate to evaluate the concentrations of airborne radioactive materials at the individual's work locations.

Airborne radioactivity monitoring is performed using applicable WIPP approved procedures including calibration and maintenance for the units.

5.6 Instrumentation and Calibration

5.6.1 Standardization

Radiological instrumentation will be standardized as much as practicable through participation in the DOE Health Physics Instrumentation Committee standardization initiative.

5.6.2 Inspection, Calibration, and Performance Tests

Radiological instruments shall be used only to measure the radiation for which their calibrations are valid (see §835.401[b][2]). ANSI N323A, "Radiation Protection Instrumentation Test and Calibrations, Portable Survey Instruments," provides appropriate comprehensive guidance for establishing and operating a radiological instrumentation calibration program. Calibrations should use National Institute of Science and Technology (NIST) traceable sources.

All calibrations, operability checks and functional checks of the radiological instrumentation are performed using applicable WIPP approved procedures. The records are maintained in accordance with the approved applicable RIDS.

5.6.3 Maintenance

A program for preventive and corrective maintenance of radiological instrumentation has been established and documented. The program is administered by the Operations Department using applicable approved procedures.

Preventive and corrective maintenance are performed using components and procedural recommendations at least as stringent as those specified by the manufacturer of the instrument.

Radiological instruments undergo calibration prior to use following any preventive or corrective maintenance or any adjustment that voids the previous calibration. A battery change or cable replacement is not normally considered maintenance.

5.6.4 Calibration Facilities

Calibrations are performed by qualified and trained individuals. The calibration procedures for radiological instrumentation use ANSI N323A as guidance. Calibrations are performed in low background areas using NIST traceable sources, or equivalent.

6.0 WIPP RADIOLOGICAL SAFETY TRAINING PROGRAM

This section describes the individual responsibilities, the training program elements, and the standards used to provide radiological safety training at WIPP. This training will assist personnel in working safely in and around radiological areas and in maintaining their individual radiation exposure and exposures of others ALARA. The WIPP Radiological Safety Training Program uses the portions of the DOE standardized radiological control core training materials that are relevant to the hazards and operations at WIPP. The DOE standardized training materials are augmented by WIPP-specific radiological safety training materials as administered by the WTS Technical Training Section.

The objectives of the WIPP Radiological Safety Training Program are to ensure that personnel involved in radiological activities at the WIPP facility:

- Are trained properly to perform their assignments safely and efficiently.
- Maintain proficiency through continued training.
- Meet the applicable requirements specified in 10 CFR Part 835.

6.1 Changes and Revisions

Improvements should be made to the Radiological Safety Training Program to reflect regulatory and WIPP requirements accurately as they change. The program should also be evaluated and upgraded through:

- Evaluation of individual employees' performance on written, operational, and oral examinations
- Management observation and appraisal of the on-the-job performance of each employee
- Employee feedback from student training evaluation forms
- Implementing changes caused by new procedures, equipment changes, changes to existing procedures, and changing industry standards pertinent to WIPP operations

6.2 Organizational Relationships and Responsibilities

Specific responsibilities for training, qualification, and qualification programs for personnel involved in radiological activities are detailed in this section.

6.2.1 RS&EM Manager

The RS&EM Manager is responsible for:

- Establishing and implementing the Radiological Safety Training Program.
- Reviewing and approving all radiological safety training.
- Obtaining and maintaining a minimum of Radiological Worker I training status.
- Ensuring that tour groups, visiting dignitaries, scientists, and specialists have received the appropriate training or escort to enter radiological areas, RMAs and RBAs commensurate with their duties.

6.2.2 Technical Training Manager

The Technical Training Manager is responsible for:

- Ensuring that all radiological safety training instructors are qualified and have the technical knowledge, experience, and instructional skills to conduct radiological training.
- Maintaining, preparing, and grading written examinations, and maintaining question banks.
- Maintaining radiological safety training records for all WIPP personnel.

6.2.3 Line Managers

Line managers are responsible for:

- Obtaining and maintaining General Employee Training (GET); MAS-124, Radiological Protection; and the appropriate level of Radiological Safety Training.
- Ensuring that all their personnel attend GET within one month of their initial assignment to WIPP and that they maintain the retraining and refresher requirements associated with GET.
- Ensuring that workers whose job assignments require access to Radiological Buffer, Radioactive Material, and/or Radiation Areas have completed Radiological Worker I training, at a minimum, and that they maintain the associated Radiological Worker I refresher training as long as their job scope requires it.
- Ensuring that workers whose job assignments involve handling waste packages and entry to any High-Radiation, Very-High-Radiation, Contamination,

High-Contamination, and Airborne Radioactivity Areas have completed Radiological Worker II training and that they maintain associated Radiological Worker II refresher training as long as their job scope requires it.

6.2.4 Radiological Control Manager

The Radiological Control Manager (RCM) is responsible for:

- Ensuring that a formal training and qualification program exists, that it is uniform and consistent, and that it is maintained for all RCT personnel.
- Verifying that the training is appropriate during the process of purchasing the services of a radiographer or radiation-generating device operator.
- Provide approval of RWPs.
- Ensuring that the appropriate training for the WIPP RCTs is maintained effective and current.
- Obtaining and maintaining Radiological Worker I training.

6.2.5 Radiological Control Technician Superintendent

The RCT Superintendent is responsible for:

- Obtaining and maintaining RCT qualification, job performance measures evaluator (JPMEs)
- Ensuring that training relates specifically to RCT tasks
- Notifying Technical Training, after review and evaluation of incoming information (e.g., changes to codes and standards, lessons learned, etc.), to integrate appropriate aspects of the information into the RCT training and qualification program

6.2.6 Technical Training Coordination

The technical training coordination is performed by the Technical Training Section. All training is conducted in accordance with WP 14-TR.01, WIPP Training Program. Technical Training is responsible for:

- Reviewing each JPM upon completion and prior to the oral examination board, and reviewing the qualification card for completeness

- Coordinating the following radiological safety training programs:

  - RCT training and qualification
  - Radiological Worker II training
  - Radiological Worker I training
  - GET
  - Visitor orientation
  - Any other radiological control support or technical training
  - ALARA training for supervisory, job planning personnel, and radiological workers

- Updating the RCT training program upon notification from the RS&EM Manager, the Radiological Control Manager, and/or the RCT Superintendent

- Assuring that the course material is current prior to use

- Maintaining and issuing the JPMs

6.2.7 Radiological Control Technician Job Performance Measures Evaluators/On-the-Job Trainers

Radiological Control Technician JPME trainers are responsible for:

- Obtaining and maintaining JPME/on-the-job training in accordance with WP 14-TR.01

- Providing on-the-job training (OJT) to nonqualified RCTs

- Evaluating unqualified RCT employees during the qualification process

- Evaluating other qualified RCTs during the requalification process

- Reviewing RCT tasks and JPMs and notifying the Radiological Control Manager of any discrepancies

- Performing the assignments and training as determined by the Radiological Control Manager

6.2.8 Radiological Control Technicians

Radiological Control Technicians are responsible for:

- Obtaining and maintaining their assigned training and qualification programs in a timely manner

- Making constructive suggestions and comments concerning the upgrading of the RCT training program

- Assisting Technical Training in radiological worker practical sessions
- Pursuing JPM/OJT (WIPP Level I) trainer qualification upon completion of initial RCT qualification

6.2.9 Radiological Worker II

Radiological Worker II personnel are responsible for:

- Obtaining Radiological Worker II training before handling waste packages and/or entering Contamination, High-Contamination, Airborne Radioactivity, High-Radiation, and/or Very-High-Radiation Areas
- Maintaining Radiological Worker II training as long as their job scope requires
- Making constructive suggestions and comments concerning the upgrading of the Radiological Safety Training Program
- Maintaining an awareness of their personal qualifications associated with performing radiological work

6.2.10 Radiological Worker I

Radiological Worker I personnel are responsible for:

- Obtaining Radiological Worker I training before entering Radiological Buffer, Radioactive Material, and/or Radiation Areas
- Maintaining Radiological Worker I training as long as their job scope requires
- Making constructive suggestions and comments concerning the upgrading of the Radiological Safety Training Program
- Maintaining an awareness of their personal qualifications associated with performing radiological work

6.2.11 Emergency Response Personnel

Emergency response personnel are responsible for:

- Obtaining and maintaining Radiological Worker II training before performing activities involving radiological emergencies
- Obtaining additional radiological emergency response training to maintain proficiency

6.2.12 Technical Support Personnel

Engineers, schedulers, and procedure writers whose job assignments support actual or potential radiological activities and radiological systems are responsible for:

- Being trained in the principles of ALARA, basic ALARA techniques, and dose-reduction techniques
- Participating in selected portions of job-specific and specialized training, particularly in situations using mock-ups, before performing their work functions

Planners and engineers who develop and review work plans and job steps involving, or associated with, actual or potential radioactivity or radioactive materials are responsible for completing appropriate ALARA training

6.2.13 Other Radiological Control Personnel

Radiological engineers are responsible for:

- Obtaining and maintaining Radiological Worker I training
- Obtaining and maintaining a combination of education and experience commensurate with their job responsibilities
- Maintaining an awareness of their job qualifications and continuing their training through external training courses, radiological control meetings, symposia, or other events helpful in enhancing their job proficiencies
- Continuing their training to remain aware of changes to the facility, operating experience, procedures, regulations, and quality assurance requirements

Dosimetry Technicians, medical personnel, and radiochemistry personnel are responsible for the following:

- Obtaining and maintaining current Radiological Worker I training, which incorporates applicable portions of DOE standardized radiological safety training materials and which is appropriate to the tasks they perform at WIPP

6.2.14 Radiological ALARA Committee Members

Radiological ALARA Committee members are responsible for:

- Obtaining and maintaining a minimum of Radiological Worker I training as required by WP 12-2
- Being trained in the principles of ALARA, basic ALARA techniques, and dose-reduction techniques

- Participating in selected portions of job-specific and specialized training, particularly in situations using mock-ups, before performing their work functions

6.2.15 Radiographers and Radiation-Generating Device Operators

Radiographers and radiation-generating device operators are responsible for:

- Obtaining and maintaining their training in 10 CFR §34, paragraph 31, "Training," before operating radiography or radiation-generating devices at WIPP

- Operating in accordance with the applicable WIPP approved procedures

6.2.16 General Employees

General employees are responsible for:

- Obtaining and maintaining GET

- Making constructive suggestions and comments concerning the upgrading of the Radiological Safety Training Program

6.3 Radiological Safety Training Requirements

Examinations for GET, Radiological Worker I and II training, and RCT qualification should be used to demonstrate satisfactory completion of theoretical and classroom material. Examinations should be written; however, the Technical Training Manager may approve alternatives to accommodate special needs. Alternative examinations should be equivalent in content to written examinations. The examination process is addressed in WIPP approved procedures.

Training should address both normal and abnormal situations in radiological control.

GET Refresher should be completed every year. Changes to the program should be incorporated as they are identified.

Radiological Worker I and II retraining should be completed every two years. In the alternate year when retraining is not performed, refresher training shall be completed.

Site-specific training and refresher training should include changes in requirements and updates of lessons learned from operations and maintenance experience and occurrence reporting, for the site and across the DOE complex.

Verification of the effectiveness of radiological safety training should be accomplished by surveying a limited subset of former students in the workplace. This verification is in addition to performance evaluations routinely performed by Technical Training. This

evaluation should include observation of practical applications and discussions of the course material, and may include written examinations. The survey should be performed by Radiological Control Manager and supervisors, quality assurance personnel, or senior instructors after the former student has had the opportunity to perform work for several months. The results should be documented.

Requirements for respiratory protection training are included in Section 5.3.1.

Training programs developed for radiological safety should meet the requirements for performance-based training and, when applicable, training accreditation.

Training records and course documentation should meet the requirements of Section 7.2.5.

6.4 General Employee Training

Personnel who may routinely enter the Controlled Area or encounter radiological barriers, postings, or radioactive materials shall receive GET. This training shall be successfully completed prior to potential occupational radiation exposure. GET is required for all employees.

GET should include the applicable standardized core course training materials.

Standardized core GET should be expanded to include site-specific information, such as site-specific radiation types, alarm responses and policies.

Information may be communicated by classroom lecture, videotape, or other applicable methods.

GET is required for all employees within one month of their initial assignment to the WIPP.

6.5 Radiological Orientation for Visitors

Visitors who enter Controlled Areas or, in special cases, other radiological areas as approved by the RS&EM Manager, should receive a radiological safety orientation that should include the following topics:

- Basic radiation protection concepts
- Risk of low-level occupational radiation exposure, including cancer and genetic effects
- Risk of prenatal radiation exposure
- Radiological protection policies and procedures

- Visitor and management responsibilities for radiation safety
- Adherence to radiological posting and labeling
- Applicable emergency procedures
- Training for issuance of dosimeters, where applicable

Information may be communicated by videotape or handout to personnel entering the WIPP site.

Records of the orientation shall be maintained. Visitor sign-in logs may be used as orientation records.

The orientation for continuously escorted individuals or groups should be commensurate with the areas to be visited. Records of orientation for such individuals or groups shall be retained.

If an escort is used in lieu of Radiological Worker I or II training, then the escort shall have completed the level of training required for the areas to be entered and the work to be performed and shall ensure that the escorted individual complies with the radiation protection program (see §835.901[d]). The escort and visitor shall comply with applicable WIPP approved procedures.

6.6 Radiological Worker Training

Radiological Worker I and II training is required for unescorted entry into areas as stated in Table 6-1. Additional training is required for special job functions with radiological consequences per Section 6.9.

Table 6-1 Radiological Worker Entry Training Requirements

Areas	GET or Visitor Orientation	Radiological Worker I	Radiological Worker II
Allows entry into Controlled Areas	YES	YES	YES
Allows entry into Radioactive Material Areas or Radiological Buffer Areas	NO	YES	YES
Allows entry into Radiation Areas	NO	YES	YES
Allows entry into High- or Very-High-Radiation Areas	NO	NO	YES
Allows entry into Contamination Areas and High-Contamination Areas	NO	NO	YES
Allows entry into Airborne Radioactivity Areas	NO	NO	YES

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

- Radiological Worker I and Radiological Worker II training are self-contained courses.

- Radiological Worker II training includes all of the requirements of Radiological Worker I training and expands on the topic of hands-on work with radioactive materials.

- Radiological Worker II training prepares the worker to deal with higher levels of radiation, radioactive contamination, and airborne radioactivity.

6.7 Radiological Worker I

Workers whose job assignments require access to RMAs, RBAs, and Radiation Areas should complete DOE standardized core Radiological Worker I training and site-specific Radiological Worker I training before being permitted entry into these areas without a qualified escort.

Radiological Worker I training should use the DOE standardized core course training materials and, in addition, shall emphasize site-specific information.

6.8 Radiological Worker II

Workers whose job assignments involve entry to High- and Very-High-Radiation, Contamination, High-Contamination, and Airborne Radioactivity Areas should complete Radiological Worker II training. Further, workers who have potential contact with hot particles or use of glove boxes with high contamination levels should complete Radiological Worker II training.

Radiological Worker II training should use the standardized core course training materials and, in addition, should emphasize site-specific information.

6.9 Specialized Radiological Worker Training

Specialized Radiological Worker Training shall be completed for nonroutine operations or work in areas with changing radiological conditions. This training is in addition to Radiological Worker II training and is required for personnel planning, preparing, and performing jobs that have the potential for high radiological consequences. Such jobs may involve special containment devices, the use of mock-ups, and ALARA considerations. Additional training for employees of specialized facilities, such as Central Characterization Facility, accelerators and laboratories, will be developed.

6.10 Radiological Control Technician Training and Qualification Program Elements

The RCT program consists of a curriculum that provides study and technical skills designed to fulfill the training objectives for RCT personnel. Knowledge is demonstrated via written and oral examinations. Skills are demonstrated by the "ability to perform" using the JPM system.

The RCT program is maintained and developed in accordance with WP 14-TR.01. All classroom training, testing, oral examination, requalification, and JPMs are developed through and maintained by Technical Training. The training records are also maintained by Technical Training.

6.10.1 Detailed Knowledge

The individual is required to have an operating, detailed level of knowledge of, and skills relating to, the following:

- Tasks performed in normal, abnormal, and emergency situations
- Principles, standards, and regulatory requirements of radiation/contamination control
- Radiological control instrumentation and its uses and limitations
- Receipt and shipment of radioactive waste
- Biological effects of radiation exposure
- Type and magnitude of potential hazards for each facility system
- Operational knowledge, responsibility, and authority of their position
- Documentation associated with the procedure/task
- Location of equipment

The individual is required to have the following emergency procedural knowledge:

- The immediate actions, including who to notify, where to go, and what documentation is required
- An understanding of the reasons for the action taken in the emergency procedure and the effect of the steps to be taken

- A detailed knowledge of their responsibilities and the skills required to fulfill those responsibilities
- Location of, and how to use, available emergency equipment

6.10.2 Temporary Radiological Control Technician Personnel

Temporary RCT personnel are usually requested by the Radiological Control Manager to fill a particular temporary need.

Temporary RCTs function in an RCT status and work under direct supervision of a qualified RCT until applicable qualification cards have been completed for the associated tasks. Once the qualifications have been completed, the temporary individual may perform these particular tasks without the direction and supervision of a qualified RCT.

6.10.3 Emergency Action Training

WP 12-9 establishes the emergency preparedness program for the protection of personnel and property for which WIPP is responsible.

The WIPP Emergency Management Program identifies lines of authority, the responsibilities of emergency response personnel and organizations, and the WIPP labor and equipment resources available to manage emergency conditions safely. In addition to the JPM requirements, classroom lectures, and drills on incident response, the following emergency training exercises are conducted throughout the year:

- An annual WIPP (sitewide) emergency action exercise
- Emergency action training drill(s) and a follow-up analysis critique for each drill
- Emergency actions addressed as a topic in formal training sessions scheduled by Technical Training
- Any additional emergency action training deemed necessary by management

6.10.4 Training Records

Training records document the training completed and provide evidence of qualification and qualification status of an individual. They also assist training personnel in preparing written and oral examinations for the individual by indicating strengths, weaknesses, accomplishments, and training progression paths associated with the individual's training background.

Training records are maintained in accordance with WP 14-TR.01. These records contain all items relating to the individual's current qualification. Training records storage is to be maintained in compliance with the current Technical Training RIDS.

7.0 RADIOLOGICAL RECORDS

7.1 Requirements

7.1.1 Purpose

This section contains the prescribed practices for preparing and retaining radiological control records. The work force and management are required to use records to document radiological safety afforded to individuals on-site. Records of radiological control programs may be required to support worker health studies and future disputes or claims. Therefore, these records should be high-quality, readily retrievable, and managed for the prescribed retention period. Consideration should be given to cross-referencing related records to aid retrievability. Records are handled such that personal privacy is protected.

To ensure that the above requirements are met, management of radiological control records are maintained in accordance of WP 15-PR, WIPP Records Management Program, and the records activities procedures.

Unless otherwise specified, radiological records shall use the following terms for radiation units and measurement: curie, rad, roentgen, or rem, including multiples and subdivisions of these units (see §835.4).

7.1.2 Record-Keeping Standards

Radiological control records should be accurate and legible. The records shall include the following:

- Identification of the facility, specific location, function, and process
- Signature or other identifying code of the preparer and date
- Legible entries in black ink
- Corrections identified by a single line-out, initialed, and dated
- Supervisory signature to ensure review and proper completion of forms

The radiological control organization maintains a file of names, signatures, and initials for future identification of the persons who signed or initialed a record.

Radiological control records should not include:

- Opaque substances for corrections (white out)
- Shorthand or other nonstandardized terms

7.2 Employee Records

7.2.1 Employment History

For each radiological worker whose occupational exposure is monitored in accordance with Section 5.1.1 or Section 5.2.1, efforts shall be made to obtain records of prior years' occupational doses. If formal records of previous occupational doses cannot be obtained, a written estimate signed by the individual may be accepted (see §835.702[e]). Where practical, the association between the radiation dose and job function should be preserved for trending purposes and future worker health studies. Maintenance of dosimetry records are further detailed in WP 12-3.

7.2.2 Personnel Radiological Records

Individual monitoring records shall be maintained to demonstrate compliance with the regulatory limits (see §835.701[a]).

- Records of doses received by all individuals for whom individual monitoring was performed as required by Section 5.1.1 or Section 5.2.1, including records of zero dose, shall be maintained (see §835.702[a]).

- These records shall be sufficient to evaluate compliance with all applicable dose limits and monitoring and reporting requirements (see §835.702[c][1] and [2]).

Radiation dose records shall contain information sufficient to identify each person, including social security, employee number, or other unique identifier (see §835.702[c][2]). For foreign nationals, the individual's passport number or a suitable alternative shall be used.

Procedures, data, and supporting information needed to reconfirm a person's dose at a later date shall be maintained.

External dose records shall include applicable extremity, skin, lens of the eye, and whole body dose monitoring results (see §835.702[c][3]). These doses are usually measured with personnel dosimeters, but records may include:

- Evaluations resulting from anomalous dose results such as unexpected high or low doses

- Dose reconstructions from lost or damaged dosimeters, or for unbadged workers

- Evaluations of nonuniform radiation doses

Internal dose records shall include committed effective dose equivalent (see §835.702[c][4][i]), committed doses to the affected organs and tissues (see §835.702[c][4][ii]), and identity of radionuclides (see §835.702[c][4][iii]). The supporting information typically includes the following:

- Applicable whole body and lung counting results (including chest wall thickness measurements where applicable)
- Applicable urine, fecal, and specimen analysis results, including estimated intake
- Dose assessment, as required

Records of the summation of external dose and committed dose equivalent to any organ receiving a reportable dose shall be maintained for the individual receiving such dose (see §835.702[c][5][ii]). The total effective dose equivalent received by each monitored individual shall be maintained for each year the individual is monitored.

Records of the summation of external dose and committed dose equivalent to any organ receiving a reportable dose shall be maintained for the individual receiving such dose (see §835.702[c][5][ii]).

The total effective dose equivalent received by each individual monitored in accordance with Section 5.1.1 or Section 5.2.1 shall be maintained for each year the individual is monitored (see §835.702[c][5][i]).

Records of the summation of external dose and committed dose equivalent to any organ receiving a reportable dose shall be maintained for the individual receiving such dose (see §835.702[c][5][ii]).

The total effective dose equivalent received by each individual monitored in accordance with Section 5.1.1 or Section 5.2.1 shall be maintained for each year the individual is monitored (see §835.702[c][5][i]).

The dose equivalent to the embryo/fetus of a declared pregnant radiological worker shall be maintained with the occupational dose records for that worker (see §835.702[c][6]).

Records of cumulative total effective dose equivalent received while an individual was employed at WIPP, since January 1, 1989, should be maintained with the individual's occupational exposure records.

Individual dose records shall include the cumulative total effective dose equivalent (see §835.702[c][5][iii]).

Efforts shall be made to obtain records of prior years' doses for each radiological worker monitored in accordance with Section 5.2.1 or Section 5.2.2 (see §835.702[e]). If an

individual's previous employer is not responsive to initial efforts to obtain these records, at least two additional attempts should be made. Records of lifetime occupational dose should be maintained with the individual's occupational dose records.

Counseling of individuals about radiological concerns should be documented and this documentation retained. The counseled individual should sign the documentation to acknowledge participation.

Records of authorization to exceed administrative control levels shall be retained.

Emergency doses and planned special exposures shall (see §835.204 and §1302) be accounted for separately, but should be maintained with the individual's occupational exposure records.

Records of nonuniform dose to the skin need not be retained in an individual's dose records if the dose is less than 2 percent of the occupational dose limit for the skin in Table 2-1 (see §835.702[b]) (see Section 7.2.3 for requirements for records of radiological incidents and occurrences).

Detailed information concerning an individual's exposure shall be made available to that individual, upon request, consistent with the PL93579, Privacy Act of 1974, as amended, which contains requirements to protect the privacy of individual records.

Personnel records that name an individual shall be strictly private information. Such records shall be available only to the employee and to personnel needing them for the performance of their duties. The release of this information to other persons will be permitted only upon specific, written approval of the individual or when required by law.

7.2.3 Other Personnel Radiological Records

The complete records of radiological incidents and occurrences involving personnel dose should be retained in, or cross-referenced to, the individual's dose records. Records related to doses exceeding the Table 2-1 limits including authorized emergency doses and planned special exposures and other, nonauthorized doses exceeding the limits, shall be maintained (see §835.1301[b]).

Records of employee radiological safety concerns that have been formally investigated and documented should be maintained.

Records of the formal written declaration of pregnancy, including the estimated conception date, and revocations of pregnancy shall be maintained. Records of the formal written declaration of pregnancy, including the estimated conception date, and revocations of declarations of pregnancy shall be maintained (see §835.704[d]). Records indicating that the pregnancy has concluded (therefore, the conditions of Section 2.1.5 do not apply) should also be maintained.

These records are maintained in accordance with WP 12-3.

7.2.4 Medical Records

Medical records should be maintained in accordance with Industrial Safety records requirements. These include the preemployment examinations, physical examinations, fit test results and medical evaluations and treatment performed in support of the radiological control program.

7.2.5 Radiological Training and Qualification Records

Records of training and qualification in radiological control are maintained to demonstrate that an individual received appropriate information to perform the work

assignment in a safe manner. Qualification standard records shall be retained for OJT and practical factor training as well as for formal classroom training.

Formal records or summary reports of training and qualification shall be readily available to first-line supervision and management of involved personnel to aid in making work assignments.

The personnel training records are maintained by Technical Training (see §835.704 [a]). At a minimum, these records should include the following:

- Course title
- Attendance sheets with instructor's name
- Employee's name, identification number, and signature
- Date of training
- Identification of the examination or evaluation form, including sufficient data to identify which test each individual completed
- Verification document or record confirming satisfaction of the training requirement
- Documentation related to exceptions for training requirements and extensions of qualification
- Examinations, with the date and name of the individual trained
- Special instructions to females, and their supervisors and coworkers, concerning prenatal radiation dose, acknowledged by the worker's signature

Records shall be retained for the following types of radiation safety training (see §835.704[a]):

- General Employee Radiological Training
- Radiological Worker Training
- Periodic training

Records are retained for the following types of radiological safety training:

- Instructor training
- Training of other radiological control personnel
- Respiratory protection training
- Qualifications for special tests or operations
- Orientation of members of the public
- Training of emergency response personnel

Records shall be maintained as necessary to demonstrate that individuals who are responsible for the development and implementation of measures necessary to ensure compliance with 10 CFR Part 835 have the appropriate education, training, and skills to execute these responsibilities (see §835.103 and §835.701[a]).

The following instructional materials should be maintained:

- Course name, with revision and approval date
- Instructor's manuals, course content, or lesson plans containing topical outlines
- Video and audio instructional materials, including the dates and lessons for which they were used
- Job-specific training documents, such as instrument use, radiological procedures, RWP special training requirements, pre-job briefings and mock-up training

Documentation of training and qualification received at another DOE location need not be duplicated. Such records are provided to Technical Training for retention in the individual's personnel training record.

7.3 Visitors

7.3.1 Record Requirements

Documentation of completion of radiological orientation shall be maintained for visitors entering an area where radiation monitoring is required.

Records of doses, including zero dose, received by all visitors for whom monitoring was performed shall be maintained. These records shall be sufficient to evaluate compliance with all applicable dose limits and monitoring and reporting requirements.

7.3.2 Reports

The dosimetry reports are performed in accordance with WP 12-3.

7.4 Radiological Control Procedures

7.4.1 Policies, Procedures and Radiological Work Permits

Records of the Radiological Control Program should consist of policy statements, procedures, work authorizations, and supporting data. The records should be maintained in a chronological sequence that will allow correlation with the corresponding support information. For example, procedures for performing radiation surveys should be identifiable with the survey results. Completed RWPs should be maintained.

The policies related to radiological control are described in this manual. Radiological control position papers provide additional clarification. Implementation should be achieved through procedures or radiological control position papers, as appropriate.

Records generated by radiological control procedures shall be maintained so that the resulting document can be tied back to the governing procedure. Procedures are developed and maintained according to the applicable WIPP approved procedures.

7.4.2 ALARA Program Records

ALARA records are maintained in accordance with WP 12-2.

7.4.3 Quality Assurance Records

Records of quality assurance reviews and audits developed for radiological control functions shall be retained to ensure that sufficient records are specified, prepared, reviewed, approved, and maintained to accurately reflect completed work (see §835.704[c]).

| DOE O 231.1A, *Environment, Safety, and Health Reporting*, and 10 CFR §830 Subpart A, Quality Assurance Requirements, provide additional information regarding quality assurance records. Quality assurance records should include:

- Assessment checklists
- Assessment methods
- Assessment results
- Assignment of corrective actions
- Completion and verification of corrective actions

Quality assurance records shall be identified and controlled in accordance with WP 15-PR.

7.5 Radiological Monitoring

7.5.1 Area Monitoring Records

Radiological control programs require the performance of radiation, airborne radioactivity, and contamination monitoring to determine existing conditions in a given location. Maps with sufficient detail to permit identification of original survey and sampling locations should be maintained. Radiological monitoring results should be recorded on appropriate standard forms and include the following common elements:

- Date, time, and purpose of the survey
- General and specific location of the survey
- Name and signature of the surveyor and analyst
- Pertinent information needed to interpret the survey results
- Reference to a specific RWP if the survey is performed to support the permit

Records shall be maintained to document:

- Results of monitoring and surveys for radiation and radioactive materials (see §835.703[a])
- Results of monitoring and calculations used to determine individual occupational doses (see §835.703[b])
- Results of surveys for release of materials from radiological areas (see §835.703[c])
- Results of sealed radioactive source leak tests and inventories (see §835.704[f])
- Results of surveys of radioactive material packages received from transportation (see §835.405 and §835.701[a])
- Changes in monitoring equipment, techniques, and procedures (see §835.704[e])

7.5.2 Radiation Monitoring

In addition to the elements provided in Section 7.5.1, records of radiation monitoring should include, at a minimum, the following information:

- Instrument model and serial number
- Results of the measurements of area dose rates

- Locations of hot spots and other radiological hazards
- Facility conditions existing during the survey that may have affected radiological conditions

7.5.3 Airborne Radioactivity Monitoring

In addition to the elements provided in Section 7.5.1, records of airborne radioactivity monitoring should include, at a minimum, the following information:

- Model and serial numbers of the sampler and laboratory counting instrument, when available, or unique identifier of each sampler and instrument and appropriate supporting parameters including counting efficiency, counting time, and correction factors
- Location of fixed samplers
- Locations of portable air samplers used for a survey
- Air concentrations in general airborne areas and breathing zones
- Supporting parameters, including collection efficiency, flow rate, duration of sampling, correction factors, and filter medium
- Identification (e.g., names and/or employee numbers) of individuals in the area for whom DAC-hour exposure should be calculated

7.5.4 Contamination Monitoring

In addition to the elements required in Section 7.5.1, records of contamination monitoring include, at a minimum, the following information:

- Model and serial number of counting equipment
- Contamination levels (using appropriate units) and appropriate supporting parameters, including counting efficiency, counting time, correction factors, type of radiation, and whether the contamination was fixed or removable
- Location of areas found to contain high concentrations of localized contamination
- Follow-up survey results for decontamination processes cross-referenced to the original survey

7.5.5 Sealed Radioactive Source Leak Tests and Inventories

In addition to the elements provided in Section 7.5.1, records of sealed radioactive source leak tests should include, at a minimum, the following information:

- Model and serial number of counting equipment
- Contamination levels (using appropriate units) and appropriate supporting parameters including counting efficiency, counting time, correction factors, and type of radiation
- Corrective actions for leaking sources

Records of accountable sealed radioactive source inventories shall include, at a minimum, the following information (see §835.704[f] and §835.1202[a]):

- The physical location of each accountable sealed radioactive source
- Verification of the presence and adequacy of associated postings and labels
- Verification of the adequacy of storage locations, containers, and devices

7.5.6 Personnel Area Monitoring Dosimetry Results

The analytical data from area monitoring dosimeters shall be maintained by Dosimetry in accordance with approved procedures. The radiological control organization should prepare trend analyses on the area monitoring dosimetry results.

7.6 Instrumentation and Calibration Records

7.6.1 Calibration and Operational Checks

Calibration records for fixed, portable and laboratory radiation measuring equipment and individual monitoring devices are maintained (see §835.703[d]). These records include frequencies, methods, dates, personnel, training, and traceability of calibration sources to NIST or other acceptable standard. All calibrations and operational checks are performed using applicable WIPP approved procedures and records are maintained in accordance with the applicable RIDS.

7.6.2 Special Calibration Records

Records of additional tests and checks of instrumentation used in conjunction with a suspected overexposure, questionable indication, or unusual occurrence should be retained. In addition, records of special instrument calibrations and modifications made in accordance with Section 5.6.2 shall be retained (see §835.703[d]).

7.7 Records Management

Records for the site are created and maintained in accordance with WP 15-PR and the approved applicable RIDS.

7.8 Radiological Reporting

7.8.1 Reports to Individuals

Individuals who are monitored shall be provided an annual report of their dose (see §835.801[c]). Upon request, an individual shall be provided detailed information concerning his or her exposure, consistent with the Privacy Act (see §835.801[d]).

Upon request, terminating employees shall be provided a written estimate, based upon available information (see §835.801[b]). These reports are further detailed in WP 12-3.

7.8.2 Annual Radiation Report

| DOE O 231.1-1A provides reporting requirements for the Annual Radiation Dose Summary. This report includes internal and external radiation dose results for monitored DOE and DOE contractor employees, and for monitored members of the public. This is further detailed in 12-3.

8.0 REFERENCES

Title 10 CFR Part 34, "Licenses for Industrial Radiography and Radiation Safety Requirements for Industrial Radiographic Operations"

Title 10 CFR Part 830 Subpart A , "Quality Assurance Requirements"

Title 10 CFR Part 835, "Occupational Radiation Protection"

Title 29 CFR §1910.134, "Respiratory Protection"

Title 40 CFR Part 61, "National Emission Standards for Hazardous Air Pollutants"

Title 40 CFR Part 191, "Environmental Radiation Protection Standards for Management
| and Disposal of Spent Nuclear Fuel, High-Level, and Transuranic Radioactive Wastes"

Title 49 CFR §171 through 49 CFR §180, "Hazardous Materials Regulations"

ANSI N2.1, *Warning Symbols - Radiation Symbol*

ANSI N323A, *Radiation Protection Instrumentation Test and Calibrations, Portable Survey Instruments*

ANSI Z88.2, *Practices for Respiratory Protection*

ASME AG-1, *Code on Nuclear Air and Gas Treatment*

ASME N509, *Nuclear Power Plant Air-Cleaning Units and Component with Addenda*

ASME N510, *Testing of Nuclear Air Treatment Systems*

Atomic Energy Act

DOE G 441.1, Series of Guides

DOE memorandum (Nov. 17, 1995), from Raymond F. Pelletier on Application of DOE O 5400.5 requirements for release and control of property containing residual radioactive material

| DOE O 231.1A, *Environment, Safety, and Health Reporting*

| DOE O 420.1A, *Facility Safety*

DOE O 435.1, *Radioactive Waste Management*

DOE O 5400.5, *Radiation Protection of the Public and the Environment*

DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities*

DOE P 450.4, *Safety Management System Policy*

DOE-STD-3020-97, *DOE Standard Specification for HEPA Filters Used by DOE Contractors*

DOE-STD-3022-98, *DOE Standard DOE HEPA Filter Test Program*

DOE-STD-3025-99, *DOE Standard Quality Assurance Inspection and Testing of HEPA Filters*

DOE-STD-3026-99, *DOE Standard Filter Test Facility Quality Program Plan*

DOE-STD-1095-95, *DOE Standard Department of Energy Laboratory Accreditation Program for Personnel Dosimetry Systems*

DOE-STD-1098-99, *DOE Standard Radiological Control*

| DOE/WIPP-95-2065 *Waste Isolation Pilot Plant Contact Handled (CH) Documented*
| *Safety Analysis*

ICRP Publication 23, *Report of the Task Group on Reference Man*

ICRP Publication 26, *Recommendations of the International Commission on Radiological Protection*

MP 1.2, Work Suspension and Stop-Work Direction

NCRP Report 65, "Management of Persons Accidentally Contaminated with Radionuclides"

NCRP Report 91, "Recommendations on Limits for Exposure to Ionizing Radiation"

PL93576, Privacy Act of 1974, as amended

Resource Conservation and Recovery Act

Toxic Substances Control Act

| WP 04-IM1000, Issues Management Program Processing of WIPP Forms

WP 10-2, Maintenance Operations Instruction Manual

WP 12-2, WIPP ALARA Program Manual

WP 12-3, WIPP Dosimetry Program

WP 12-9, WIPP Emergency Management Program

WP 12-HP3200, Radioactive Material Control

WP 14-TR.01, WIPP Training Program

WP 15-PR, WIPP Records Management Program

APPENDIX - GLOSSARY

abnormal situation: Unplanned event or condition that adversely affects, or potentially affects or indicates degradation in, the safety, security, environmental, or health protection performance or operation of a facility.

accountable sealed radioactive source: A sealed radioactive source having a half-life equal to or greater than 30 days and an isotopic activity equal to or greater than the corresponding value provided in WP 12-HP3200 (see §835.2[a]).

activation: Process of producing a radioactive material by bombardment with neutrons, protons, or other nuclear particles.

administrative control level: A numerical dose constraint established at a level below the occupational dose limits provided in Section 2.0 to administratively control and help reduce individual and collective doses.

airborne radioactivity: Radioactive material in the air in the form of dusts, fumes, particulates, mists, vapors, or gases (see §835.2[a]).

Airborne Radioactivity Area: Any area, accessible to individuals, where the measured concentration of airborne radioactivity, above natural background, exceeds or is likely to exceed 30 percent of the DAC values listed in Appendices A and C of 10 CFR Part 835 (12 DAC-hr from §835.2(a)(2) ÷ 40 hrs in a work week = 0.3 DAC).

annual limit on intake (ALI): The derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. The ALI is the smaller value of intake of a given radionuclide in a year by the reference man (ICRP Publication 23, Report of the Task Group on Reference Man) that would result in a CEDE of 5 rems (0.05 sievert) or a committed dose equivalent of 50 rems (0.5 sievert) to any individual organ or tissue (see §835.2[a]).

as low as reasonably achievable (ALARA): The approach to radiation protection to manage and control exposures (individual and collective) to the workforce and the general public to as low as is reasonable, taking into account social, technical, economic, practical, and public policy considerations. As used in this manual, ALARA is not a dose limit but a process that has the objective of attaining doses as far below the applicable controlling limits as is reasonably achievable (see §835.2[a]).

ALARA Committee: Multidisciplined forum that reviews and advises management on improving progress toward controlling radiation exposure and radiological releases.

assessment: Evaluation or appraisal of a process, program, or activity to estimate its acceptability.

APPENDIX - GLOSSARY

background radiation: Radiation from:

- Naturally occurring radioactive materials that have not been technologically enhanced;
- Cosmic sources;
- Global fallout as it exists in the environment (such as from the testing of nuclear explosive devices);
- Radon and its progeny in concentrations or levels existing in buildings or the environment which have not been elevated as a result of current or prior activities; and
- Consumer products containing nominal amounts of radioactive material or producing nominal amounts of radiation (see §835.2[a]).

becquerel (Bq): The International System (SI) unit for activity of radioactive material. One becquerel is that quantity of radioactive material in which one atom is transformed per second or undergoes one disintegration per second.

bioassay: The determination of the kinds, quantities, or concentrations and, in some cases, locations of radioactive material in the human body, whether by direct measurement or by analysis and evaluation of radioactive materials excreted or removed from the human body (see §835.2[a]).

calibration: The process of adjusting or determining either:

- The response or reading of an instrument relative to a standard (e.g., primary, secondary, or tertiary) or to a series of conventionally true values; or
- The strength of a radiation source relative to a standard (e.g., primary, secondary, or tertiary) or conventionally true value (see §835.2[a]).

check source: A radioactive source used to confirm the continuing satisfactory operation of an instrument's detector and associated electronics.

collective dose: The sum of the total effective dose equivalent values for all individuals in a specified population. Collective dose is expressed in units of person-rem (or person-sievert).

committed dose equivalent ($H_{T,50}$): The dose equivalent calculated to be received by a tissue or organ over a 50-year period after the intake of the radionuclide into the body. It does not include contributions from radiation sources external to the body. Committed dose equivalent is expressed in units of rem (or sievert).

APPENDIX - GLOSSARY

committed effective dose equivalent ($H_{E,50}$): The sum of the committed dose equivalents to various tissues in the body ($H_{T,50}$), each multiplied by the appropriate weighting factor (W_T) - that is $H_{E,50}=\Sigma W_T H_{T,50}$. CEDE is expressed in units of rem (or sievert).

company-issued clothing: Clothing provided by the company, such as work coveralls and shoes. For radiological control purposes, company-issued clothing shall be considered the same as personal clothing.

containment device: Barrier such as a glove bag, glove box, or tent for inhibiting the release of radioactive material from a specific location. The containment device most routinely used at WIPP is the vent hood.

contamination (radioactive): Deposits of radioactive material in an unwanted place with levels greater than the values specified in Table 2-5.

Contamination Area: Any area, accessible to individuals, where contamination levels are greater than the values specified in Table 2-5 but less than or equal to 100 times those values (see §835.2[a]).

continuing training: Training scheduled over a specified time, such as over a two-year period, for the purpose of maintaining and improving technical knowledge and skills.

continuous air monitor (CAM): Instrument that continuously samples and measures the levels of airborne radioactive materials on a "real-time" basis and has alarm capabilities at preset levels. Also referred to as a "real-time" air monitor.

control point: Access and egress point to posted areas limiting access to properly trained or escorted and authorized personnel.

Controlled Area: Any area to which access is managed by or for the DOE to protect individuals from exposure to radiation and/or radioactive material (see §835.2[a]).

counseling: Advice, information exchange, and guidance provided to employees on radiologically related topics, such as dose perspectives, potential health effects from radiation exposure, skin contaminations, contaminated wounds, internally deposited radioactivity, pregnancy, and radiation exposure. This advice and guidance is normally provided by knowledgeable, senior professionals from the radiological control organization and other organizations, such as medical, as appropriate.

critique: Meetings of personnel involved in or knowledgeable about an event (either a success or an abnormal event) to document a chronological listing of the facts.

APPENDIX - GLOSSARY

cumulative total effective dose equivalent: The sum of the total effective dose equivalents recorded for an individual for each year of employment at a DOE or DOE contractor site or facility, effective January 1, 1989.

declared pregnant worker: A woman who has voluntarily declared to her employer, in writing, her pregnancy for the purpose of being subject to occupational exposure limits to the embryo/fetus as provided in Section 2.1.5. This declaration may be revoked, in writing, at any time by the declared pregnant worker (see §835.2[a]).

decontamination: Process of removing radioactive contamination and materials from personnel, equipment, or areas.

deep dose equivalent: The dose equivalent derived from external radiation at a tissue depth of 1 cm in tissue.

derived air concentration (DAC): For the radionuclides listed in Appendix A of 10 CFR Part 835, the airborne concentration that equals the ALI divided by the volume of air breathed by an average worker for a working year of 2,000 hours (assuming a breathing volume of 2,400m^3). For radionuclides listed in Appendix C of 10 CFR Part 835, the air immersion DACs were calculated for a continuous, nonshielded exposure via immersion in a semi-infinite atmospheric cloud. The values are based upon the DAC found in Table 1 of the Environmental Protection Agency's Federal Guidance Report No. 11, *Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion,* published September 1988 (see §835.2[a]).

derived air concentration hours (DAC-hours): The product of the concentration of radioactive material in air (expressed as a fraction or multiple of the DAC for each radionuclide) and the time of exposure to that radionuclide, in hours [see §835.2(a)].

disintegration per minute (dpm): The rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

DOELAP: Department of Energy Laboratory Accreditation Program for personnel dosimetry and bioassay programs.

dose: Various technical terms, such as dose equivalent, effective dose equivalent, and collective dose, are used to describe the amount of radiation an exposed individual receives. These terms are used to describe the differing interactions of radiation with tissue as well as to assist in the management of personnel exposure to radiation.

Some types of radiation, such as neutron and alpha, deposit their energy more densely in affected tissue than gamma radiation, thereby causing more damage to tissue. The term.

APPENDIX - GLOSSARY

dose equivalent: measured in units of rem, is used to take into account this difference in tissue damage. Therefore, 1 rem from gamma radiation causes damage **equivalent** to 1 rem from alpha radiation. However, it takes one-twentieth as much energy from alpha radiation, as compared with gamma radiation, to produce this 1 rem **dose equivalent**.

Definitions for dose terms necessary for various exposure calculations and record-keeping purposes include the following:

dose equivalent (H): The product of the absorbed dose (D) (in rad or gray) in tissue, a quality factor (Q), and all other modifying factors (N). Dose equivalent is expressed in units of rem (or sievert) (1 rem = 0.01 sievert) (see §835.2[b]).

dose rate: Absorbed dose or dose equivalent delivered per unit time.

effective dose equivalent (H_E): The summation of the products of the dose equivalent received by specified tissues of the body (H_T) and the appropriate weighting factors (W_T) - that is ($H_E = \Sigma W_T H_T$). It includes the dose from radiation sources internal and/or external to the body. For purposes of demonstrating compliance with the regulatory dose limits, deep dose equivalent to the whole body may be used as effective dose equivalent for external exposures. The effective dose equivalent is expressed in units of rem (or sievert) (see §835.2[b]).

embryo/fetus: Developing human organism from conception until birth. Same as unborn child.

engineering controls: Use of components and systems to reduce airborne radioactivity and the spread of contamination by using piping, containments, ventilation, filtration, or shielding.

external dose or exposure: That portion of the dose equivalent received from radiation sources outside the body (e.g., "external sources") (see §835.2[b]).

extremity: Hands and arms below the elbow or feet and legs below the knee (see §835.2[b]).

facility: For the purposes of this manual, 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, accommodations for analytical examinations of components, pipelines, ponds, impoundments, landfills and the like, motor vehicle and rolling stock, and aircraft.

APPENDIX - GLOSSARY

fixed contamination: Radioactive material that cannot be readily removed from surfaces by nondestructive means, such as casual contact, wiping, brushing, or laundering.

general employee: An 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 the DOE or uses DOE facilities (see §835.2[b]).

gestation period: The time from conception to birth, approximately nine months.

gray (Gy): SI unit of absorbed dose. One gray is equal to an absorbed dose of 1 joule per kilogram (100 rads).

high-efficiency particulate air (HEPA) filter: Throwaway extended pleated medium dry-type filter with (1) a rigid casing enclosing the full depth of the pleats, (2) a minimum particle removal efficiency of 99.97 percent for thermally generated monodisperse di-octyl phalate smoke particles with a diameter of 0.3 micrometer, and (3) a maximum pressure drop of 1.0 inch w.g. when clean and operated at its rated airflow capacity.

High-Contamination Area: Any area where contamination levels are greater than 100 times the values specified in Table 2-5 (see §835.2[a]).

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 Sv) in one hour at 30 cm from the radiation source or from any surface that the radiation penetrates (see §835.2[a]).

infrequent or first-time activities: Radiological work activities or operations that require special management attention and consideration of new or novel radiological controls. The designation of infrequent or first-time activities is specifically applicable to facilities that conduct routine and recurring process operations, and is not applicable to facilities that routinely conduct first-time activities, such as experimental or research facilities.

intake: Quantity of radioactive material inhaled or ingested (also see uptake).

internal dose or exposure: That portion of the dose equivalent received from radioactive material taken into the body (e.g., "internal sources").

job performance measure evaluator: A cognizant individual most knowledgeable on an equipment item, system, operation, or process. This person has also been trained and qualified to instruct others on their particular subject matter. To be certified as an JPME at WIPP, an individual must be designated in writing by his or her manager, must be qualified as a Level I Instructor, must have passed a formal JPME course, and must have passed an RCT 01-C board.

APPENDIX - GLOSSARY

leak test: The testing of a radioactive source to indicate whether or not radioactive material has leaked or otherwise been removed from the source.

lens of eye dose equivalent: The dose equivalent derived from external radiation at a tissue depth of 0.3 cm in tissue.

mixed waste: Waste containing both radioactive and hazardous components as defined by the Atomic Energy Act and the Resources Conservation and Recovery Act, respectively (see §835.2[a]).

monitoring: Actions intended to detect and quantify radiological conditions.

occupational dose: An individual's dose due to exposure to ionizing radiation (external and internal) as a result of that individual's work assignment. Occupational exposure does not include planned special exposures, exposure received as a medical patient, background radiation, or voluntary participation in medical research programs (see §835.2[a]).

personal protective equipment (PPE): Equipment such as respirators, face shields, and safety glasses used to protect workers from excessive exposure to radioactive or hazardous materials.

personnel dosimeters: Devices designed to be worn by a single person for the assessment of dose equivalent such as film badges, TLDs, and pocket ionization chambers. The personnel dosimetry used at WIPP consists of TLDs as primary dosimeters and digital electronic dosimeters as supplemental dosimeters.

personnel monitoring: Systematic and periodic estimate of radiation dose received by personnel during working hours. Also, the monitoring of personnel, their excretions, skin, or any part of their clothing to determine the amount of radioactivity present.

planned special exposure: Preplanned, infrequent exposure to radiation, separate from and in addition to the annual dose limits.

prenatal radiation exposure: The exposure of an embryo/fetus to radiation.

primary dosimeter: A dosimeter worn on the body and used to obtain the formal record of whole body radiation dose. The primary dosimeter used at WIPP is the TLD.

protection factor: A measure of the protection afforded by a respirator; the ratio of the concentration of the radionuclide in the ambient atmosphere to the concentration inside the respiratory equipment (usually inside the face piece) under the conditions of use.

APPENDIX - GLOSSARY

protective clothing (PC): Clothing provided to personnel to minimize the potential for skin, and personal and company-issued clothing contamination; also referred to as "anticontamination clothing," "anti-Cs," and "PCs."

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 radiological control technicians at DOE facilities, including WIPP.

rad: Unit of absorbed dose. One rad is equal to an absorbed dose of 100 ergs per gram, or 0.01 joules per kilogram (0.01 gray).

radiation or ionizing radiation: Alpha particles, beta particles, gamma rays, X-rays, neutrons, high-speed electrons, high-speed protons, and other particles capable of producing ions. Radiation as used in this manual does not include nonionizing radiation, such as radio- or microwaves, or visible, infrared, or ultraviolet light (see §835.2[a]).

radiation area: Any area, accessible to individuals, in which radiation levels could result in an individual's receiving a deep dose equivalent in excess of 0.005 rem (0.05 mSv) in one hour at 30 cm from the radiation source or from any surface that the radiation penetrates (see §835.2[a]).

radioactive material: For the purposes of this manual, radioactive material includes any material, equipment, or system component determined to be contaminated or suspected of being contaminated. Radioactive material also includes activated material, sealed and unsealed sources, and material that emits radiation. Items located in Contamination, High-Contamination or Airborne Radioactivity Areas and having the potential to become contaminated are considered radioactive material until uncontrolled released from that area.

radioactive material area (RMA): Any area within a Controlled Area, accessible to individuals, in which items or containers of radioactive material exist and the total activity of radioactive material exceeds the applicable values provided in 10 CFR Part 835, Appendix E.

radioactive waste: Solid, liquid, or gaseous material that contains radionuclides regulated under the Atomic Energy Act, as amended, and is of negligible economic value considering the cost of recovery.

radioactivity: A natural and spontaneous process by which the unstable atoms of an element emit or radiate excess energy from their nuclei and, thus, change (or decay) to atoms of a different element or to a lower energy state of the same element.

APPENDIX - GLOSSARY

radiography: Examination of the structure of materials by nondestructive methods, using a radioactive source or a radiation-generating device.

radiological area: Any area(s) within a Controlled Area (but not including the Controlled Area) defined as a Radiation Area, High-Radiation Area, Very High-Radiation Area, Contamination Area, High Contamination Area, or Airborne Radioactivity Area (see §835.2[a]).

radiological buffer area (RBA): An intermediate area established to prevent the spread of radioactive contamination and/or to protect personnel from radiation exposure.

radiological control hold point: Cautionary step in a technical work document requiring the radiological control organization to perform some action or verification.

radiological label: Label on an item which indicates the presence of radiation or radioactive materials.

radiological posting: Sign, marking, or label that indicates the presence or potential presence of radiation or radioactive materials.

radiological work: Any work that requires the handling of radioactive material or access to RMAs, RBAs, or radiological areas.

radiological work permit (RWP): Permit that identifies radiological conditions, establishes worker protection and monitoring requirements, and contains specific approvals for radiological work activities. The RWP serves as an administrative process for planning and controlling radiological work and informing the worker of the radiological conditions.

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 (1 mSv) per year TEDE (see §835.2[a]).

real-time air monitoring: Measurement of the concentrations or quantities of airborne radioactive materials on a continuous basis [see §835.2(a)]. Also see "continuous air monitor."

refresher training: Training scheduled on the alternate year when full retraining is not completed for Radiological Worker I and Radiological Worker II personnel.

release to uncontrolled areas: Release of material from administrative control after confirming that the residual radioactive material meets the guidelines in DOE O 5400.5.

APPENDIX - GLOSSARY

rem: Unit of dose equivalent. Dose equivalent in rem is numerically equal to the absorbed dose in rad multiplied by a quality factor, distribution factor, and any other necessary modifying factor (1 rem = 0.01 sievert).

removable contamination: Radioactive material that can be removed from surfaces by nondestructive means, such as casual contact, wiping, brushing or washing (also referred to as loose surface contamination).

response check: Verification that a radiation detection system responds, within a predetermined specification, to a radiation source.

sealed radioactive source: A radioactive source manufactured, obtained, or retained for the purpose of utilizing the emitted radiation. The sealed radioactive source consists of a known or estimated quantity of radioactive material contained within a sealed capsule, sealed between layer(s) of nonradioactive material, or firmly fixed to a non-radioactive surface by electroplating or other means intended to prevent leakage or escape of the radioactive material. Sealed radioactive sources do not include reactor fuel elements, nuclear explosive devices, and radioisotope thermoelectric generators (see §835.2[a]).

shallow dose equivalent: The dose equivalent deriving from external radiation at a depth of 0.007 cm in tissue.

sievert (Sv): SI unit of any of the quantities expressed as dose equivalent. The dose equivalent in sieverts is equal to the absorbed dose in grays multiplied by the quality factor (1 Sv = 100 rems).

smear: See swipe.

source leak test: A test to determine if a sealed radioactive source is leaking radioactive material [see §835.2(a)].

source custodian: The person responsible for ensuring that all accountability, storage, handling, and movement requirements are met for the sources assigned to them.

standard radiological warning trefoil: Symbol designed and proportioned as illustrated in ANSI N2.1.

step-off pad: Transition area between contaminated and noncontaminated areas that is used to allow exit of personnel and removal of equipment.

APPENDIX - GLOSSARY

survey: An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation. When appropriate, such an evaluation includes a physical survey of the location of radioactive material and measurements or calculations of levels of radiation, or concentrations or quantities of radioactive material present.

swipe: A technique for sampling for removable surface contamination using a small, round piece of cloth or paper.

technical work document: A generic term used to identify formally approved documents that direct work, such as procedures, work packages, or job or research plans.

thermoluminescent dosimeter: Radiation monitoring device used to record the radiological exposure of personnel or areas to certain types of radiation.

total effective dose equivalent: The sum of the effective dose equivalent (for external exposures) and the CEDE (for internal exposures). Deep dose equivalent to the whole body may be used as effective dose equivalent for external exposures.

transuranic waste: Without regard to source or form, waste that is contaminated with alpha-emitting TRU radionuclides having half-lives greater than 20 years and concentrations greater than 100 nCi/g at the time of assay.

unusual occurrence: Nonemergency occurrence that has significant impact or potential for impact on safety, environment, health, security, or operations.

uptake: The deposition and retention of radioactive material in body organs and tissues.

very-high-radiation area: An 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.

visitor: Person requesting access to a Controlled Area who has not been trained to the level required to permit unescorted access. This includes members of the general public and workers who have not completed GET.

weighting factor (W_T): The fraction of the overall health risk, resulting from uniform, whole body irradiation, attributable to specific tissue (T). The dose equivalent to the affected tissue, H_T, is multiplied by the appropriate weighting factor to obtain the effective dose equivalent contribution from that tissue.

APPENDIX - GLOSSARY

whole body: For the purposes of external exposure, head, trunk (including male gonads), arms above and including the elbow, or legs above and including the knee.

whole body dose: The sum of the effective dose equivalent for external exposures and the CEDE for internal exposures. Also referred to as TEDE.

year: The period beginning on or near January 1 and ending on or near December 31 of that same year used to determine compliance with the provisions of 10 CFR Part 835. The starting date of the year used to determine compliance may be changed provided that the change is made at the beginning of the year and that no day is omitted or duplicated in consecutive years (see §835.2[a]).