



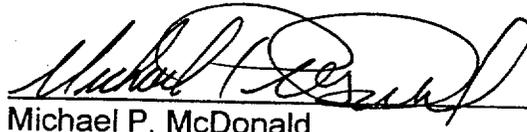
Procedure No: RPO-402

Revision No: 1

Effective Date: 9-1-02

RADIOLOGICAL POSTING AND LABELING

Authored By:



Michael P. McDonald
Radiological Engineer

5-30-02
Date

Reviewed By:



Jeffrey W. Lively
Health Physicist

8/16/02
Date

Approved By:



Steven D. Rima
Radiological Engineering Manager

8/16/02
Date

This page intentionally left blank.

RADIOLOGICAL POSTING AND LABELING

1.0 PURPOSE

- 1.1 The purpose of this procedure is to provide instruction for the posting and labeling of radiologically controlled areas, equipment, and material. This procedure also identifies the requirements for documenting and inspecting these posted areas.

2.0 APPLICABILITY

- 2.1 This procedure applies to MACTEC, Inc. management, supervisors, individuals and contractors that post or label radiologically controlled areas, equipment, and materials where their work assignment is controlled by MACTEC, Inc.

3.0 REFERENCES

- 3.1 10 CFR 20, "Standards for Protection Against Radiation."
3.2 10 CFR 835, "Occupational Radiation Protection."
3.3 RPO-101, "Radiation Protection Program Overview."
3.4 NRC Regulatory Guide 8.38, June 1993.

4.0 DEFINITIONS AND ABBREVIATIONS

- 4.1 See RPO Glossary.
4.2 Permanent Posting - Any area intended or expected to be posted for a period of greater than 90 days shall be considered a Permanent Posting.

5.0 GENERAL

5.1 EQUIPMENT

- 5.1.1 Radiological warning signs, stickers, labels, and tags
5.1.2 Information inserts for warning signs
5.1.3 Radiological warning rope, ribbon, chain, or tape
5.1.4 Stanchions

PROCEDURE NO: RPO-402

REVISION NO: 1

PAGE NO: 1 OF 7

5.2 SAFETY CONSIDERATIONS

Not applicable

5.3 RESPONSIBILITIES

5.3.1 RSO (or designee):

- Implement this procedure.
- Ensure individuals are qualified to perform this procedure.
- Implement oversight and specific control measures needed for entry into high and very high radiation areas.

5.3.2 Health Physics Staff:

- Comply with this procedure.
- Ensure compliance with posting, labeling, and access control requirements during the conduct of work activities.

5.4 PREREQUISITES

Not applicable

5.5 RECORDS

- 5.5.1 Related documents and/or records shall be stored, arranged, indexed, retained, retrieved, and disposed of in accordance with this procedure and all applicable document regulations and requirements.

5.6 PRECAUTIONS AND LIMITATIONS

- 5.6.1 Ensure that only current, up-to-date radiological survey information is used to post and label radiologically controlled areas, equipment, and material.

- 5.6.2 Hot particles represent a radiological hazard due to beta or beta/gamma radiation. Most hot particles contain either ^{60}Co or fission products. Experience has shown that some hot particles can be almost pure beta emitters. The likely sources of most Hot Particles are operations involving cutting, grinding or welding of reactor fuel or activated items containing cobalt.

5.7 REVISIONS

PROCEDURE NO: RPO-402	REVISION NO: 1	PAGE NO: 2 OF 7
-----------------------	----------------	-----------------

5.7.1 This procedure shall be reviewed at least every two years, with documentation to support the completion of such review.

5.8 OTHER

Not applicable

5.9 ATTACHMENTS

Attachment 1 - Radiological Posting Requirements

Attachment 2 - General Guidance - Signs and Labels

Attachment 3 - Establishing Physical Access Controls

Attachment 4 - Radiological Postings

Attachment 5 - Radioactive Materials Label

Attachment 6 - Recommended Inserts for Radiological Postings

Attachment 7 - Ranking Of Radiological Posting Based On Hazard

Attachment 8 - Radiological Posting Inspection

Attachment 9 - Radiological Posting Log

Attachment 10 - Radiological Posting Log Continuation Sheet

6.0 PROCEDURE

6.1 GENERAL REQUIREMENTS

6.1.1 Results from radiological surveys shall be used as the basis for all radiological posting, labeling, and access control measures.

- RSO may authorize the use of radiological data from existing surveys in lieu of new survey for areas with stable, well-characterized radiological conditions, or if ALARA considerations preclude a new survey.
- Routine survey data shall be used as a means to verify the adequacy of existing controls.

6.1.2 All signs, labels, rope, tape, chain, ribbon, etc., used as visual indicators of the presence of radiological hazards shall comply with the following requirements:

- All postings shall be in accordance with the requirements of Attachment 1.
- Inserts shall be used with signs, as appropriate, to provide sufficient information to satisfy access control requirements.
- All signs, labels, rope, tape, chain, ribbon, etc. shall be constructed of materials that can endure environmental conditions without significant deterioration of color, legibility, strength, or other physical characteristics.
- Signs and other postings communicating the existence of radiological hazards under certain conditions shall specify those conditions (i.e., "Potential Internal Contamination" or "Radiation Area When Light Is On" etc.)

6.1.3 Health Physics personnel observing the use of radiation protection signs, labels, rope, tape, chain, ribbon, etc., which are not authorized or are not being used in accordance with this procedure shall:

- Notify the RSO.
- Stop the unauthorized use of the material.

6.2 ESTABLISHING PHYSICAL CONTROLS (BARRIERS, POSTING, ETC.)

6.2.1 Using current radiological survey data, compare measured or estimated radiological conditions to posting criteria in Attachment 1 and determine the type of postings appropriate for the area and the hazards involved.

- 6.2.2 Determine if barriers are required to control access to the area.
- 6.2.3 Identify locations at which barriers will be required and potential access/egress points to establish access control. Guidance can be found in Attachments 1 through 3.
- 6.2.4 Determine if collection containers for used protective clothing and equipment are needed.
- 6.2.5 Obtain materials required to establish and post access barriers.
 - Area selected shall have sufficient room for location of collection containers, if required.
 - Consider the numbers of personnel that will be entering or leaving the area.
- 6.2.6 Place stanchions, rope, tape, chain, ribbon, etc., to establish the physical boundaries of the area. Keep posted areas as small as reasonable possible when placing boundaries.
 - Post with entry requirements (Attachment 4).
 - Place step-off pads outside of barrier at access/egress point.
 - Create a movable barrier such as a rope, chain, ribbon, etc., across access/egress point if no door/barrier exists.

WARNING: Do NOT establish any control that would prevent the rapid exit of personnel from the area under emergency conditions.

- 6.2.7 It is not necessary to post sections of boundaries that consist of permanent structural barriers (i.e., walls, buildings, structures, etc.)
- 6.2.8 Place a sufficient number of signs/labels, etc., to clearly indicate to personnel the conditions within the barriers. As a minimum, place a sign at each access point and at least one sign on each side of bounded area. Additional signs should be placed approximately every 20 feet on boundaries of large areas.
- 6.2.9 If postings or barricades must be moved to facilitate the removal or transfer of equipment or material, move the posting or barricade and:
 - Replace the moved posting/barricade with temporary posting/barricade, such as rope or tape with a sign.

- Return permanent posting/barricades when removal or transfer process is complete.

6.2.10 Notify the RSO if areas, for which controls have been established, are new or if area posting and/or access control requirements have changed.

6.2.11 Verify, by radiological survey, that radiological conditions at new or relocated boundaries are adequate for the affected area.

6.2.12 Posting requirements may be waived for periods of less than 12 continuous hours when the area is placed under the continuous observation and control of an individual knowledgeable of and empowered to implement required access and exposure control measures.

6.2.12 Document all changes or additions/deletions to radiological postings in accordance with Section 6.3.

6.3 RADIOLOGICAL POSTING DOCUMENTATION

6.3.1 Record information regarding radiological posted areas on the Radiological Posting Log and Radiological Posting Log Continuation Sheet (Attachments 9 and 10). The minimum information recorded shall include the:

- Location.
- Posting classification (e.g., Contamination Area, Radiation Area, Airborne Radioactivity Area, etc.)
- Posting type - temporary or permanent.
- Signature and date of HPT installing posting.
- Signature and date of HPT removing posting.

6.3.2 Do not record materials or areas requiring only radioactive material tags or labels on the Radiological Posting Log.

7.0 QUALITY ASSURANCE

7.1 Perform an inspection of all areas posted under this procedure on a monthly basis or as required by the RSO.

7.2 The inspection shall consist of reviewing and visually verifying posted areas are properly posted. The inspector shall ensure that the Radiological Posting Log

and the Radiological Posting Log Continuation Sheet (Attachments 9 and 10) accurately reflect the posted areas inspected. The inspection results shall be documented on a Radiological Posting Inspection form (Attachment 8).

- 7.3 If the individual performing the inspection finds a posting that is in error, that individual should make the correction (if qualified to post radiological areas) and notify the RSO of the error and corrective action taken. If the correction cannot be made during the inspection, the individual shall identify and note the unsatisfactory condition in the "Comments" section of the Radiological Posting Inspection form and notify the RSO.
- 7.4 The RSO shall review the Posting Inspection form for accuracy and completeness. The RSO shall document the review by signing and dating the Posting Inspection Form.

RADIOLOGICAL POSTING REQUIREMENTS

Radiological Condition	Required Posting
At a nuclear facility, an area outside of a restricted area but within the site boundary, to which access can be limited by the licensee for any reason.	Controlled Area
An area, where access is limited by the licensee for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials.	Restricted Area
Any area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.005 rem (0.05 mSv) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.	Radiation Area
Any area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving a dose equivalent in excess of 0.1 rem (1 mSv) in 1 hour at 30 centimeters from the radiation source or 30 centimeters from any surface that the radiation penetrates.	High Radiation Area
Any area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving an absorbed dose in excess of 500 rads (5 grays) in 1 hour at 1 meter from a radiation source or 1 meter from any surface that the radiation penetrates.	Very High Radiation Area
Any room, enclosure or operating area where there exists loose surface contamination at levels greater than the established regulatory guideline/limit.	Contamination Area

PROCEDURE NO: RPO-402

REVISION NO: 1

ATTACHMENT 1
PAGE NO: 1 OF 2

RADIOLOGICAL POSTING REQUIREMENTS

<p>A room, enclosure, or area in which airborne radioactive materials, composed wholly or partly of licensed material, exist in concentrations:</p> <p>(1) In excess of the DAC listed in Appendix B, to 10 CFR 20.1001 - 20.2401, or</p> <p>(2) To such a degree that an individual present in the area without respiratory protective equipment could exceed, during the hours an individual is present in a week, an intake of 0.6 percent of the annual limit on intake (ALI) or 12 DAC-hours, or</p> <p>(3) In excess of 10 % of the DAC listed in Appendix B to 10 CFR 835 (for sites regulated under 10 CFR 835).</p>	<p>Airborne Radioactivity Area</p>
<p>Any room, enclosure, operating area, or surface where there exists contamination that is not easily removed from the surface, at levels greater than the established regulatory guideline/limit.</p>	<p>Fixed Contamination Area</p>
<p>Any room, area or enclosure in which licensed material is used or stored. The licensee shall post each room, area or enclosure in which there is used or stored an amount of licensed material exceeding 10 times the quantity of such material specified in Appendix C to Part 20.</p>	<p>Radioactive Material Area</p>

GENERAL GUIDANCE - SIGNS AND LABELS

1. Only approved labels, signs and symbols shall be used for posting and labeling of Radiological Areas and Radioactive Materials.
2. Radiological Areas shall be clearly and conspicuously posted.
3. Signs and labels shall not be altered or defaced in any way to change their meaning.
4. When used for illustrative purposes, warning signs and labels shall be clearly marked to indicate that the radiological condition does not exist (e.g., FOR TRAINING USE ONLY).
5. Postings and labels shall be securely affixed and located such that they can be expected to remain in place under normal environmental conditions in the posted location.
6. Posting shall be completed prior to commencement of work, maintained current and updated periodically when changes in radiological conditions occur, and shall be removed as soon as possible when no longer required.
7. Boundary identifiers shall be posted on all sides of radiological areas if the boundaries can be breached by personnel. (It is not necessary to post solid walls if the other side contains a radiological area.)
8. Each area boundary shall be posted with area conditions if personnel could encounter that barrier in their pathway through the work area. At least one sign should be visible from any normal avenue of approach.
9. Postings shall be mounted on chains, stanchions, walls, doors, fences, or other permanent structures, whenever possible.
10. Signs shall not be placed such that they will be blocked from view during normal operations.
11. Inserts, when used on postings, shall contain pertinent information about the requirements for entry into the area or about the area itself.
12. Posting may be used to reflect potential or intermittent conditions.
13. If more than one radiological condition exists within an area, posting for each condition shall be identified, beginning with the condition with the highest hazard.

PROCEDURE NO: RPO-402

REVISION NO: 1

ATTACHMENT 2
PAGE NO: 1 OF 2

GENERAL GUIDANCE - SIGNS AND LABELS

- This statement should not be interpreted to mean that every access point should be posted with all of the conditions that might be encountered within that access point. Posting the entry to a building containing multiples types of radiologically posted areas does not have to include all of the posted area designators.
- If access controls are established at the entry point to an area with different radiological requirements, post the access point with the most restrictive conditions included in that area.

PROCEDURE NO: RPO-402

REVISION NO: 1

ATTACHMENT 2
PAGE NO: 2 OF 2

ESTABLISHING PHYSICAL ACCESS CONTROLS

1. The number of access and egress points for an area requiring posting shall be kept to a minimum.
2. Area boundaries shall be clearly identified with rope, tape, chain, ribbon, etc., if existing structural barriers cannot be used. Structural boundaries shall be used as much as possible.
3. It is not necessary to erect physical barriers to identify the boundaries of areas that are not accessible to personnel.
4. Appropriate signs shall be placed intermittently along the boundary of an area (e.g., fences, barricades, ropes, tapes, etc.) At least one sign shall be placed on each side of an area boundary, and a sign should be visible from any normal avenue of approach. Rope, tape, chain, ribbon, or similar barrier material used to designate radiological areas should be yellow and magenta in color.
5. Rope, chain, or ribbon barriers shall be placed a sufficient distance from the floor to prevent creating a tripping hazard.
6. Radiological postings and barriers SHALL NOT be placed in a manner that interferes with the operation of emergency exits.
7. Rope, chain, or ribbon shall be attached in a manner preventing inadvertent loosening and failure. Combinations of taping and knotting, as appropriate, is the preferred technique.
8. Rope, chain, or ribbon shall not be attached to operating handles, valves or operating components.
9. Access/egress points shall not be in locations offering threats to worker safety and shall be located in lowest dose areas when possible.
10. Containers, for collection and segregation of disposable and reusable materials, shall be placed at egress points from Contamination and Airborne Radioactivity Areas. These containers shall be located inside the area boundary and close to the egress point.
11. Frisking stations, with posted frisking instructions, shall be located as close as possible to egress points from Contamination and Airborne Radioactivity Areas.
12. Areas of fixed contamination, which are located outside of radiological areas, shall be established by clearly marking those areas to advise personnel of the

PROCEDURE NO: RPO-402

REVISION NO: 1

ATTACHMENT 3
PAGE NO: 1 OF 2

ESTABLISHING PHYSICAL ACCESS CONTROLS

presence of fixed contamination. Areas shall be clearly identified as described below.

- Painted with different colored paint so that wear of surfaces can clearly be identified prior to exposing the fixed contamination. The colors used shall be different than the color used for surrounding areas.
- Clearly marked to indicate the boundaries of the fixed contamination and identified as Fixed Contamination.

PROCEDURE NO: RPO-402

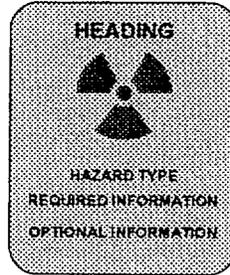
REVISION NO: 1

ATTACHMENT 3
PAGE NO: 2 OF 2

RADIOLOGICAL POSTINGS

Examples of radiological postings and signage are provided to achieve uniformity and consistency for posting areas with known or potential radiological conditions. The Trefoil warning symbol and text shall be either black or magenta in color on a yellow background.

Standard Radiological Posting:



Radiation Area - shall be posted with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, RADIATION AREA" as a minimum.

High Radiation Area - shall be posted with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, HIGH RADIATION AREA" or "DANGER, HIGH RADIATION AREA" as a minimum.

Very High Radiation Area - shall be posted with a conspicuous sign or signs bearing the radiation symbol and the words "GRAVE DANGER, VERY HIGH RADIATION AREA" as a minimum.

Airborne Radioactivity Area - shall be posted with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, AIRBORNE RADIOACTIVITY AREA" or "DANGER, AIRBORNE RADIOACTIVITY AREA" as a minimum.

Contamination Area - shall be posted with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, CONTAMINATION AREA" as a minimum.

Radioactive material rooms or areas in which there is used or stored an amount of licensed material exceeding 10 times the quantity of such material specified in Appendix C to part 20 - shall be posted with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, RADIOACTIVE MATERIAL(S)" or "DANGER, RADIOACTIVE MATERIAL(S)" as a minimum.

Fixed Contamination - Areas or surfaces with fixed contamination shall be conspicuously posted with a sign and/or label bearing the radiation symbol and the words "CAUTION, FIXED CONTAMINATION" as a minimum.

PROCEDURE NO: RPO-402	REVISION NO: 1	ATTACHMENT 4 PAGE NO: 1 OF 1
-----------------------	----------------	---------------------------------

RADIOACTIVE MATERIALS LABEL

Radioactive material labels shall be used when there is a need to help identify that an area, material, or object is radioactive, contains radioactive material, or has the potential to become contaminated with radioactive material. Radioactive material labels shall not be used in place of the proper posting of an area, material, or object as required by regulation.

The two most commonly used colors for radioactive material labels are the magenta on yellow or black on white schemes. However, these colors are not a requirement. If using colors other than magenta on yellow or black on white, ensure the colors are of high contrast to each other.

Examples of radioactive material labels include (but are not limited to):

Equipment that is internally contaminated or potentially contaminated shall be labeled "Caution Internal Contamination" or "Potential Internal Contamination".
The region in a radiation/contamination area in which the level of radiation/contamination is significantly greater than in neighboring regions in the area might be labeled.
Containers of radioactive materials shall be clearly labeled "Caution Radioactive Material". A sufficient number of labels shall be used such that the containers contents can be clearly identified when viewed from any angle.
Radioactive sources, or there containers, shall be labeled "Caution Radioactive Material".

RECOMMENDED INSERTS FOR RADIOLOGICAL POSTINGS

HEALTH PHYSICS RESTRICTED AREA	RADIOACTIVE MATERIAL(S)
VERY HIGH RADIATION AREA	HIGH RADIATION AREA
RADIATION AREA	CONTAMINATION AREA
AIRBORNE RADIOACTIVITY AREA	FIXED CONTAMINATION
INTERNAL CONTAMINATION	POTENTIAL INTERNAL CONTAMINATION
CONTACT HEALTH PHYSICS PRIOR TO ENTRY	NOTIFY HEALTH PHYSICS BEFORE REMOVING ANY MATERIAL FROM THIS AREA
EATING, DRINKING, CHEWING, SMOKING PROHIBITED	ENTRANCE
EXIT	KEEP OUT
NOT AN ENTRANCE	TLD REQUIRED
RWP REQUIRED FOR ENTRY	FRISK REQUIRED UPON EXIT

This is not intended to be an all inclusive list. Special conditions may require specific inserts not listed here. The above inserts are intended to be used for routine postings.

PROCEDURE NO: RPO-402	REVISION NO: 1	ATTACHMENT 6 PAGE NO: 1 OF 1
-----------------------	----------------	---------------------------------

RANKING OF RADIOLOGICAL POSTING BASED ON HAZARD

Posting of multiple radiological conditions can be successfully accomplished using one of two commonly used practices. The first practice is to post each radiological condition on a separate sign with appropriate supplemental wording. The second practice is to post all radiological conditions on one sign (using inserts) using the most stringent heading with the radiological areas listed in decreasing order of importance. For example, a sign delineating both a contamination area and high radiation area would carry the heading "Danger" rather than "Caution." Any supplemental information would follow the radiological area designations. In the case of very high radiation areas, posting in combination with any other radiological area is strongly discouraged.

- 1) DANGER, VERY HIGH RADIATION AREA
- 2) DANGER, HIGH RADIATION AREA
- 3) CAUTION, AIRBORNE RADIOACTIVITY AREA
- 4) CAUTION, RADIATION AREA
- 5) CAUTION, CONTAMINATION AREA
- 6) CAUTION, FIXED CONTAMINATION
- 7) CAUTION, HEALTH PHYSICS RESTRICTED AREA

Example: If both a Radiation Area and a Contamination Area exists in the same space, post the Radiation Area as the top insert followed by the Contamination Area insert.

PROCEDURE NO: RPO-402	REVISION NO: 1	ATTACHMENT 7 PAGE NO: 1 OF 1
-----------------------	----------------	---------------------------------

RADIOLOGICAL POSTING INSPECTION

Inspected for the month of: _____

Inspected by: _____ Date: _____

Results of Radiological Posting Inspection: SAT _____ UNSAT* _____

* NOTE: Describe all "unsatisfactory conditions" in the comments section. Any unsatisfactory condition corrected by the inspector shall also be noted in the comments section.

Comments:

Inspector Signature: _____ Date: _____

RSO Signature: _____ Date: _____

Form RPO-402-08-1

PROCEDURE NO: RPO-402	REVISION NO: 1	ATTACHMENT 8 PAGE NO: 1 OF 1
-----------------------	----------------	---------------------------------

RADIOLOGICAL POSTING LOG

Page ____ of ____

For all radiological postings, indicate on the Radiological Posting Log Sheet the location of the posting (building, room, area, etc.), posting classification (Radiation Area, Contamination Area, Airborne Radioactivity Area, etc.), whether the posting is temporary (T) or permanent (P), the date and initials of the HPT installing posting, and the date and initials of the HPT removing posting.

Location		Classification		T or P
HPT Installing Posting (Signature)	Date	HPT Removing Posting (Signature)	Date	

Location		Classification		T or P
HPT Installing Posting (Signature)	Date	HPT Removing Posting (Signature)	Date	

Location		Classification		T or P
HPT Installing Posting (Signature)	Date	HPT Removing Posting (Signature)	Date	

Location		Classification		T or P
HPT Installing Posting (Signature)	Date	HPT Removing Posting (Signature)	Date	

Location		Classification		T or P
HPT Installing Posting (Signature)	Date	HPT Removing Posting (Signature)	Date	

Form RPO-402-09-1

PROCEDURE NO: RPO-402	REVISION NO: 1	ATTACHMENT 9 PAGE NO: 1 OF 1
-----------------------	----------------	---------------------------------

RADIOLOGICAL POSTING LOG

Continuation Sheet

Page ____ of ____

Location		Classification		T or P
HPT Installing Posting (Signature)	Date	HPT Removing Posting (Signature)	Date	

Location		Classification		T or P
HPT Installing Posting (Signature)	Date	HPT Removing Posting (Signature)	Date	

Location		Classification		T or P
HPT Installing Posting (Signature)	Date	HPT Removing Posting (Signature)	Date	

Location		Classification		T or P
HPT Installing Posting (Signature)	Date	HPT Removing Posting (Signature)	Date	

Location		Classification		T or P
HPT Installing Posting (Signature)	Date	HPT Removing Posting (Signature)	Date	

Location		Classification		T or P
HPT Installing Posting (Signature)	Date	HPT Removing Posting (Signature)	Date	

Form RPO-402-10-1

PROCEDURE NO: RPO-402	REVISION NO: 1	ATTACHMENT 10 PAGE NO: 1 OF 1
-----------------------	----------------	----------------------------------



Procedure No: RPO-403

Revision No: 0

Effective Date: 1/2/02

ACCESS TO RADIOLOGICAL AREAS

Authored By:

Michael P. McDonald
Radiological Engineer

12-27-01

Date

Reviewed By:

Jeffrey W. Lively
Health Physicist

12/31/01

Date

Approved By:

Steven D. Rima
Radiological Engineering Manager

1/3/02

Date

This page intentionally left blank.

ACCESS TO RADIOLOGICAL AREAS

1.0 PURPOSE

1.1 The purpose of this procedure is to provide instruction in the control of access to Restricted Areas and radiologically controlled areas.

2.0 APPLICABILITY

2.1 This procedure applies to MACTEC, Inc. management, supervisors, individuals and contractors that control access to Restricted Areas and radiologically controlled areas, where their work assignment is controlled by MACTEC, Inc.

3.0 REFERENCES

3.1 10 CFR 20, "Standards for Protection Against Radiation."

3.2 10 CFR 835, "Occupational Radiation Protection."

3.3 RPO-101, "Radiation Protection Program Overview."

3.4 RPO-402, "Radiological Posting and Labeling."

4.0 DEFINITIONS AND ABBREVIATIONS

4.1 See RPO Glossary.

5.0 GENERAL

5.1 EQUIPMENT

5.5.1 Various access control equipment described in this procedure (as necessary).

5.2 SAFETY CONSIDERATIONS

Not applicable

5.3 RESPONSIBILITIES

5.3.1 RSO (or designee):

- Implement this procedure.
- Ensure individuals are qualified to perform this procedure.
- Ensure that all survey documentation is reviewed in a timely manner.

- Implement oversight and specific access control measures needed for Restricted Areas and radiologically controlled areas.
- Ensure appropriate entry controls are installed and maintained where required.
- Ensure minors and members of the public do not have access to radiologically controlled areas.

5.3.2 Health Physics Staff:

- Comply with this procedure.
- Operate radiological survey instrumentation in accordance with approved operating procedures.
- Ensure compliance with posting, labeling, and access control requirements during the conduct of work activities.

5.4 PREREQUISITES

Not applicable

5.5 RECORDS

- 5.5.1 Radiological documents and/or records shall be stored, arranged, indexed, retained, retrieved, and disposed of in accordance with all applicable NRC document regulations and requirements.

5.6 PRECAUTIONS AND LIMITATIONS

- 5.6.1 Access control measures shall **NOT** be installed at any radiologically controlled area exit that would prevent rapid evacuation of personnel under emergency conditions.

5.7 REVISIONS

- 5.7.1 This procedure shall be reviewed at least every two years, with documentation to support the completion of such review.

5.8 OTHER

Not applicable

5.9 ATTACHMENTS

PROCEDURE NO: RPO-403	REVISION NO: 0	PAGE NO: 2 OF 7
-----------------------	----------------	-----------------

Not applicable

6.0 PROCEDURE

6.1 ACCESS CONTROL - GENERAL REQUIREMENTS

WARNING: Do NOT establish any access control that would prevent the rapid exit of personnel from the area under emergency conditions.

6.1.1 Access control shall be maintained for each Restricted Area, Radiologically Controlled Area, Radiological Buffer Area, and/or Radiological Area.

- Radiological Buffer Areas are established around Contamination Areas as a secondary boundary to minimize the spread of contamination.
- Equipment used for radioactive contamination monitoring shall be located within and at the exit point of the Restricted Area, Radiologically Controlled Area, or Radiological Buffer Area.

6.1.2 The degree of control shall be commensurate with existing and potential radiological hazards within the area.

6.1.3 Use one or more of the following methods to implement access control:

- Signs and barricades.
- Control devices on entrances.
- Conspicuous visual and/or audible alarms.
- Locked entranceways.
- Administrative controls.

6.1.4 Implement written authorization (i.e., RWP) to:

- Control entry into and work within areas.
- Specify radiological protection measures commensurate with existing and potential hazards.

6.1.5 Provide a method or technique for ensuring that individuals entering areas have:

- Authorization to enter the area.
- Proper training and qualifications commensurate with existing and potential hazards of the area.

- Required dosimetry.
- Required personnel protective equipment.

6.2 CONTAMINATION and AIRBORNE RADIOACTIVITY AREAS

6.2.1 Step-off pads shall be used at major access points of long-term Contamination Areas and Airborne Radioactivity Areas.

6.2.2 The type of protective clothing required for entry into any area shall be prescribed (on the RWP) based upon considerations of contamination levels, chemical and physical form of the contaminant, activities to be performed, and area accessibility.

- Other area and activity hazards, such as heat, flame, hazardous chemicals, physical obstructions, electrical shock, and limited visibility, shall be considered when prescribing protective clothing.
- When penetration of protective clothing by a contaminant is likely, such as during activities likely to induce heavy sweating or otherwise wet the individual, an additional layer of impenetrable clothing should be considered.

6.2.3 Necessary tools and equipment needed for work in Contamination Areas, or Airborne Radioactivity Areas shall be available and serviceable prior to work entry.

6.2.4 Hoses, electrical cables, etc. shall be properly secured to prevent movement of such items across boundaries of Contamination and Airborne Radioactivity Areas.

6.2.5 High-efficiency particulate air (HEPA) units may be used to provide ventilation to work areas or containments, or as part of HEPA vacuum units. Contact the RSO for additional guidance.

6.2.6 For individuals exiting areas where the only Contaminated Areas are laboratory bench surfaces or exhaust hoods, or where contamination potential is limited to specific portions of the body, the frisking should concentrate on affected areas as prescribed by the RWP for the job.

6.2.7 Individuals exiting contamination or airborne radioactivity areas shall perform whole body monitoring.

- If background radiation levels or other conditions at the exit point preclude performance of personnel frisking, the exit point should be relocated to an area of lower background levels. If relocation of the exit point is not

practicable, individuals should proceed directly from the exit point to an appropriate area to perform a whole body frisk. The travel path should be monitored frequently for the spread of contamination during use and after the detection of any contamination at the frisking station.

6.3 HIGH RADIATION AREAS

6.3.1 High Radiation Areas shall be monitored (dose rate) as necessary to determine the exposure rates to individuals in the area.

6.3.2 Hand-held radiation detectors shall be used in addition to any installed radiation area monitors.

6.3.3 A supplemental dosimeter shall be required for access to High Radiation Areas.

- This dosimeter must be capable of providing an immediate estimate of the individual's integrated deep dose equivalent during the entry.

6.3.4 Where a supplemental dosimeter is impractical or ineffective (e.g., when monitoring doses from neutron radiation), other means (e.g., knowledge of the area exposure rate and tracking of individual access times) may be used to provide an immediate estimate of an individual's dose.

6.3.5 One or more of the following controls shall be used for each access point to a High Radiation Area:

- A control device that prevents entry into the area when high-radiation levels exist or that, upon entry, causes the radiation level to be reduced below levels that define a High Radiation Area.
- A device that functions automatically to prevent use or operation of the radiation source or field while individuals are in the area.
- A control device that energizes a conspicuous visible or audible alarm signal so that the individual entering the High Radiation Area and the supervisor of the activity are made aware of the entry. The audible signal shall be of a frequency (or be capable of producing a sound-pressure level) that can be heard over background noise.
- Entryways that are locked. During periods when access to the area is required, positive control over each entry is maintained.
- Continuous, direct, or electronic surveillance that is capable of preventing unauthorized entry.

- A control device that will automatically generate audible and visual alarm signals to alert personnel in the area of the intended use or operation of the radiation source in sufficient time to either evacuate the area or activate a secondary control device that will prevent use or operation of the source.

6.4 VERY HIGH RADIATION AREAS

- 6.4.1 In addition to the requirements in Section 6.3, additional control measures, such as double controlled locks, shall be used to ensure individuals are not able to gain unauthorized or inadvertent access to Very High Radiation Areas.

7.0 QUALITY ASSURANCE

- 7.1 Any records generated during the performance of this procedure shall be evaluated as part of the annual audit of the Health Physics program.



MACTEC, Inc.

Procedure No: RPO-404

Revision No: 1

Effective Date: 9-1-02

SEALED SOURCE ACCOUNTABILITY AND LEAK CHECKS

Authored By:

Michael P. McDonald
Radiological Engineer

5-30-02

Date

Reviewed By:

Jeffrey W. Lively
Health Physicist

8/16/02

Date

Approved By:

Steven D. Rima
Radiological Engineering Manager

8/16/02

Date

This page intentionally left blank.

SEALED SOURCE ACCOUNTABILITY AND LEAK CHECKS

1.0 PURPOSE

- 1.1 The purpose of this procedure is to provide instruction for the performance of leak checks and accountability checks of radioactive sources.

2.0 APPLICABILITY

- 2.1 This procedure applies to MACTEC, Inc. management, supervisors, individuals and contractors that perform leak check and accountability checks of radioactive sources where their work assignment is controlled by MACTEC, Inc.

3.0 REFERENCES

- 3.1 10 CFR 20, "Standards for Protection Against Radiation."
3.2 10 CFR 835, "Occupational Radiation Protection."
3.3 RPO-101, "Radiation Protection Program Overview."
3.4 RPO-103, "Radiation Protection Audits, Assessments and Oversight."
3.5 RPO-201, "Operation of Portable Radiological Survey Instruments."
3.6 RPO-301, "Radiological Surveys."
3.7 RPO-610, "Procurement, Receipt, and Control Of Radioactive Material."

4.0 DEFINITIONS AND ABBREVIATIONS

- 4.1 See RPO Glossary.

5.0 GENERAL

5.1 EQUIPMENT

- 5.1.1 Radiation and contamination survey instrumentation
5.1.2 Smear material
5.1.3 Various Personnel Protective Clothing

PROCEDURE NO: RPO-404	REVISION NO: 1	PAGE NO: 1 OF 8
-----------------------	----------------	-----------------

5.2 SAFETY CONSIDERATIONS

Not applicable

5.3 RESPONSIBILITIES

5.3.1 RSO (or designee):

- Implement this procedure.
- Ensure that individuals are qualified to perform this procedure.
- Notify individuals and schedule source leak checks and inventories when due.
- Evaluate the results of leak checks and consult with the source owner when a source fails a leak check.
- Dispose of radioactive sources that are leaking or are no longer desired/required.
- Ensure that all radiological survey documentation, relating to source leak checks, is reviewed.

5.3.2 Health Physics Staff:

- Comply with this procedure.
- Exercise appropriate contamination control techniques in the performance of radiological surveys and while handling sample media.
- Comply with entry requirements.
- Operate radiological survey instrumentation in accordance with approved operating procedures

5.4 PREREQUISITES

Not applicable

5.5 RECORDS

PROCEDURE NO: RPO-404

REVISION NO: 1

PAGE NO: 2 OF 8

- 5.5.1 Related documents and/or records shall be stored, arranged, indexed, retained, retrieved, and disposed of in accordance with this procedure and all applicable document regulations and requirements.
- 5.5.2 A log will be maintained containing a inventory of all accountable radioactive sources (Attachment 1) and a record of each individual source with its leak check and inventory result (Attachment2).
- 5.5.3 Source leak check and inventory records shall be maintained for a minimum of five years from the date of the inventory. Leak check and inventory records shall be available for audits and inspection.

5.6 PRECAUTIONS AND LIMITATIONS

5.6.1 When perform leak checks on electroplated sources or sources with a thin/fragile covering, DO NOT smear the active electroplated surface or the thin/fragile covering. This may damage the source and give a false indication that the source is leaking.

5.6.2 Source leak check results shall be recorded in units of microcuries.

5.7 REVISIONS

5.7.1 This procedure shall be reviewed at least every two years, with documentation to support the completion of such review.

5.8 OTHER

Not applicable

5.9 ATTACHMENTS

Attachment 1 - Source Inventory Log

Attachment 2 - Source Leak Check and Inventory Record

6.0 PROCEDURE

6.1 SOURCE RECEIPT

- 6.1.1 Upon receipt of a new radioactive source, assign a unique source identification number.
- 6.1.2 Add the source information to the Source Inventory Log (Attachment 1)
- 6.1.3 Complete an individual Source Leak Check and Inventory Record (Attachment 2).
- 6.1.4 Add the leak check and inventory record to the logbook.
- 6.1.5 Perform a source leak check in accordance with Section 6.3.

6.2 GENERAL REQUIREMENTS for SOURCE ACCOUNTABILITY and LEAK CHECKS

NOTE: Sealed sources are exempt from leak check and inventory requirements when the source activity is less than the activity stated in the regulations regarding exempt sources.

- 6.2.1 Leak check and inventory each sealed source containing licensed material, with a half-life greater than thirty days and in any form other than gas or H-3, for leakage and/or contamination at intervals not to exceed six (6) months. Leak check sources designed for the purpose of emitting alpha particles at intervals not to exceed three (3) months.
- 6.2.2 Leak check all new sources prior to placing them in service.
- 6.2.3 The periodic leak check interval for sealed sources that are stored and not being used will not exceed 3 years. Leak check sources held in long term storage for leakage prior to any use or transfer to another person unless they have been leak checked within six months prior to the date of use or transfer.
- 6.2.4 Source leak checks shall be capable of detecting the presence 0.005 microcuries of radioactive material on the sample media (smear material). A smear shall be taken from the sealed source or from the surfaces of the device in which the sealed source is permanently or semi-permanently mounted or stored on which one might expect contamination to accumulate.

6.2.5 If the leak check reveals the presence of 0.005 microcuries or more of removable contamination:

- Immediately withdraw the sealed source from use.
- Decontaminate, repair, or dispose of the source in accordance with regulations.
- Immediately contact the RSO. The RSO will file a report with the U.S. Nuclear Regulatory Commission, describing the equipment involved, the leak check results, and the corrective actions taken within five (5) days.

6.3 CONDUCTING A SOURCE LEAK CHECK

6.3.1 Prior to leak checking new or unfamiliar radioactive sources, determine how the source is used and decide which surfaces need to be surveyed. If there is a question on how to conduct a source leak check for a particular source, contact the RSO for guidance.

6.3.2 Using a dry smear, gently wipe the accessible area of the source and/or source container and place smear in a clean coin envelope or suitable collection container.

NOTE: See precaution in Section 6.4 for performing leak checks on plated sources or sources with thin or fragile coverings.

6.3.3 Using an appropriate portable survey meter, scan all smears to identify any elevated activity that could contaminate laboratory counting equipment.

6.3.4 Record the date and source location on the Source Leak Check and Inventory Record (Attachment 2).

6.3.5 Count the smear (in accordance with Ref. 3.6, Section 6.9) for the appropriate alpha or beta radiation and record the results in microcuries.

6.3.6 When performing sealed source leak checks:

- Minimize direct contact with the source surface to limit extremity exposure.
- Use extension devices, such as tongs or tweezers, to leak check sources when dose rates are in excess of 10 millirem per hour (mrem/hr) at one foot.

PROCEDURE NO: RPO-404	REVISION NO: 1	PAGE NO: 5 OF 8
-----------------------	----------------	-----------------

- Perform a frisk of your hands after performing the survey.
- Wear appropriate PPE and dosimetry.

6.4 CONDUCTING LEAK CHECKS OF PLATED SOURCES OR SOURCES WITH THIN/FRAGILE COVERINGS

CAUTION

DO NOT WIPE THE SURFACE OF THE SOURCE. THIS MAY DAMAGE THE SOURCE OR GIVE A FALSE INDICATION THAT THE SOURCE IS LEAKING

- 6.4.1 Perform a survey for removable surface contamination on suspect surfaces, such as the inside of the source storage container and/or the area around the source. Use standard smear material if possible, otherwise use a cotton swab.

6.5 CONDUCTING LEAK CHECKS OF ENCAPSULATED SOURCES

- 6.5.1 Perform a survey for removable surface contamination on the accessible area of the source.

- Pay particular attention to seams or joints in the casing material since these areas are the most likely to develop a leak.
- Sources that are housed in a storage/use assembly need not be directly accessed (to maintain ALARA).

6.6 INTERPRETATION OF SOURCE LEAK CHECK RESULTS

- 6.6.1 If source leak check results are greater than or equal to 0.005 microcuries, perform the following actions:

- Immediately contain the source and restrict access to source storage/use locations until area surveys are performed.
- Notify the RSO.
- Conduct contamination surveys in source storage, use, and transit locations to identify the potential spread of contamination.

- 6.6.2 If source leak check results exceed regulatory removable contamination limits, but are below 0.005 microcuries, perform the following actions:

PROCEDURE NO: RPO-404

REVISION NO: 1

PAGE NO: 6 OF 8

- Instruct the source owner to contain the source and restrict access to source storage/use locations until area surveys are completed.
- Conduct contamination surveys in source storage, use, and transit locations to identify the potential spread of contamination.
- Notify the RSO.

6.6.3 Assist the source owner with interpretation of positive survey results. Provide, as needed, written instruction (e.g., remarks on survey form or e-mail) that clarifies appropriate actions for sources that are leaking or contaminated.

6.7 SOURCE ACCOUNTABILITY

6.7.1 Register new sources, or sources removed from long term storage, by recording the appropriate information on Attachment 1 and Attachment 2, within 5 days of receipt.

6.7.2 When a new source is received, retain copies of the shipping documents and any manufacturer-supplied documents (e.g., leak test results or calibration certificates) for the life of the source.

6.7.3 During the inventory of both active and stored sources, pay particular attention to whether the source:

- Is present and accounted for.
- Appears free of any damage.
- Is properly posted/labeled.
- Is properly stowed and the storage device (locker, drawer, cabinet, etc.) is properly posted/labeled.

6.7.4 For in-use (not in storage) sources, perform a physical inventory at least every six (6) months.

6.7.5 Document source inventory results on Attachment 2.

6.7.6 When a source is removed from service, note the date of removal on the Source Inventory Log and remove the Source Leak check and Inventory Record form from the active section of the source logbook and place it in inactive section.

- If the source is to be disposed of, indicate disposal in the location column of the inventory record and dispose of in accordance with Ref. 3.7.

7.0 QUALITY ASSURANCE

- 7.1 Documents generated during the performance of this procedure shall be audited in accordance with Reference 3.4.



MACTEC, Inc.

Procedure No: RPO-405

Revision No: 1

Effective Date: 9-1-02

RESPIRATORY PROTECTION

Authored By:

Michael P. McDonald
Radiological Engineer

6-14-02

Date

Reviewed By:

Jeffrey W. Lively
Health Physicist

8/16/02

Date

Approved By:

Steven D. Rima
Radiological Engineering Manager

8/16/02

Date

This page intentionally left blank.

RESPIRATORY PROTECTION

1.0 PURPOSE

- 1.1 The purpose of this procedure is to provide instruction to the Health Physics Staff in the proper selection, issue, and use of respiratory protection for individuals wearing respiratory protection for the purpose of limiting intakes of radioactive material. This procedure also provides programmatic requirements and cautions for the various aspects of respiratory protection equipment use.

2.0 APPLICABILITY

- 2.1 This procedure applies to MACTEC, Inc. management, supervisors, individuals and contractors using respiratory protection for the purpose of limiting intakes of radioactive materials where their work assignment is controlled by MACTEC, Inc.

3.0 REFERENCES

- 3.1 10 CFR 20, "Standards for Protection Against Radiation."
- 3.2 10 CFR 835, "Occupational Radiation Protection."
- 3.3 NRC Regulatory Guide 8.15, "Acceptable Programs For Respiratory Protection," October 1999.
- 3.4 29 CFR 1910.134, "Respiratory Protection."
- 3.5 29 CFR 1910.1048, Appendix E "Qualitative and Quantitative Fit Testing Procedure."
- 3.6 49 CFR 173 and 178, "Shipping Container Specification Regulations of the Department of Transportation."
- 3.7 CGA G-7.1-1997, "Commodity Specification for Air."
- 3.8 RPO-101, "Radiation Protection Program Overview."
- 3.9 RPO-303, "Area Air Sampling."

4.0 DEFINITIONS AND ABBREVIATIONS

- 4.1 See RPO Glossary.

5.0 GENERAL

PROCEDURE NO: RPO-405	REVISION NO: 1	PAGE NO: 1 OF 10
-----------------------	----------------	------------------

5.1 EQUIPMENT

5.1.1 Various Respiratory Protection Equipment

5.1.2 Various Personnel Protective Clothing

5.2 SAFETY CONSIDERATIONS

Not applicable

5.3 RESPONSIBILITIES

5.3.1 RSO (or designee):

- Implement this procedure.
- Ensure individuals that issue respiratory protection equipment are qualified to perform this procedure.
- Provide support for determination of feasible engineering controls when assessing the need for respiratory protection.
- Assist in the selection of the appropriate type/class of respirator that will provide adequate protection for each radiological contaminant.
- Provide adequate equipment or material, to supplement respiratory protective equipment, to reduce the likelihood that respirator use might contribute to workplace accidents or injury. (i.e., spectacle adapters, voice amplification equipment, material or equipment to prevent or reduce fogging of respirator lenses, and body-cooling equipment in environments with high temperature or high humidity).
- Estimate and review, as necessary, the concentration of radiological contaminants in the work area, both prior to respirator selection and periodically during respirator use.
- Recommend the performance of work without respiratory protection if the total effective dose equivalent (TEDE) would be lower by not using respiratory devices.

5.3.2 Health Physics Staff:

- Assess the radiological respiratory hazard(s) in a work area and assigning the appropriate respiratory protection for this work, as needed.

PROCEDURE NO: RPO-405

REVISION NO: 1

PAGE NO: 2 OF 10

- Perform periodic monitoring of radiological hazards in the work area, in accordance with Reference 4, to ensure that the assigned respiratory protection is effective against the hazard(s) of concern.
- Survey respirators that are to be released from Airborne Radiological Areas and verify that surface contamination levels on respiratory equipment do not exceed the limits for unrestricted release.
- Inform the RSO when contamination is found on the inside of a respirator facepiece and/or on an individual's face after removal of respiratory equipment.

5.4 PREREQUISITES

- 5.4.1 Individuals requiring respiratory protection equipment for the protection against airborne radioactive materials shall complete a suitable respiratory protection training program, including hands-on training, prior to being issued respiratory protection equipment or being fit tested for a tight-fitting respirators.
- 5.4.2 The worker shall be fit-tested with the same make, model, style, and size of respirator that will be used at the work location. A successful fit test shall be conducted, for each respirator used, prior to issuance of respiratory protection equipment to the individual.
- 5.4.3 Medical screening, respirator training, and respirator fit testing is a prerequisite for issuance and usage of respiratory protection equipment.
- 5.4.4 Any individual wearing a respirator shall be clean shaven.

5.5 RECORDS

- 5.5.1 Respiratory protection related documents and/or records shall be stored, arranged, indexed, retained, retrieved, and disposed of in accordance with this procedure and all applicable document regulations and requirements.

5.6 PRECAUTIONS AND LIMITATIONS

- 5.6.1 Any change or modification to respiratory protection equipment, however minor, may void the respirator approval (NIOSH certification) and significantly affect the performance of the respirator. Changes or modifications to respiratory protection equipment, except by a manufacturer's certified technician, is NOT allowed.
- 5.6.2 Work involving industrial hazards as well as radiological hazards may require special respiratory equipment or filtration canisters/cartridges and require

additional engineering controls to be implemented. Consult with the RSO to determine the appropriate respirator use.

- 5.6.3 When wearing an airline respirator (also known as a supplied-air respirator), the user is restricted in movement by the hose and must return to a respirable atmosphere by retracing the route of entry. In addition, the hose is subject to being severed, pinched, or disconnected.
- 5.6.4 The time period over which protection is provided is dependent on the canister, cartridge, or filter type; the concentration of the contaminant; the temperature and humidity levels in the ambient atmosphere; the user's respiratory rate; etc.
- 5.6.5 While wearing a respirator, communication can be difficult. Therefore, prior consideration as to how individuals will communicate, especially in the event of an emergency, is essential.
- 5.6.6 Half-face respirators shall NOT be used for protection from airborne radioactive materials.
- 5.6.7 When used in environments below 32°F, SCBAs must be equipped with a full facepiece that is certified for use below 32°F and equipped with a nose cup or other suitable accessory or coating to maintain NIOSH certification.
- 5.6.8 While using an SCBA or a combination of a airline respirator with SCBA under Immediately Dangerous to Life or Health (IDLH) conditions, at least one standby person shall be present.
- The standby person shall have the proper equipment available to assist the respirator wearer in case of difficulty.
 - Communications (visual, voice, signal line, telephone, radio, or other suitable means) shall be maintained between the standby person and the respirator wearer.
 - While working in the IDLH atmosphere, the wearer shall be equipped with safety harness and safety lines to permit removal to a safe area, if necessary. Provisions for rescue other than safety harness and lines may be used, if equivalent.
- 5.6.9 When respirator use is required, the user is expected to leave the area anytime the following conditions occur:
- Equipment malfunction.

- Undue physical or psychological distress.
- Procedural or communication failure.
- Significant deterioration of operational conditions.
- Or any other condition requiring relief by the wearer.

5.6.10 Anything in the face-to-facepiece seal area of a tight-fitting respirator that is under the control of the respirator user is prohibited. The list of prohibited materials includes (but is not limited to) facial hair of any kind in the seal area (the worker must be clean-shaven), hair from the head intruding into the seal area, cosmetics, spectacle temple bars, protective clothing, and equipment. Any item worn inside the respirator must be approved for use with the respirator.

5.6.11 The periods of time respirators are worn continuously and the overall duration of use should be kept to a minimum. Under no circumstances shall a worker be allowed to wear a respirator for more than 4 consecutive hours without a break of at least 15 minutes.

5.6.12 Use of air-supplied suits requires special training and qualifications. Consult the RSO for guidance.

5.6.13 Respirator fit testing shall be in accordance with the requirements of 29 CFR 1910.1048 Appendix E. Fit testing may only be performed by individuals trained to perform those activities.

5.7 REVISIONS

5.7.1 This procedure shall be reviewed at least every two years, with documentation to support the completion of such review.

5.8 OTHER

5.8.1 This procedure, as a stand-alone document, does NOT fulfill all the respiratory protection program requirements of Subpart H of 10 CFR Part 20. However, this procedure does address, as well as fulfill, the radiological considerations and requirements portion of an adequate respiratory protection program.

5.9 ATTACHMENTS

Attachment 1 - Respirator Use Recommendation Charts

PROCEDURE NO: RPO-405	REVISION NO: 1	PAGE NO: 5 OF 10
-----------------------	----------------	------------------

6.0 PROCEDURE

6.1 GENERAL INFORMATION

6.1.1 Engineering controls, administrative controls, and safe work practices are the primary means to contain radioactivity at the source, thereby reducing the need for respiratory protection. Consider the use of respiratory protection under the following conditions:

- When engineering and administrative controls have been applied and the potential for airborne radioactivity still exists.
- During breach or dismantlement of contaminated systems or components.
- When work is to be done in areas or on equipment identified as Contamination Areas.
- During work on contaminated or activated surfaces with the potential to generate airborne radioactivity in excess of 0.5 times the Derived Air Concentration (DAC).

6.1.2 Only respirators approved by the RSO (NIOSH certified) shall be used at the work site. Any change or modification, however minor, may void the respirator approval and significantly affect the performance of the respirator.

6.2 SELECTION OF RESPIRATORY PROTECTION DEVICES

6.2.1 To the extent possible, determine the following:

- Radionuclides of concern and the physical properties of each. This information should be recorded in the RWP covering the job.
- Worker activity, such as continuous or intermittent, and rate, such as light, medium, or heavy.
- Work location and area(s) of potential hazard(s).
- Duration of the job.

6.2.2 Measure or estimate the area dose rate(s) of the work site, if any.

6.2.3 Obtain a representative air sample to determine the airborne radionuclide concentration(s) at the work site, unless:

- The acquisition of an air sample(s) is not practical.
- The acquisition of air sample(s) is not consistent with ALARA.
- The work itself may generate airborne activity later in the job.

6.2.4 For these cases, contact the RSO for guidance in estimating the potential airborne radionuclide concentration(s) and the need for respiratory protection.

6.2.5 Determine the DAC for each radionuclide of concern.

6.2.6 Determine the fraction of the DAC in the work area by dividing the measured or estimated radionuclide concentration by the corresponding DAC value.

$$\frac{\text{Radionuclide Activity Concentration } (\mu \text{ Ci/ml})}{\text{DAC } (\mu \text{ Ci/ml})} = \text{DAC Fraction}$$

6.2.7 If two or more radionuclides of concern are present and the concentration of each radionuclide can be determined, calculate the DAC fraction as follows:

$$\frac{\mu \text{ Ci/ml}_A}{\text{DAC}_A} + \frac{\mu \text{ Ci/ml}_B}{\text{DAC}_B} + \dots + \frac{\mu \text{ Ci/ml}_n}{\text{DAC}_n} = \text{DAC Fraction}$$

6.2.8 If two or more radionuclides of concern are present, and the concentration of one or more of the radionuclides is not known, calculate the DAC fraction based on the most restrictive DAC for the radionuclides of concern.

6.2.9 If the DAC fraction is < 0.5, document that respiratory protection equipment is not required.

6.2.10 If the DAC fraction is ≥ 0.5 and a radiation dose rate exists, determine if the use of respiratory protection is recommended.

- Use the appropriate chart in Attachment 1 and find the point where the area dose rate (measured or estimated) and the DAC fraction intersect.
- Respiratory protection is recommended when intersecting points are located outside of the shaded area of the graph.

NOTE: Respiratory protection may not be warranted for short-term jobs. If needed, contact the RSO for guidance.

6.2.11 If respiratory protection is recommended, select a respirator that has an Assigned Protection Factor (APF) greater than the value of the DAC fraction, if available.

- APFs for commonly used respirators are listed below. Contact the RSO to obtain the appropriate APF for respirators not listed.

Respirator Type	APF
Air Purifying (APR) - Full Face	50
Airline Hood (Supplied-Air)	10
SCBA	10,000

NOTE: The use of positive pressure respiratory protection devices is recommended wherever practicable to alleviate fatigue and increase comfort.

6.2.12 All APRs used to protect against the inhalation of radioactive material shall employ an approved High Efficiency Particulate (HEPA) or combination HEPA and canister/cartridge.

6.2.13 Contact the RSO for assistance if:

- There is a potential for an oxygen-deficient environment.
- A confined space hazard exists.
- Work time limits and/or body cooling devices are needed to reduce heat stress when work is to take place in hot environments.

6.2.14 Obtain written permission from the RSO prior to allowing personnel to incur internal exposure.

- Specific justification of the need to accept the exposure, including a description of measures taken to mitigate the airborne radioactivity, shall be documented in the RWP as part of the authorization process.

6.2.15 Document the type of respirator selected and any work time restrictions on the RWP.

6.2.16 Attach or include supporting calculations with the RWP, as applicable.

PROCEDURE NO: RPO-405	REVISION NO: 1	PAGE NO: 8 OF 10
-----------------------	----------------	------------------

6.3 USE OF RESPIRATORY PROTECTION DEVICES

WARNING: HPTs should remind personnel that fit checks of respirators shall be performed each time a respirator is donned or adjusted.

- 6.3.1 While respiratory protection equipment is in use, evaluate the level of airborne radioactivity in the workplace through the use of continuous air monitors or grab air-samplers.
- 6.3.2 Evaluate air sample media as soon as practicable to ensure that the appropriate respiratory protection is being used.
- 6.3.3 Stop the job and re-evaluate respiratory requirements if air sample results demonstrate the potential for the DAC fraction to exceed the APF of the respirator.

6.4 REMOVAL OF RESPIRATORY PROTECTION DEVICES

- 6.4.1 If an operation requires that respiratory protection devices be re-used prior to release, or the RWP requires a survey be performed, perform a surface contamination survey on the inside of the respirator facepiece and on the external surface(s) of respiratory equipment and document.
- 6.4.2 If the respiratory equipment is not going to be re-used that day, perform a release survey of respiratory equipment (checking inside and outside the mask) as soon as possible upon its removal. Be careful not to contaminate the inside of the facepiece during removal.
- 6.4.3 If contamination is found on the inside of a respirator facepiece, restrain the individual from leaving the immediate area. Contact the RSO immediately.

6.5 RELEASE OF RESPIRATORY PROTECTIVE DEVICES

- 6.5.1 If respirator contamination levels are below the release limits, remove the respirator from the radiologically controlled area as soon as practicable.
- 6.5.2 If respirator contamination levels exceed the release limits, control the equipment as radioactive material. Instruct the user that the respirator will either need to be decontaminated, stored for decay, or disposed of as radioactive waste.

NOTE: Respirator cartridges and canisters, with any detectable contamination levels, shall be treated and disposed of as radioactive material. Combination HEPA and chemical cartridges or canisters shall be disposed of as mixed waste.

6.5.3 Document the respirator release survey.

6.6 RESPIRATOR DECONTAMINATION

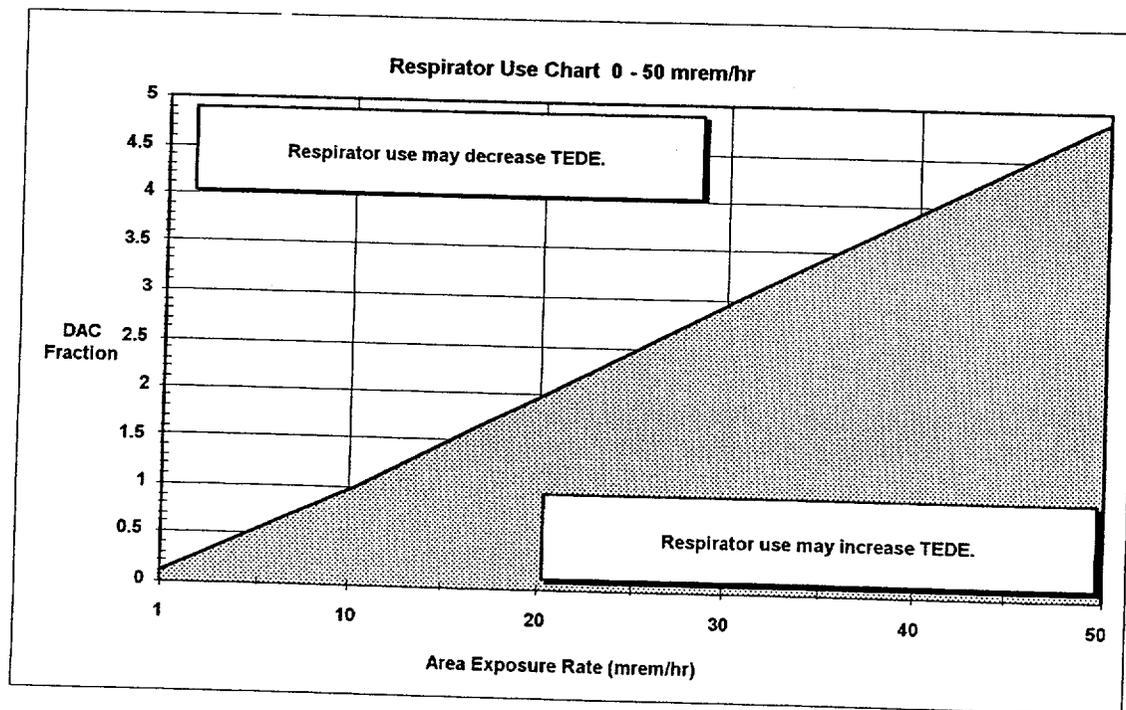
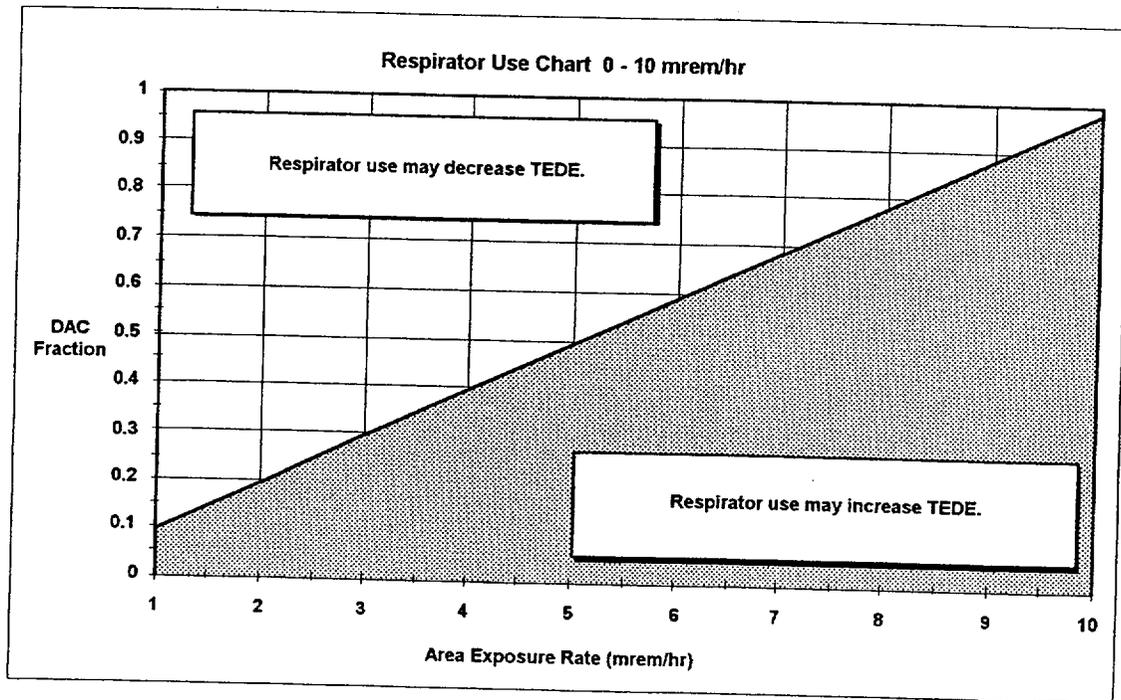
6.6.1 Decontaminate respiratory protection equipment if required. Use only commercially available wipes or water and a mild detergent. Avoid solvents or harsh chemicals as decontamination agents.

6.6.2 Treat respirator cleaning effluents (materials and fluids) as radioactive waste.

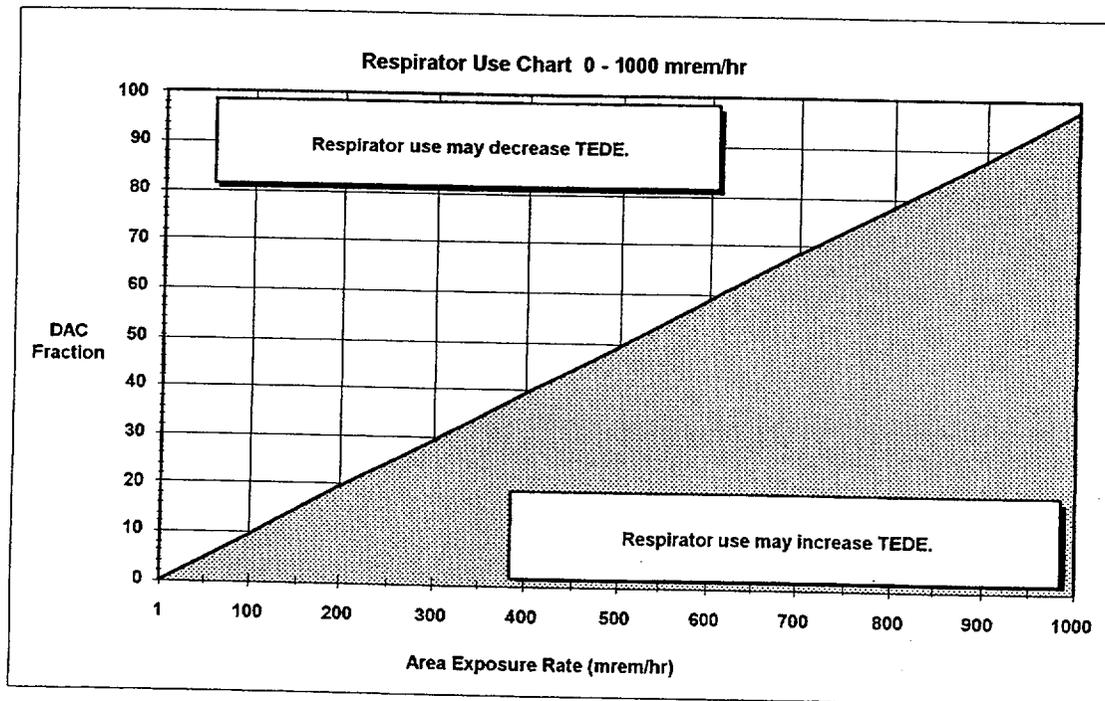
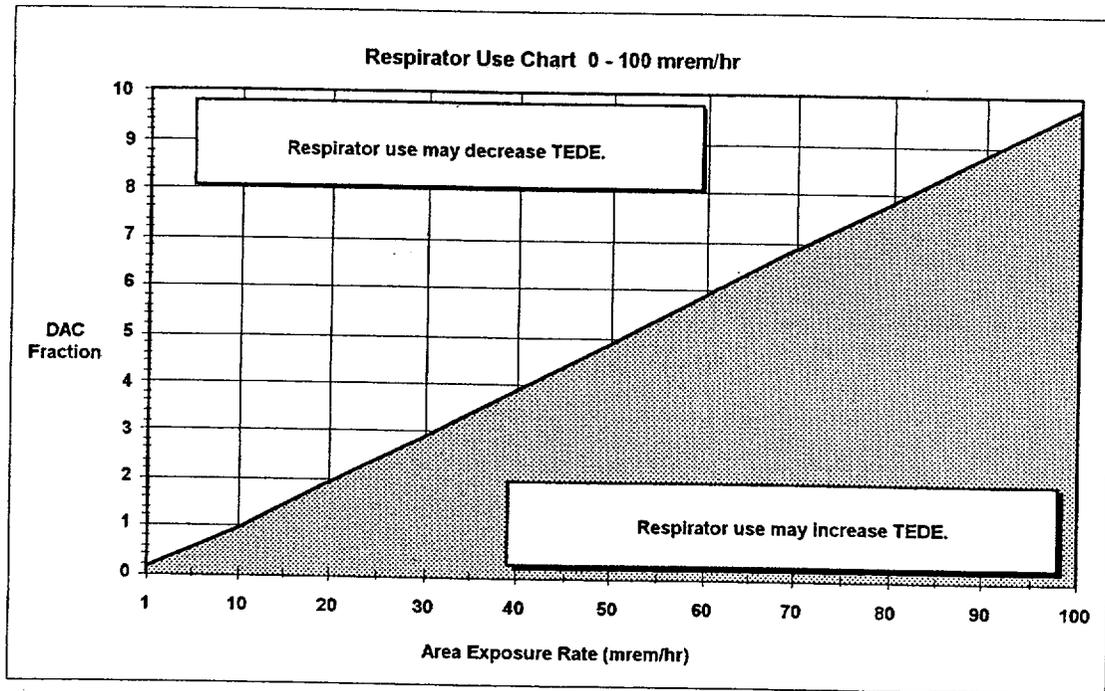
7.0 QUALITY ASSURANCE

- 7.1 Inspect respirator facepieces, that are routinely available for issue, at least every month or in accordance with manufacturer's instructions. If such devices are stored in clear plastic bags, they should be handled and examined, but need not be removed from the bags for this inspection as long as the inspector can determine that the device is ready for issue.
- 7.2 Inventory and functionally test equipment, used in conjunction with facepiece respirators (e.g., belt- or facepiece-mounted air regulators, air-supply hoses, portable distribution manifolds), periodically or prior to use.
- 7.3 Visually inspect emergency respiratory protection equipment, monthly and operationally tested at least quarterly. Visually inspect escape-only devices monthly.
- 7.4 Test breathing air cylinders, including SCBA cylinders, as prescribed in the Shipping Container Specification Regulations of the Department of Transportation. Each breathing air cylinder should be permanently and legibly marked "Breathing Air" or "Compressed Breathing Air."
- 7.5 The quality of the air delivered to any atmosphere-supplying respirator shall meet the requirements of Grade D air for breathing air systems, as defined in CGA G-7.1-1997, "Commodity Specification for Air."

RESPIRATOR USE RECOMMENDATION CHARTS



RESPIRATOR USE RECOMMENDATION CHARTS





MACTEC, Inc.

Procedure No: RPO-406

Revision No: 1

Effective Date: 9-1-02

INTERNAL AND EXTERNAL PERSONNEL MONITORING

Authored By:

Michael P. McDonald
Radiological Engineer

6-14-02

Date

Reviewed By:

Jeffrey W. Lively
Health Physicist

8/16/02

Date

Approved By:

Steven D. Rima
Radiological Engineering Manager

8/16/02

Date

This page intentionally left blank.

INTERNAL AND EXTERNAL PERSONNEL MONITORING

1.0 PURPOSE

- 1.1 The purpose of this procedure is to provide guidance and instruction for the monitoring, documentation, and reporting of occupational radiation exposure.

2.0 APPLICABILITY

- 2.1 This procedure applies to MACTEC, Inc. management, supervisors, individuals and contractors that are involved in the monitoring of occupational exposure (internal and external) to radiation from licensed and unlicensed radiation sources, where their work assignment is controlled by MACTEC, Inc.

3.0 REFERENCES

- 3.1 10 CFR 20, "Standards for Protection Against Radiation."
- 3.2 10 CFR 835, "Occupational Radiation Protection."
- 3.3 RPO-101, "Radiation Protection Program Overview."
- 3.4 RPO-301, "Radiological Surveys."
- 3.5 RPO-303, "Area air Sampling."
- 3.6 RPO-209, "Operation and Calibration of Lapel Air Samplers."
- 3.7 NRC Regulatory Guide 8.4, "Direct-reading and Indirect-reading Pocket Dosimeters."
- 3.8 NRC Regulatory Guide 8.7, "Instructions for Recording and Reporting Occupational Radiation Exposure Data."
- 3.9 NRC Regulatory Guide 8.25, "Air Sampling in the Workplace."
- 3.10 NRC Regulatory Guide 8.34, "Monitoring Criteria and Methods to Calculate Occupational Radiation Doses."
- 3.11 NRC Regulatory Guide 8.36, "Radiation Dose to the Embryo/Fetus."

4.0 DEFINITIONS AND ABBREVIATIONS

- 4.1 See RPO Glossary.

PROCEDURE NO: RPO-406	REVISION NO: 1	PAGE NO: 1 OF 11
-----------------------	----------------	------------------

5.0 GENERAL

5.1 EQUIPMENT

5.1.1 Various types of personnel monitoring devices.

5.2 SAFETY CONSIDERATIONS

Not applicable

5.3 RESPONSIBILITIES

5.3.1 RSO (or designee):

- Implement this procedure.
- Ensure individuals are qualified to perform this procedure.

5.3.2 Health Physics Staff:

- Comply with this procedure.

5.4 PREREQUISITES

5.4.1 Dosimetry issued to personnel shall be capable of measuring the appropriate and expected external radiation field(s).

5.4.2 Dosimetry shall only be issued to currently qualified and trained individuals and shall be worn only by the individual issued the dosimeter.

5.4.3 Prior to initial issue of dosimetry, the lifetime and current year exposure shall be determined in accordance with this procedure. A dose estimate provided by the worker may be used for the current year while awaiting receipt of exposure records or if such records are not received from other facilities.

5.5 RECORDS

5.5.1 Any documents and/or records created in the evaluation or reporting of worker exposures shall be stored, arranged, indexed, retained, retrieved, and disposed of in accordance with this procedure and all applicable document regulations and requirements.

5.6 PRECAUTIONS AND LIMITATIONS

Not applicable

5.7 REVISIONS

5.7.1 This procedure shall be reviewed at least every two years, with documentation to support the completion of such review.

5.8 OTHER

Not applicable

5.9 ATTACHMENTS

Attachment 1 - Occupational Dose Limits

Attachment 2 - Exposure Request Form

Attachment 3 - Personnel Exposure History

Attachment 4 - TLD Issue Log

Attachment 5 - DAC Hour Tracking Log

6.0 PROCEDURE

6.1 EXTERNAL MONITORING

6.1.1 MACTEC, Inc. shall monitor individuals, where their work assignment is controlled by MACTEC, Inc. for occupational radiation exposure received from licensed and unlicensed radiation sources, and shall supply and require the use of individual monitoring devices.

6.1.2 For individuals at a work location where the regulatory requirements are NRC based, dosimetry shall be issued for:

- Adults likely to receive, in 1 year from sources external to the body, a dose in excess of 10 % of the regulatory limits.
- Minors likely to receive, in 1 year, from radiation sources external to the body, a deep dose equivalent in excess of 0.1 rem (1 mSv), a lens dose equivalent in excess of 0.15 rem (1.5 mSv), or a shallow dose equivalent to the skin or to the extremities in excess of 0.5 rem (5 mSv).
- Declared pregnant women likely to receive during the entire pregnancy, from radiation sources external to the body, a deep dose equivalent in excess of 0.05 Rem (.5 mSv).

6.1.3 For individuals at a work location where the regulatory requirements are DOE based, dosimetry shall be issued for:

- Radiological workers who, under typical conditions, are likely to receive an effective dose equivalent to the whole body of 0.1 rem (0.001 sievert) or more in a year.
- Radiological workers who, under typical conditions, are likely to receive a shallow dose equivalent to the skin or to any extremity of 5 rems (0.05 sievert) or more in a year.
- Radiological workers who, under typical conditions, are likely to receive a lens of the eye dose equivalent of 1.5 rems (0.015 sievert) or more in a year.
- Declared pregnant workers who are likely to receive from external sources a dose equivalent to the embryo/fetus in excess of 10 percent of the applicable limit at 10 CFR 835.206(a).

- Occupationally exposed minors likely to receive a dose in excess of 50 percent of the applicable limits at 10 CFR 835.207 in a year from external sources.
- Members of the public entering a controlled area likely to receive a dose in excess of 50 percent of the limit at 10 CFR 835.208 in a year from external sources.
- Individuals entering a high or very high radiation area.

6.1.4 Work restrictions shall be implemented for any worker reaching 50% of the limits of Attachment 1 or as required by the RSO.

6.1.5 When required, external exposure monitoring shall normally be accomplished using thermoluminescent dosimeters (TLD). The RSO shall approve the use of monitoring devices other than TLDs.

6.1.6 Self-reading pocket dosimeters may be used to provide real time exposure readings for external deep dose measurements but should only be used as an estimate of exposure and not legal dose. If pocket dosimeters are utilized, they must meet the performance specifications as identified in NRC Regulatory Guide 8.4.

6.1.7 Monitoring device(s) shall be worn on the front of the upper torso unless otherwise directed by the RSO.

6.1.8 For work areas where the external radiation field is non-uniform, and requires the use of exposure monitoring devices, extremity dosimetry shall also be issued to the worker.

6.1.9 Radiological surveys shall be performed to supplement personnel monitoring when work is being performed where workers are required to be monitored for occupational exposure to radiation.

6.2 PLANNED SPECIAL EXPOSURES (PSE)

6.2.1 Provisions for planned special exposures, which are in addition to and accounted for separately from routine occupational doses, shall be authorized by the Corporate RSO.

6.2.2 Planned Special Exposures should only be authorized in exceptional situations when alternatives which might avoid the higher exposure are unavailable or impractical.

6.2.3 The following conditions apply to all planned special exposures:

- The individual(s) involved are informed of the purpose of the planned operation.
- The individual(s) involved are informed of the estimated exposure and special radiation or other conditions that might be involved in performing the task.
- The individual(s) involved are instructed in the measures to be taken to keep their exposure ALARA considering other risks that may be present.
- A complete and documented lifetime exposure history for each individual shall be available.
- A PSE shall not be authorized that would cause an individual to receive a dose from all planned special exposures and doses in excess of the limits to exceed the numerical values of any of the federal limits in any year, and five (5) times the annual limits during the individual's lifetime

6.2.4 MACTEC shall maintain records of all Planned Special Exposures in accordance with federal regulations and report to the individuals in writing the best estimate of their exposure within 30 days of the exposure.

6.2.5 MACTEC shall submit a written report to the Administrator of the appropriate NRC Regional Office listed in appendix D to part 20 within 30 days following any planned special exposure conducted, informing the Commission that a planned special exposure was conducted and indicating the date the planned special exposure occurred and the information required.

6.3 MONITORING DEVICES

6.3.1 All personnel dosimeters issued to individuals shall be of the appropriate type, range, accuracy, and sensitivity for the radiation being measured.

6.3.2 TLD's used for record dose monitoring must be selected and processed under the following conditions:

- Processing lab must have accreditation from the National Voluntary Laboratory Accreditation Program (NVLAP) or DOE Laboratory Accreditation Program (DOELAP); and
- Approved in this accreditation process for the type of radiation or radiations included in the accreditation program that most closely approximates the type

of radiation or radiations for which the individual wearing the dosimeter is monitored.

6.3.3 A record shall be maintained of TLD's issued to individuals for monitoring purposes. Attachment 4 is an example of an approved TLD issue log.

6.4 INTERNAL MONITORING

6.4.1 MACTEC, Inc. shall monitor the occupational intake of radioactive material during any work activity (routine or special operations).

6.4.2 For individuals at a work location where the regulatory requirements are NRC based, monitoring shall take place for, and assess the committed effective dose equivalent to:

- Adults likely to receive, in 1 year, an intake in excess of 10 % of the applicable ALI(s) in table 1, Columns 1 and 2, of appendix B to 10 CFR 20.1001-20.2402.
- Minors likely to receive, in 1 year, a committed effective dose equivalent in excess of 0.1 rem (1 mSv).
- Declared pregnant women likely to receive, during the entire pregnancy, a committed effective dose equivalent in excess of 0.05 Rem (.5 mSv).

6.4.3 For individuals at a work location where the regulatory requirements are DOE based, monitoring shall take place for, and assess the committed effective dose equivalent to:

- Radiological workers who, under typical conditions, are likely to receive a committed effective dose equivalent of 0.1 rem (0.001 sievert) or more from all occupational radionuclide intakes in a year;
- Declared pregnant workers likely to receive an intake or intakes resulting in a dose equivalent to the embryo/fetus in excess of 10 percent of the limit stated at 10 CFR 835.206(a);
- Occupationally exposed minors who are likely to receive a dose in excess of 50 percent of the applicable limit stated at 10 CFR 835.207 from all radionuclide intakes in a year; or
- Members of the public entering a controlled area likely to receive a dose in excess of 50 percent of the limit stated at 10 CFR 835.208 from all radionuclide intakes in a year.

- 6.4.4 Routine internal exposure shall be determined by sampling the air within the breathing zone of the worker.
- 6.4.5 Internal dose shall be determined by converting airborne concentrations to intakes in accordance with NRC Regulatory Guide 8.34, Position 3.3.
- 6.4.6 Dose tracking shall be maintained using the DAC Hour Tracking Log (Attachment 5).
- 6.4.7 When a potential or actual condition exists where the individual(s) could have received an unmonitored intake of radioactive material, determine intake by measurements of quantities of radionuclides excreted from or retained in the body by:
- Urine or fecal analysis.
 - Whole body counting.
- 6.4.8 Calculation of declared pregnant worker intake to committed effective dose equivalent (for the conversion of declared worker intake to embryo/fetus dose), shall be performed in accordance with NRC Regulatory Guide 8.36, Positions 2 and 3.
- 6.4.9 Work restrictions shall be implemented for any worker with an intake in excess of 50% of the applicable ALI(s), or as required by the RSO.
- 6.4.10 Work restrictions shall be implemented for any worker with an intake in excess of 50% of the chemical toxicity limits for soluble uranium, or as required by the RSO.

6.5 SUMMATION OF INTERNAL AND EXTERNAL EXPOSURES

- 6.5.1 Results of internal and external dose monitoring shall be used to calculate the total organ dose equivalent and total effective dose equivalent as required.
- 6.5.2 Summation calculations shall be performed in accordance with NRC Regulatory Guide 8.34, Position 7.1.
- 6.5.3 For a declared pregnant worker, sum the internal exposure of the embryo/fetus with the external dose to the declared pregnant worker to obtain the dose equivalent to the embryo/fetus.

6.6 DOCUMENTATION

- 6.6.1 For those individuals for whom monitoring is required, a determination of current year occupational exposure at other facilities is required.
- 6.6.2 Personnel Exposure History (Attachment 3) shall be completed prior to providing any dose monitoring devices to the individual.
- 6.6.3 For missing exposure reports an Exposure History Request Form (Attachment 2) may be sent to the licensee from whom the exposure record is required.
- 6.6.3 Acceptable dose reports are those issued by specific licensees or a completed NRC Form 4, or equivalent, signed by the individual and countersigned by an appropriate official of the most recent employer or current employer.
- 6.6.4 If an individual's records are estimates or incomplete MACTEC shall make reasonable efforts (at least two written attempts) to obtain complete records of each individual's prior years' occupational dose.
 - If complete records cannot be obtained, a written estimate signed by the individual may be accepted to demonstrate compliance with federal regulations.
- 6.6.5 A NRC Form 5, or equivalent, shall be maintained for each individual being monitoring.
- 6.6.6 The Form 5, or equivalent, shall be at a minimum updated quarterly.

NOTE: Organ doses (committed dose equivalent to the organ receiving the highest dose) need not be calculated if the committed effective dose equivalent does not exceed 1 rem and there are no overexposures in any dose category within the monitoring year, including doses previously reported by other licensees.

- 6.6.7 For a declared pregnant worker, the embryo/fetus' dose for the entire gestation period shall be recorded, but need not be included on NRC Forms 4 and 5.
 - If requested by the monitored woman, a letter report shall be provided to subsequent licensees to document prior embryo/fetus dose.
- 6.6.8 If dose monitoring is performed in compliance with 10 CFR 20.1502, a dose report to the monitored individuals(s) will be issued in accordance with 10 CFR 19.13.
 - A copy of the report shall also be issued to the NRC in accordance with 10 CFR 20.2205

PROCEDURE NO: RPO-406	REVISION NO: 1	PAGE NO: 9 OF 11
-----------------------	----------------	------------------

6.6.9 Dosimetry records, including detailed information, identified with a specific individual shall be readily available to that individual and to others on a need-to-know basis (e.g., the individual's supervisor, management, and safety personnel).

- Individuals can request their dosimetry records from the Corporate RSO.

6.6.10 Upon request, MACTEC, Inc. shall provide dose records to an individual terminating employment as soon as the data is available, but not later than 90 days after termination.

- If requested, a written estimate of the radiation dose received by that employee (based on available information) shall be provided at the time of termination.

6.7 NOTIFICATION and REPORTING

6.7.1 The appropriate regulatory agency shall be immediately notified for any event involving byproduct, source, or special nuclear material possessed by the licensee that may have caused, or threatens to cause, an individual to receive:

- A total effective dose equivalent of 25 rems (0.25 Sv) or more; or
- A lens dose equivalent of 75 rems (0.75 Sv) or more; or
- A shallow-dose equivalent to the skin or extremities of 250 rads (2.5 Gy) or more.

6.7.2 The appropriate regulatory agency shall be notified within 24 hours of discovery of an event involving the loss of control of licensed material possessed by the licensee that may have caused, or threatens to cause an individual to receive:

- A total effective dose equivalent exceeding 5 rems (0.05 Sv); or
- A lens dose equivalent exceeding 15 rems (0.15 Sv); or
- A shallow-dose equivalent to the skin or extremities exceeding 50 rems (0.5 Sv)

6.7.3 In addition to the notification(s) required above, each licensee shall submit a written report within 30 days for any incident for which notification is required by step 6.7.1 or 6.7.2; or after learning of any of the following occurrences:

- Doses in excess of the occupational dose limits for adults; or

- Doses in excess of the occupational dose limits for a minor; or
- Doses in excess of the limits for an embryo/fetus of a declared pregnant woman; or
- Doses in excess of the limits for an individual member of the public; or
- Doses in excess of any applicable limit in the license; or

7.0 QUALITY ASSURANCE

- 7.1 This procedure and related documents shall be made available as part of the annual audit of the Health Physics Program.

OCCUPATIONAL DOSE LIMITS

General Employees	
Whole body (total effective dose equivalent)	5 rems
Individual organ or tissue other than the lens of the eye	50 rems
Lens of the eye	15 rems
Skin or to any extremity	50 rems
Embryo/fetus of a declared pregnant worker	0.5 rems
Occupationally Exposed Minors	
Whole body (total effective dose equivalent)	0.1 rems
Lens of the eye	1.5 rems
Skin or to any extremity	5 rems
Members of the Public	0.1 rems

The assigned deep-dose equivalent and shallow-dose equivalent must be for the part of the body receiving the highest exposure.

The deep-dose equivalent, lens dose equivalent, and shallow-dose equivalent may be assessed from surveys or other radiation measurements for the purpose of demonstrating compliance with the occupational dose limits, if the individual monitoring device was not in the region of highest potential exposure, or the results of individual monitoring are unavailable.

PROCEDURE NO: RPO-406

REVISION NO: 1

ATTACHMENT 1
PAGE NO: 1 OF 1

Exposure History Request Form

In accordance with Title 10 Part 19.13(c) of the Code of Federal Regulations, I am requesting a record of radiation exposure received by me under State/NRC license at your facility.

Facility Name: _____

Location: _____

Requester's Name: _____

Social Security Number: _____ - _____ - _____

Exposure Period: From _____ To _____

Signature: _____ Date: _____

Please mail records to:

MACTEC Constructors, Inc.
546 Main Street
Suite 401
Grand Junction, CO 81501
Attn: Radiation Safety Officer

Phone: (970) 243-2861
Fax: (970) 256-7356

Form RPO-406-01-2

PROCEDURE NO: RPO-406	REVISION NO: 1	ATTACHMENT 2 PAGE NO: 1 OF 1
-----------------------	----------------	---------------------------------

PERSONAL EXPOSURE HISTORY

Name (print) _____

Social Security Number: _____ - _____ - _____

Employee:

Have you ever received an occupational exposure to ionizing radiation during periods of previous employment and/or while serving in the military?

YES NO

If yes, please complete the following information.

Is a NRC Form 4 (or similar) attached? YES NO

Previous Employer: _____

Address: _____

Exposure Period: From _____ to _____

Previous Employer: _____

Address: _____

Exposure Period: From _____ to _____

Previous Employer: _____

Address: _____

Exposure Period: From _____ to _____

(use additional sheets as necessary)

Signature: _____ Date: _____

Form RPO-406-01-3

PROCEDURE NO: RPO-406	REVISION NO: 1	ATTACHMENT 3 PAGE NO: 1 OF 1
-----------------------	----------------	---------------------------------

TLD ISSUE LOG

For quarter beginning:

Name	SS #	TLD #	Date Issued	Date Pulled	Form 5 Update

Form RPO-406-01-4

Reviewed By: _____ Date: _____

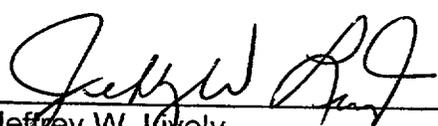


MACTEC, Inc.

Procedure No: RPO-501
Revision No: 1
Effective Date: 9-1-02

RADIOLOGICAL INCIDENT RESPONSE

Authored By:  6-14-02
Michael P. McDonald
Radiological Engineer
Date

Reviewed By:  8/16/02
Jeffrey W. Lively
Health Physicist
Date

Approved By:  GHP 8/16/02
Steven D. Rima
Radiological Engineering Manager
Date

This page intentionally left blank.

RADIOLOGICAL INCIDENT RESPONSE

1.0 PURPOSE

1.1 The purpose of this procedure is to provide guidance on the appropriate response in the event of a radiological incident.

2.0 APPLICABILITY

2.1 This procedure applies to MACTEC, Inc. management, supervisors, individuals and contractors that may be involved with, or need to respond to, a radiological incident in the work environment, where their work assignment is controlled by MACTEC, Inc.

3.0 REFERENCES

3.1 RPO-101, "Radiation Protection Program Overview."

3.2 10 CFR 20, "Standards for Protection Against Radiation."

3.3 10 CFR 835, "Occupational Radiation Protection."

3.4 NUREG 1556, Volume 11, Appendix R, "General Topics for Safe Use of Radioisotopes and Model Incident Procedures."

4.0 DEFINITIONS AND ABBREVIATIONS

4.1 See RPO Glossary.

5.0 GENERAL

5.1 EQUIPMENT

Not applicable

5.2 SAFETY CONSIDERATIONS

5.2.1 Never put yourself or others in harms ways to carry out the actions of this procedure. If danger is perceived, leave the area immediately and contact your supervisor, RSO, or the person in charge.

5.2.2 Perform only remedial actions you are qualified to perform.

5.3 RESPONSIBILITIES

5.3.1 RSO (or designee):

- Implement this procedure.
- Ensure that individuals are qualified and trained to perform this procedure.
- Ensure sufficient resources (response personnel as well as response supplies) are available for incident response activities.
- Ensure rapid notification/activation as directed in this procedure and as required by regulatory requirements.

5.3.2 Affected/Response Personnel:

- Comply with this procedure.
- Identify abnormal radiological situations.
- If first responding person, assume the lead role, manage the radiological incident response actions, and prescribe the controls and personal protection equipment (PPE) necessary to mitigate the radiological hazards, until properly relieved.

5.4 PREREQUISITES

Not applicable

5.5 RECORDS

- 5.5.1 Records that are generated as a result of the requirements of federal regulations must be retained until NRC authorizes their disposition.

5.6 PRECAUTIONS AND LIMITATIONS

- 5.6.1 Radiological incident response is a dynamic situation that requires good judgment and prompt actions. Quick response, protection of personnel, protection of property, mitigation of the incident, and maintaining exposures As Low As Reasonably Achievable (ALARA) are the priorities for responding personnel. Note that during the time critical response phase, some "normal operational" requirements may be waived (such as posting areas, writing RWP's, etc.), but as soon as the time critical elements have been accomplished and recovery operations begin, normal operational requirements shall be followed.

5.7 REVISIONS

- 5.7.1 This procedure shall be reviewed at least every two years, with documentation to support the completion of such review.

5.8 OTHER

PROCEDURE NO: RPO-501	REVISION NO: 1	PAGE NO: 2 OF 18
-----------------------	----------------	------------------

Not applicable

5.9 ATTACHMENTS

Not applicable

6.0 PROCEDURE

6.1 GENERAL

- 6.1.1 Immediate actions may be performed in any order unless specified otherwise. Concurrent actions are preferred to expedite hazard mitigation and ensure exposures are ALARA.
- 6.1.2 Complete supplementary actions after immediate actions have been performed.
- 6.1.3 If continued work in the affected area will impede the implementation of incident response actions, stop the work and inform the RSO/Person in Charge of the stop work order.

NOTE: The intent of notifications in this procedure is to ensure that sufficient resources are available to resolve the incident situation. If immediate notification of the RSO is not possible, the responding/affected individual should notify the Person in Charge and request additional support, as necessary.

- 6.1.4 When a radiological incident has occurred that is not addressed in this procedure, contact the RSO/Radiological engineer for guidance and assistance, if necessary.

6.2 RESPONSE TO A SPILL INVOLVING RADIOACTIVE MATERIAL OR LOSS OF CONTROL OF RADIOACTIVE MATERIAL

Immediate Actions

- 6.2.1 Stop or secure the operation causing the spill.
- 6.2.2 Warn others in the immediate area.
- 6.2.3 Isolate the area. Evacuate potentially contaminated personnel to a "holding area" until surveyed.
- 6.2.4 Minimize personnel exposure.
- 6.2.5 Secure or redirect ventilation that is not HEPA filtered, if possible and as appropriate.
- 6.2.6 Contact RSO.

Supplementary Actions

- 6.2.7 Verify there is no radioactive material outside established boundaries.
- 6.2.8 Remediate the spill area, as necessary.

6.3 RESPONSE TO CONTAMINATED PERSONNEL

NOTE: This procedure applies to the proper handling of personnel with radioactively contaminated clothing (other than PPE), skin, and wounds, as well as personnel with known or potential inhalation or ingestion of radioactive material. This procedure does not apply to personnel contaminated with hazardous chemical or mixed materials.

6.3.1 Safety Considerations

- The health of the individual always has priority over personnel decontamination.
- In responding to an accident, check for hazards in the area. Ensure that entry can be accomplished in a safe manner prior to entry. Do not enter the area if a dangerous situation exists.

Immediate Actions

6.3.2 Stop work immediately.

6.3.3 Evaluate/survey the condition of personnel and the incident site, checking for hazards in the area.

6.3.4 If personnel are severely injured or unconscious, dial 911, otherwise call the RSO and relay the following information:

- a. Incident description;
- b. Incident location;
- c. Number and condition of personnel involved;
- d. Conditions of the incident site.

6.3.5 If it is safe to enter the incident site, proceed to the affected person(s) and evaluate her/his condition.

- a. If the affected person is unconscious, and/or a serious wound or a life-threatening condition is apparent, summon help and GO directly to Section 6.4.
- b. If the affected person has a minor wound or non-life threatening injury, GO to Section 6.5.

PROCEDURE NO: RPO-501	REVISION NO: 1	PAGE NO: 5 OF 18
-----------------------	----------------	------------------

- c. If the affected person is not injured, but is known or suspected to be internally contaminated (e.g., inhalation or ingestion of radioactive materials), GO to Section 6.6.
- d. If the affected person is not injured, but is externally contaminated, GO to Section 6.7.

6.4 RESPONSE TO SERIOUS WOUND OR LIFE-THREATENING CONDITION

NOTE: Medical treatment of injuries takes precedence over radiological considerations.

6.4.1 Follow directions provided by responding medical professionals (e.g., nurse, doctor, EMT, etc.) for the treatment of injuries.

6.4.2 If trained in First Aid, administer appropriate first aid measures, such as control of bleeding, CPR, artificial respiration, resuscitation, treatment of shock, etc. If not trained in first aid, find an individual who is trained and can assist.

NOTE: Do not move an injured person unless there is an acute hazard in the area (e.g., fire, toxic gas, Very High Radiation Areas) unless directed by a responding medical professional.

6.4.3 Notify the RSO and/or response team.

6.4.4 Reassure the injured person that help is coming and keep her/him as calm as possible.

6.4.5 While waiting for responding medical professionals to arrive, perform a contamination survey of the skin/clothing adjacent to the wound.

NOTE: Do not swipe or decontaminate the wound. Wound decontamination shall be directed/performed by responding medical professionals.

6.4.6 Perform a whole-body contamination survey (as much as possible) of the injured individual(s). Continue to monitor the condition of the injured individual.

6.4.7 Cover wounds to prevent the possibility of further contamination.

6.4.8 Provide radiological control support (e.g., contamination monitoring and control) as needed or requested, and follow instructions given by the responding medical professionals.

6.4.9 Accompany the individual to the medical facility, as requested by the responding medical professionals, to provide radiological support as needed. Take precautions to prevent spread of contamination during the transport and movement of the individual.

6.4.10 At the conclusion of the response/treatment/decontamination activities, perform contamination surveys of individuals who were directly involved, as well as any vehicles, stretchers, blankets, etc., used in transporting the injured individual, and any room(s), equipment, and supplies (e.g., gauze bandages, towels, PPE) used during the treatment and/or decontamination of the individual.

6.4.11 Assist in any additional personnel, equipment, and facility decontamination activities, as needed or required.

6.4.12 Ensure that contaminated items, articles, etc., are removed, collected, bagged, tagged, and segregated for later inspection, analysis, and disposition, as necessary.

6.5 RESPONSE TO MINOR WOUNDS OR NON-LIFE-THREATENING INJURIES

6.5.1 Follow directions provided by responding medical professionals (e.g., nurse, doctor, EMT, etc.) for the treatment of injuries.

6.5.2 If trained in First Aid, administer appropriate first aid measures. If not trained in first aid, find an individual who is trained and can assist.

NOTE: Do not move an injured person unless there is an acute hazard in the area (e.g., fire, toxic gas, Very High Radiation Areas) unless directed by a responding medical professional.

6.5.3 Notify the RSO.

6.5.4 If necessary, transfer the injured individual to the medical facility and perform steps 6.4.8 through 6.4.12.

6.5.5 If it is not necessary to transport the individual to the medical facility, perform a whole-body contamination survey (as much as possible) of the injured individual(s).

6.5.6 Obtain RSO authorization and perform personal decontamination.

6.6 RESPONSE TO INTERNAL CONTAMINATION OF PERSONNEL

6.6.1 Notify the RSO of suspected internal contamination of personnel.

6.6.2 Perform a whole-body contamination survey of the affected individual(s) to determine the extent of external contamination.

6.6.3 Obtain nose swipes for qualitative indication of intakes.

NOTE: Nose swipes should be obtained within 10 minutes after the suspected or known intake. The sample may be taken by the individual, but care should be

taken to prevent cross contamination of the sample. Nose swipes should also be obtained before affected personnel attempt to remove any nasal contamination (e.g., nose blowing or bathing).

6.6.4 Field count nose swipes as soon as possible and notify the RSO of the results. Swipes shall be saved in the event further analysis is necessary.

6.6.5 Follow directions provided by the RSO.

6.6.6 Proceed to Section 6.7.3.

6.7 RESPONSE TO EXTERNAL CONTAMINATION OF PERSONNEL

6.7.1 Survey clothing and exposed skin and hair, paying particular attention to the face, pausing at the nose, mouth, and ears, and any wounds or burns.

NOTE: If the radioactive isotope (contaminate) is not known, survey for both beta/gamma and alpha contamination. Be aware that overlying tissue or residual moisture on the skin or in clothing may inhibit or totally prevent detection of alpha contamination by a portable instrument.

6.7.2 If contamination of the face, eyes, ears, nose, or mouth is detected, or internal contamination is suspected, GO to Section 6.6.

6.7.3 If external contamination (i.e., skin/hair, clothing) is confirmed:

- a. Establish a temporary Contamination Area at the person's location.
- b. Prevent tracking of contaminants by appropriate use of floor covering and boundary methods.
- c. Restrict access to the Contamination Area, as necessary.

6.7.4 Remove contaminated PPE and personal clothing, as appropriate, and survey skin surfaces underneath. Be careful to prevent the spread of contamination when removing contaminated clothing.

NOTE: Care should be taken to ensure that modesty of the affected individual(s) is protected as much as possible.

6.7.5 If skin/hair contamination is confirmed, cover the contaminated skin/hair with clean PPE, or other suitable covering, to prevent contamination of the body parts or surfaces and take the individual to an area where skin/hair decontamination can be performed. GO to Section 6.8.

6.8 PERSONNEL DECONTAMINATION

6.8.1 Ensure that personnel involved in the decontamination effort don appropriate PPE before starting decontamination.

6.8.2 Carefully remove clothing, coverings, etc., necessary to expose contaminated skin/hair.

6.8.3 Ensure that decontamination activities will not result in cross-contamination of other body parts or surfaces.

6.8.4 Perform decontamination of skin and/or hair:

a. Ensure that water, wipes, and other decontamination materials are collected and analyzed, as necessary.

b. Use only lukewarm (body temperature) water and mild soap to clean/decontaminate affected areas. As an alternative, alcohol-free baby wipes may be used.

NOTE: Extreme care should be taken to avoid abrading or breaking the skin. Brushing or rubbing the affected area(s) should be avoided.

c. Gently pat dry the affected area(s) and resurvey for residual contamination.

d. Repeat steps b. and c., until contamination is removed. If contamination levels do not continue to decrease with repeated cleanings, or the affected areas become irritated, stop the decontamination process.

e. Notify the RSO of the decontamination effort.

6.8.5 If necessary, accompany the individual to the medical facility, as directed by the RSO. Provide radiological control support. Follow instructions given by medical professionals. Take precautions to prevent spread of contamination during transport and movement of the individual, as applicable.

6.8.6 At the conclusion of response/treatment/decontamination activities, perform contamination surveys of individuals who were directly involved, as well as any vehicles, stretchers, blankets, etc., used in transporting the individual to the medical facility, and any room(s), equipment, and supplies (e.g., gauze bandages, towels, PPE) used during the treatment and/or decontamination of the individual.

6.8.7 Assist in additional personnel, equipment, and facility decontamination activities, as required.

6.8.8 Ensure that contaminated items, articles, etc., are removed, collected, bagged, tagged, and segregated for later inspection, analysis and disposition.

6.9 RESPONSE TO UNATTENDED AND UNCONTROLLED RADIOACTIVE MATERIAL

Immediate Actions

6.9.1 Assume temporary responsibility of, and control access to, the radioactive material.

6.9.2 Minimize exposure.

6.9.3 Instruct someone to contact the RSO while continuing to safe-guard the radioactive material, if possible.

6.9.4 Survey the radioactive material and surrounding areas as necessary.

6.9.5 Mark the radioactive material and post the areas in accordance with applicable procedures or move the material to an appropriate posted area.

Supplementary Actions

6.9.6 Identify and notify the individual who has been assigned the responsibility for the radioactive material.

6.9.7 If satisfied, the RSO may transfer responsibility of the radioactive material back to the individual who has been assigned the responsibility for the radioactive material.

6.10 RESPONSE TO LOST, STOLEN, OR UNACCOUNTED RADIOACTIVE MATERIAL

Immediate Actions

6.10.1 Contact the RSO.

6.10.2 Conduct an investigate with the individuals involved.

6.10.3 Perform surveys of potentially affected areas.

Supplementary Actions

6.10.4 Search for the radioactive material until found and the required controls are put in place or until the RSO declares the material can not be accounted for (and is a complete loss).

6.11 RESPONSE TO A DAMAGED OR LEAKING SOURCE

NOTE: Do not handle the source until radiation and contamination surveys are performed.

Immediate Actions

- 6.11.1 Warn others in the immediate area.
- 6.11.2 Isolate the area. Evacuate potentially contaminated personnel to a "holding area" until surveyed.
- 6.11.3 Minimize personnel exposure to radiation and contamination.
- 6.11.4 Secure or redirect ventilation that is not HEPA filtered, if possible and as appropriate.
- 6.11.5 Inform RSO of source condition.

Supplementary Actions

- 6.11.6 Verify there is no contamination outside established boundaries.
- 6.11.7 Decontaminate, as necessary.
- 6.11.8 Remove the damaged/leaking source from service.
- 6.11.9 Survey users and potentially affected areas.

6.12 RESPONSE TO UNANTICIPATED AIRBORNE RADIOACTIVITY

NOTE: When CAMS or tritium monitors are used in areas which do not require respiratory protection, an alarm should be considered caused by unanticipated airborne radioactivity. Evacuation may not be required for monitors that are used for process status only.

Immediate Actions

- 6.12.1 Immediately stop work in the affected area and evacuate personnel. Isolate work area to minimize the spread of airborne radioactive material.
- 6.12.2 Note CAM output, if available.
- 6.12.3 Start, or ensure operation of, HEPA filtered ventilation, if equipped.
- 6.12.4 Isolate workers, in an unaffected area, and check affected personnel for contamination.

6.12.5 Contact RSO.

Supplementary Actions

6.12.6 Consider airborne monitoring in affected and adjacent areas.

6.12.7 Post radiological areas, as necessary. Verify boundaries of affected areas.

6.12.8 Coordinate and perform decontamination of the affected area(s), as required.

6.12.9 Attempt to identify the cause of the abnormal radiological situation.

6.12.10 Entry into the affected area may be performed under the following conditions:

- a. Monitoring is performed with air sampling equipment and appropriate PPE and respiratory protection is worn for the measured hazard, or
- b. If monitoring is not available, entry may be performed using appropriate PPE and SCBA.

6.12.11 If the alarm is determined to be caused by a mechanical or electrical problem, work activities may be resumed when the monitor has been determined to be fully functional or an alternate means of monitoring is established. If the alarm is determined to be caused by an expected temporary increase in external radiation levels, work activities may be resumed when the monitor has been reset and no longer alarms due to external radiation.

6.13 RESPONSE TO UNANTICIPATED RADIATION LEVELS

NOTE: This section is applicable when radiological levels exist outside the scope of the work, if radiological posting levels are exceeded which would require the use of additional protective measures, or if directed by an HPT or RSO.

Immediate Actions

6.13.1 If a criticality alarm has sounded, immediately evacuate as rapidly as possible. Ensure that personnel criticality dosimeters are evaluated.

6.13.2 Inform others in affected work area.

6.13.3 Stop work.

6.13.4 Evacuate affected work area.

PROCEDURE NO: RPO-501	REVISION NO: 1	PAGE NO: 12 OF 18
-----------------------	----------------	-------------------

6.13.5 Note RAM and supplemental dosimetry, if applicable.

6.13.6 Contact RSO.

6.13.7 Account for all possibly affected personnel.

Supplementary Actions

6.13.8 Survey affected and adjacent areas, and post radiological areas as discovered.

6.13.9 Attempt to identify the cause of the abnormal radiological situation.

6.13.10 Process affected personnel's dosimeters, if requested by the RSO.

6.14 RESPONSE TO A FIRE INVOLVING RADIOACTIVE MATERIAL

Immediate Actions

6.14.1 Take actions as required with any fire (i.e., report using 911). Include in the report the presence of radiation/radioactive materials and magnitude if known.

6.14.2 Assist in evacuation and accounting of personnel.

6.14.3 Use portable extinguisher, if safe and trained to do so and if radioactive material is not directly involved in the fire. Never attempt to fight a structure fire with a portable fire extinguisher.

6.14.4 Assist and advise responding fire-fighting/ response team personnel.

6.14.5 Contact RSO.

6.14.6 Attempt to minimize the spread of radioactivity.

Supplementary Action

6.14.7 Segregate and survey firefighters, response team personnel, and any other affected personnel and equipment.

6.15 RESPONSE TO FAILED RADIOLOGICAL SURVEY INSTRUMENT or OUT OF CALIBRATION INSTRUMENT

Immediate Actions

6.15.1 If a radiological survey instrument is being used to protect the health and safety of the work force or public:

a. Stop the evolution in progress.

- b. Evacuate individuals from the suspect affected area.
- c. Contact the RSO immediately.
- d. Investigate and evaluate potential exposure.

6.15.2 If a radiological survey instrument is being used to protect the environment:

- a. Stop the evolution in progress.
- b. Contact the RSO immediately.
- c. Investigate and evaluate potential release to the environment.

6.15.3 If a radiological survey instrument is being evaluated (pre and post use response checks, QC checks or other performance checks):

- a. Stop the evolution in progress.
- b. Contact the RSO immediately.
- c. Investigate and evaluate past potential exposure.

6.15.4 If a radiological survey instrument is not in use, but is identified as being used during an out of calibration period:

- a. Contact the RSO immediately.
- b. Investigate and evaluate past potential exposure.

Supplementary Action

6.15.5 Tag the instrument "Out of Service."

6.15.6 Take corrective actions for all identified past exposures that may have been incorrectly determined due to failed or out of calibration instrumentation.

6.15.7 Take corrective actions for all identified past releases that may have been incorrectly identified/monitored due to failed or out of calibration instrumentation.

6.15.8 Calibrate instrument prior to placing back in service.

RADIOLOGICAL INCIDENT FOLLOW-UP ACTIVITIES

6.16.1 The HPT shall complete radiological survey forms, incident reports, or any other report/form as requested by the RSO, and promptly submit to the RSO.

6.16.2 The HPT shall collect and record the following information (as applicable) and forward the information to the RSO:

- a. physical and chemical form of contaminant(s) (if known);
- b. identity of radionuclide(s) of concern;
- c. radionuclide particle size (if available);
- d. intake pathway (inhalation, injection, absorption, ingestion);
- e. personnel contamination levels on skin and/or around wound;
- f. contamination level(s) on the object that caused the wound;
- g. airborne radioactivity concentration(s);
- h. duration of exposure to airborne radioactivity; and/or
- i. protective clothing and respiratory protection in use at the time of the incident.

6.16.3 After the response/treatment/decontamination efforts have been completed, obtain (or provide assistance to obtain) a complete history of the incident, especially as it relates to the activities of the affected individual(s).

6.17 NOTIFICATION and REPORTING

6.17.1 The appropriate regulatory agency shall be immediately notified for any event involving byproduct, source, or special nuclear material possessed by the licensee that may have caused, or threatens to cause:

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

6.17.2 The appropriate regulatory agency shall be notified as soon as possible, but not later than 4 hours, after the discovery of an event that prevents immediate protective actions necessary to avoid exposures to radiation or radioactive materials that could exceed regulatory limits or releases of licensed material that could exceed regulatory limits (events may include fires, explosions, toxic gas releases, etc.).

6.17.3 The appropriate regulatory agency shall be notified within 24 hours of discovery of an event involving licensed material as described below:

- An unplanned contamination event that requires access to the contaminated area, by workers or the public, to be restricted for more than 24 hours by imposing additional radiological controls or by prohibiting entry into the area; an unplanned contamination event that involves a quantity of material greater than five times the lowest annual limit on intake specified in Appendix B of §§ 20.1001–20.2401 of 10 CFR part 20 for the material; and an unplanned contamination event that has access to the area restricted for a reason other than to allow isotopes with a half-life of less than 24 hours to decay prior to decontamination.
- An event in which equipment is disabled or fails to function as designed when the equipment is required by regulation or license condition to prevent releases exceeding regulatory limits, to prevent exposures to radiation and radioactive materials exceeding regulatory limits, or to mitigate the consequences of an accident; an event in which equipment is disabled or fails to function as designed when the equipment is required to be available and operable when it is disabled or fails to function; and an event in which equipment is disabled or fails to function as designed when no redundant equipment is available and operable to perform the required safety function.
- An event that requires unplanned medical treatment at a medical facility of an individual with spreadable radioactive contamination on the individual's clothing or body.
- An unplanned fire or explosion damaging any licensed material or any device, container, or equipment containing licensed material when the quantity of material involved is greater than five times the lowest annual limit on intake specified in appendix B of §§ 20.1001–20.2401 of 10 CFR part 20 for the material; and the damage affects the integrity of the licensed material or its container.

6.17.4 The appropriate regulatory agency shall be notified within 24 hours of discovery of an event involving the loss of control of licensed material possessed by the licensee that may have caused, or threatens to cause:

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

6.17.5 In addition to the notification(s) required above, each licensee shall submit a written report within 30 days for any incident for which notification is required or after learning of any of the following occurrences:

- Doses in excess of the ALARA constraints for air emissions; or

- Levels of radiation or concentrations of radioactive material in a restricted area in excess of any applicable limit in the license; or
- Levels of radiation or concentrations of radioactive material in an unrestricted area in excess of 10 times any applicable limit set forth in the applicable regulation or in the license; or
- For licensees subject to the provisions of EPA's generally applicable environmental radiation standards in 40 CFR part 190, levels of radiation or releases of radioactive material in excess of those standards, or of license conditions related to those standards.

6.18 RADIOLOGICAL CRITIQUES

NOTE: The RSO is responsible for determining if a critique is required.

6.18.1 The RSO is responsible for:

- Identifying personnel who should participate in the critique.
- Scheduling the critique.
- Notifying participants of the time and place.
- Facilitating the critique.
- Ensuring that the minutes of the critique are taken.
- Signing the recorded minutes once complete.

6.18.2 During the critique, the RSO shall ensure that the following actions are performed:

- Distributing the critique attendance roster.
- Introducing personnel at the critique, if required.
- Stating the purpose of the critique.
- Identifying fire exits, security requirements, facilities and personal expectations of decorum.
- Outlining the events leading up to the incident, through its fruition and mitigation.
- Reviewing, with the critique members, the documentation pertaining to the abnormal radiological situation and its response.

PROCEDURE NO: RPO-501	REVISION NO: 1	PAGE NO: 17 OF 18
-----------------------	----------------	-------------------

- Developing an incident time line.

6.18.3 The RSO shall initiate a Radiological Improvement Report (RIR) based on the outcome of the critique.

6.18.4 The RSO shall recommend mitigation actions based on the critique to Management to minimize the possibility of abnormal radiological situation reoccurrence.

6.18.5 The RSO shall track the accomplishment of mitigation actions and corrective actions as required by the RIR.

7.0 QUALITY ASSURANCE

7.1 Any records generated during the performance of this procedure shall be evaluated as part of the annual audit of the health physics program.



MACTEC, Inc.

Procedure No: RPO-601

Revision No: 1

Effective Date: _____

SHIPPING and TRANSPORTATION OF RADIOACTIVE MATERIALS

Authored By:

Michael P. McDonald
Radiological Engineer

6-14-02

Date

Reviewed By:

Jeffrey W. Dively
Health Physicist

8/16/02

Date

Approved By:

Steven D. Rima
Radiological Engineering Manager

8/16/02

Date

This page intentionally left blank.

SHIPPING and TRANSPORTATION OF RADIOACTIVE MATERIALS

1.0 PURPOSE

1.1 The purpose of this procedure is to provide instruction in the shipping and transportation of radioactive materials.

2.0 APPLICABILITY

2.1 This procedure applies to MACTEC, Inc. management, supervisors, individuals and contractors that perform shipping and transportation of radioactive materials, where their work assignment is controlled by MACTEC, Inc.

3.0 REFERENCES

- 3.1 10 CFR 20, "Standards for Protection Against Radiation."
- 3.2 10 CFR 835, "Occupational Radiation Protection."
- 3.3 10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste."
- 3.4 10 CFR 71, "Packaging and Transportation of Radioactive Material."
- 3.5 49 CFR 171-178, "Hazardous Materials Regulations."
- 3.6 RPO-105, "Special Nuclear Materials Accountability, Transfer and Control Procedure."
- 3.7 RPO-201, "Operation of Portable Radiological Survey Instruments."
- 3.8 RPO-204, "Calibration and Quality Control of Portable Radiological Survey Instruments."
- 3.9 RPO-205, "Operation and Calibration of the Protean Alpha/Beta Counter."
- 3.10 RPO-301, "Radiological Surveys."
- 3.11 RAMREG-001-98, USDOT, "Radioactive Material Regulations Review."

4.0 DEFINITIONS AND ABBREVIATIONS

4.1 See RPO Glossary.

5.0 GENERAL

PROCEDURE NO: RPO-601	REVISION NO: 1	PAGE NO: 1 OF 5
-----------------------	----------------	-----------------

5.1 EQUIPMENT

5.1.1 Radiation and contamination survey instrumentation

5.1.2 Smear material

5.1.3 Various Personnel Protective Clothing

5.1.4 Various shipping containers

5.1.5 Shipping labels

5.2 SAFETY CONSIDERATIONS

Not applicable

5.3 RESPONSIBILITIES

5.3.1 RSO (or designee):

- Implement this procedure.
- Ensure individuals are qualified to perform this procedure.
- Ensure that all survey documentation is reviewed in a timely manner.
- Determine the radiological instrumentation to be utilized to perform radiological surveys, if necessary.

5.3.2 Health Physics Staff:

- Comply with this procedure.
- Operate radiological survey instrumentation in accordance with approved operating procedures.

5.4 PREREQUISITES

Not applicable

5.5 RECORDS

5.5.1 Shipping and transportation documents and/or records shall be stored, arranged, indexed, retained, retrieved, and disposed of in accordance with this procedure and all applicable document regulations and requirements.

5.6 PRECAUTIONS AND LIMITATIONS

Not applicable

5.7 REVISIONS

5.7.1 This procedure shall be reviewed at least every two years, with documentation to support the completion of such review.

5.8 OTHER

Not applicable

5.9 ATTACHMENTS

Attachment 1 - Guidance for Shipment Of Limited Quantity of Radioactive Material

Attachment 2 - Radioactive Material Shipping Record

Attachment 3 - Limited Quantity Statement

Attachment 4 - Shipping and Transportation - Questions and Answers

6.0 PROCEDURE

6.1 GENERAL RADIOACTIVE SHIPPING REQUIREMENTS

- 6.1.1 Individuals involved in the shipping of radioactive materials shall be trained in accordance with 49 CFR 172.700 and 172.701.
- 6.1.2 Shipment and/or transportation of radioactive material, radioactive waste, radioactive samples being sent for analysis, etc., shall be conducted in accordance with the requirements of 49 CFR 171 through 178; 10 CFR 20, 61 and 71; state laws; and in accordance with this procedure.
- 6.1.3 SI radiological units shall be the controlling units used for shipping and transportation of radioactive materials, radioactive wastes, radioactive samples, etc.
- 6.1.4 Low level waste shall be delivered to a carrier for transport to an approved waste processor and/or disposal facility.
- 6.1.5 Current copies of licenses shall be maintained and verified for processors or disposal facilities.

6.2 SHIPMENT OF RADIOACTIVE MATERIAL (GENERAL GUIDANCE)

- 6.2.1 For general guidance on the shipment of radioactive materials, refer to Attachment 6, Shipping and Transportation - Questions and Answers.

6.3 SHIPMENT OF VOLUMETRIC SAMPLES FOR ANALYSIS

- 6.3.1 For the shipment of volumetric samples to offsite facilities, refer to Attachment 1.

6.4 NON-DOT RADIOACTIVE MATERIAL

- 6.4.1 49 CFR 173.403 defines radioactive material as any material with a specific activity greater than 70 Bq per gram (.002 microcurie/g). This activity is significantly greater than the license and/or procedural free release criteria for most sites.
- 6.4.2 Shipments of radioactive material greater than the site release criteria but below DOT requirements will be performed in accordance with this procedure with the following exception:
- The limited quantity statement defined in 49 CFR 172.422 will not be included with the shipping paperwork or in the package(s) of material.

7.0 QUALITY ASSURANCE

7.1 This procedure and related documents shall be made available as part of the annual health physics program audit.

LIMITED QUANTITY SHIPMENT OF RADIOACTIVE MATERIAL

INTRODUCTION:

This attachment provides guidance for shipment of volumetric samples to offsite facilities for the analysis of radioactive or chemical contaminants. This attachment applies only to samples shipped as "Excepted Package Limited Quantity Of Material" in accordance with 49 CFR 173.421.

SURVEYING:

1. Prior to packaging, the outside of each sample container shall be surveyed for loose surface contamination. The results from each sample container survey shall be less than site releasable limits for loose surface contamination. If not, the container can not be shipped.
2. Package contamination surveys for radioactive material shipments shall be performed and are nominally based on a 300 cm² survey area.
3. A dose rate survey shall be performed on all external surfaces of the shipping package. The maximum radiation level on any external surface of the package is 0.5 mrem/hr (0.005mSv/hr).

U-235 ACTIVITY DETERMINATION:

If shipping samples containing U-235, the activity of each individual sample and/or the total activity of the package shall be determined. Individual U-235 activity shall be included with each activity analysis identified. The total activity of U-235 per package shall be converted to "grams of U-235." The maximum quantity of U-235 for "Excepted Packages Limited Quantity Of Material" is 15 grams. The number of grams of U-235 shall be entered on the Radioactive Material Shipping Record (RMSR) (Attachment 2). Contact the RSO or Radiological Engineer for direction on the determination of uranium activity, as needed.

BYPRODUCT ACTIVITY DETERMINATION

The total activity of byproduct material must be determined by analysis or calculation and included with the uranium and daughter product activity. The maximum activity per package of byproduct material is 10⁻³ times the A₂ Value for normal form material.

TOTAL ACTIVITY

The total activity for the shipment shall include the total uranium, uranium daughter and byproduct activity.

PACKAGING:

1. Radioactive material shall be packaged in a strong tight container that will not leak any of the radioactive material during conditions normally incident to transportation. The RSO shall inspect each package to ensure it meets the strong tight container requirements.

PROCEDURE NO: RPO-601

REVISION NO: 1

ATTACHMENT 1
PAGE NO: 1 OF 2

LIMITED QUANTITY SHIPMENT OF RADIOACTIVE MATERIAL

2. Sufficient packing material shall be used to prevent the movement of samples inside the shipping container.
3. Sample containers shall be enclosed in a plastic bag(s) labeled as "Radioactive Material."

DOCUMENTATION:

1. A completed Radioactive Material Shipping Record (RMSR) shall accompany limited quantity shipments of radioactive material.
2. All sections of the RMSR shall be completed or have N/A written in the blank spaces.
3. Only individuals designated by the RSO shall be allowed to complete the RMSR. The Radiation Safety Officer or his designee shall review the completed RMSR.
4. A copy of the RMSR shall accompany each shipment.
5. A copy of the limited quantity statement (Attachment 3) shall be placed in the package or attached to the RMSR.
6. The original copy of the RMSR shall be maintained in the radioactive material shipping file.

URANIUM ACCOUNTABILITY:

For shipments containing ≥ 0.5 gram of U-235, the RSO shall be notified. Additional paperwork is required to be completed in accordance with Reference 3.6, Special Nuclear Materials Accountability, Transfer and Control Procedure. Accountability paperwork can only be completed by the RSO.

MISCELLANEOUS:

1. Shipment of radioactive material is made only to facilities that are licensed by the NRC or Agreement State to receive the material. A copy of the facility's license must be on file, or verified by the RSO, prior to the shipment of any radioactive material.
2. The US Department of Transportation (DOT) regulates shipments of Limited Quantity radioactive material. Only individuals trained in accordance with Title 49 of the Code of Federal Regulations may ship radioactive materials.

PROCEDURE NO: RPO-601

REVISION NO: 1

ATTACHMENT 1
PAGE NO: 2 OF 2

RADIOACTIVE MATERIAL SHIPMENT RECORD

Shipper Information	Shipment Information	Consignee Information
From: _____	Date: _____	Name: _____
Address: _____	Carrier: _____	Company: _____
Phone: (a.m.) _____	Vehicle #: _____	Address: _____
(p.m.) _____	Shipment: _____	Phone: _____
NRC License #: _____		NRC License #: _____

Description of material: _____

Hazardous material classification (If required) 49 CFR 172 & 173: _____

Proper shipping name: **"Radioactive Material Excepted Package-Limited Quantity of Material UN2910"**

Shipment - Exclusive Use: Yes No (If checked 'Yes, Driver must sign exclusive use papers.)

Form Type: _____

Chemical State: _____ Physical Form: Solid Liquid

Radionuclides: _____ Pkg. Gross Weight: _____

Total Activity: (MBq/Ci) _____ / _____ Total Grams U-235: _____

Package ID.	Gross WT.	Seal #	Label	Container Type	Activity: MBq/Ci
Pkg. #1					/
Pkg. #2					/

Radiation Levels (mSv/hr / mrem/hr.) Contact: _____ / _____ 1 Meter: _____ / _____

Contamination Levels (Bq /100cm² / dpm/100cm²)

Internal - Alpha: _____ Beta: _____ Package - Alpha: _____ Beta: _____

____ License verification on file: _____ Init. _____

____ Shipper's certification of hazardous material attached: _____ Init. _____

____ Bill of lading attached and properly completed: B/L #: _____ Init. _____

____ Inner containers tight, properly marked and packaged _____ Init. _____

____ Limited Quantity Statement Included: _____ Init. _____

Prepared by: _____ (Signature) Reviewed by: _____ (Signature)

(Printed Name)

(Printed Name)

Form RPO-601-02-1

PROCEDURE NO: RPO-601	REVISION NO: 1	ATTACHMENT 2 PAGE NO: 1 OF 1
-----------------------	----------------	---------------------------------

“This package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, excepted package – limited quantity of material, UN2910”

Shipping and Transportation - Questions and Answers

Attachment 6, Shipping and Transportation - Questions and Answers, is provided as a question and answer guide during the shipping and transportation process. Its use is intended to be only a guide, as regulatory references can change. Use this guide to direct you to a reference document, answer a shipping question, or to assist you in your shipping and transportation process.

Questions are listed below for quick reference.

What radionuclides are being shipped?.....	1
What quantity of the radionuclides is being shipped?.....	1
What are the A ₁ and A ₂ quantity limits?.....	1
Will the package be shipped as highway route controlled quantity?.....	2
What are the radiation level limits for packages in non-exclusive use conveyances and package stowage restrictions?.....	2
What are the exclusive-use shipment radiation limits?.....	3
What's a transport index (TI)?.....	3
How do you determine the TI?.....	3
What is the maximum ti for a single freight container?.....	4
What are the contamination limits for a package?.....	4
Are there any special requirements when performing a contamination survey?.....	4
Are there different types of packaging?.....	5
What are the requirements for excepted packaging?.....	5
Are there other types of exempt packaging?.....	6
What are the requirements for type A packages?.....	7
What are the requirements for type B packages?.....	8
What are the requirements for industrial packaging (IP-1, IP-2, and IP-3)?.....	9
What are the requirements for fissile radioactive material packages and shipments?.....	9
What are the general packaging requirements?.....	9
Can I ship radioactive material as LSA or SCO?.....	9
What is LSA?.....	10
What is SCO?.....	11
What are the radiation level limits for unshielded ISA/SCO materials?.....	11
What type of packaging is authorized for LSA/SCO?.....	11
What are the conveyance activity limits for LSA/SCO?.....	12
What are the 49 CFR part 172 hazmat communications and related requirements?	12

Shipping and Transportation - Questions and Answers

Where is the list of hazardous materials and proper shipping names for radioactive materials?.....	13
What are the most commonly used proper shipping names for radioactive material?...	13
What are the shipping paper requirements?.....	13
What are the requirements for documentation of excepted packages?.....	15
When is a shipper's certification required? (§172.204).....	16
When is it required to use the proper shipping names for fissile materials?.....	16
What markings are required?	17
What are the labeling requirements?.....	18
How is the label category determined?.....	19
What are the placarding requirements?.....	19
What are the placarding requirements for exclusive-use shipments of LSA and SCO?	19
What are the emergency response information requirements?	19
Are there training requirements for individuals that ship radioactive material?.....	20
Are there other regulatory requirements for shipping and transportation of radioactive materials?.....	21
Are there different types of carriers and carrier requirements?.....	23
What are the motor carrier safety requirements?	24
What are the quality assurance/quality control requirements?	24
Are you shipping uranium hexafluoride (UF ⁶)?	25
Are there any DOT or NRC enforcement policies for shipping?	25

Shipping and Transportation - Questions and Answers

What radionuclides are being shipped?

49 CFR 173.435 lists the "A₁" and "A₂" values for approximately 400 specific radionuclides. 49 CFR 173.433 provides "ground rules" for developing the values for unlisted, unknown, or mixtures of radionuclides. When using those ground rules, the shipper must obtain approval from DOT/RSPA for the use of any A₁ or A₂ value which has been derived by a shipper for an unlisted radionuclide [see §173.433(b)].

What quantity of the radionuclides is being shipped?

The requirements are directly related to the total quantity of radioactivity in a package in terms of activity, e.g., Becquerel or "Bq", Curies "Ci", millicurie "mCi", and microcuries "µCi".

Is the material in special form? (quantity is compared to A₁)

Special form materials are limited to those materials which, if released from a package, would present a hazard due to direct external radiation only. Usually, due to the high physical integrity of a special form material, radioactive material contamination is not expected even under severe accident conditions. This high physical integrity is occasionally the result of inherent natural properties of the material, such as its being in nondispersible solid form. Most often, however, it is an acquired characteristic, resulting from being welded (encapsulated) into an extremely durable metal capsule.

Is the material in normal form? (quantity is compared to A₂)

As defined in §173.403, normal form radioactive material means a Class 7 material which does not qualify as a "special form Class 7 material".

What are the A₁ and A₂ quantity limits?

The regulations use the A₁ and A₂ values as points of reference for quantity limits for each radionuclide. Each radionuclide is assigned an A₁ and an A₂ value. These two values (in Becquerel or curies) are the maximum activity of that radionuclide that may be transported in a TYPE A package. The A₁ value is the limit of activity for a particular special form radionuclide in a Type A package. The A₂ value is the limit for the amount of activity that can be transported in a type A package if the material is not is special form, i.e. "normal form".

The A₁ and A₂ values are used in the regulations as a normalized measurement of radiological risk for all radionuclides. Their uses go beyond the activity limits for Type A packages in determining when Type B packages must be used. Other uses involving large multiples of A₁ or A₂ or different fractions of A₁ or A₂ include:

- special routing of packages with large quantities

PROCEDURE NO: RPO-601	REVISION NO: 1	ATTACHMENT 4 PAGE NO: 1 OF 25
-----------------------	----------------	----------------------------------

Shipping and Transportation - Questions and Answers

- total activity in packages and conveyances
- designating limits for packages excepted from most requirements
- designating specific activity of contaminated material and associated packaging

The derivation of the A_1 and A_2 values in the IAEA regulations is based on a series of dosimetric models, i.e., the "Q-system". The limiting value for A_1 results from worst case assumptions of external direct gamma radiation levels from an unshielded source at a certain distance. Generally the A_1 value for a radionuclide is the quantity of that radionuclide that will result in a dose rate of 0.1 Sv/h (10 rem/h) at a distance of 1 meter.

The A_2 value, however, is based on the applicability of the most conservative worst case value for five different scenarios, which include the A_1 scenario plus external beta radiation to skin, inhalation, ingestion and external gamma radiation from immersion in a gaseous cloud of material released from a breached package.

As a result of an arbitrary limitation established by IAEA, no radionuclides have been assigned A_1 or A_2 values greater than 40 TBq (1080 Ci). However, based on their low specific activity and low toxicity, some radionuclides were assigned "unlimited" A_1 and A_2 values.

Will the package be shipped as Highway Route Controlled Quantity?

The HRCQ applies to the content of a single package - not to the sum of contents of all packages, i.e., in a shipment which exceeds: (1) 3000 times the A_1 value of the radionuclide as specified in §173.435 for special form Class 7 material; or (2) 3000 times the A_2 value of the radionuclide as specified in §173.435 for normal form Class 7 materials; or (3) 1000 TBq (27,000 Curies), whichever is least.

What are the radiation level limits for packages in non-exclusive use conveyances and package stowage restrictions?

Packages [§173.441(a)]:

- 10 mrem/hr (0.1 mSv/h) at one meter
- 3 mrem/hr at one meter (0.03 mSv/h) if package is intended for shipment on passenger-carrying aircraft [§175.700 (a), §173.448 (e)]
- 200 mrem/hr (2.0 mSv/h) at any point on package surface

Package Stowage Restrictions: (See §173.447 for stowage incidental to transportation)

PROCEDURE NO: RPO-601	REVISION NO: 1	ATTACHMENT 4 PAGE NO: 2 OF 25
-----------------------	----------------	----------------------------------

Shipping and Transportation - Questions and Answers

- Total of 50 TI (sum of individual package transport indexes) in vehicle or storage area group
- Each group of packages must be stowed at least 20 ft. (6 m) from other groups of radioactive packages
- Each package/group must be stowed at prescribed distances from areas occupied by persons, based on tables of cumulative TI versus separation distance found in DOT carrier regulations including shipments by: Rail §174.700, Air §175.700, Water §176.708, or Highway §177.842.

What are the exclusive-use shipment radiation limits?

The package limits as stated above (except for certain exclusive-use closed transport vehicles) also apply to exclusive use shipments. In this case, these limits are supplemented by limits on the radiation level from the transport vehicle itself [§173.441(b)].

Limits for exclusive-use closed transport vehicles:

- 10 mrem/hr (0.1 mSv/h) at two meter from the outer lateral surface of the vehicle
- 1000 mrem/hr (10 mSv/h) at the external surface of the package
- 200 mrem/hr (2.0 mSv/h) at any point on the external surface of the vehicle
- 2 mrem/hr in the cab of the vehicle

What's a transport index (TI)?

The transport index, often called the TI, is the dimensionless number (rounded up to the first decimal place, i.e., tenths) placed on the label of a package to designate the degree of control to be exercised by the carrier during transportation. The TI of the package must be indicated in the rectangular TI block in the lower half of the Category II and III Yellow RADIOACTIVE labels. The TI is the key parameter used by the carrier for stowage distance control of radioactive packages in non-exclusive use vehicles. (§173.403)

How do you determine the TI?

- Based on the radiation level for non-fissile material packages, divide by 100 the maximum radiation level in millisievert(s) per hour at one meter (3.3 feet) from the external surface of the package

Shipping and Transportation - Questions and Answers

- Based on the nuclear criticality safety evaluation, divide 50 by the allowable number of packages which may be transported together
- The applicable TI is the higher of the above two values

In either case, the maximum allowable TI on a fissile material package is 10 (unless the package is shipped in a "fissile material, controlled shipment").

What is the maximum TI for a single freight container?

You'll need to look in §176.704(a).

What are the contamination limits for a package?

The level of removable (non-fixed) surface radioactive contamination on a package of radioactive material must not exceed: (Table 11 of §173.443)

Contaminant	Bq/cm ²	uCi/cm ²	dpm/cm ²
Beta and gamma emitters and low toxicity alpha emitters	0.4	10 ⁻⁵	22
All other alpha emitting radionuclides	0.04	10 ⁻⁶	2.2

The contamination limits apply to all non-exclusive use shipments of radioactive material packages. For packages shipped as exclusive-use shipments by rail or highway, the removable (non-fixed) radioactive surface contamination at any time during transport may not exceed 10 times the limits for non-exclusive use shipments.

At the beginning of transport the levels must not exceed those listed above. If nonfixed surface contamination levels on packages in an exclusive use vehicle have risen during transportation above the limits, the transport vehicle must be surveyed with appropriate radiation detection instruments after each use. It shall not be returned to service until the external radiation on the surface is below 0.005 mSv per hour (0.5 mrem per hour) and the removable surface contamination is below the limits.

An exception to this vehicle survey requirement applies to closed highway or rail transport vehicles which are dedicated solely to the transport of radioactive packages and are appropriately marked, on the exterior, as dedicated vehicles "For Radioactive Materials Use Only." In such cases the removable surface contamination on the packages may be as high as the "factor of 10" limit at the beginning of transport.

Are there any special requirements when performing a contamination survey?

PROCEDURE NO: RPO-601	REVISION NO: 1	ATTACHMENT 4 PAGE NO: 4 OF 25
-----------------------	----------------	----------------------------------

Shipping and Transportation - Questions and Answers

Don't forget that when you perform a contamination survey for shipment, you smear an area of 300 square centimeters of the surface compared to the normal 100 square centimeters. Smear with an absorbent material, using moderate pressure. A sufficient number of measurements must be taken in the most appropriate locations to yield a representative assessment of the non-fixed contamination levels. The amount of radioactivity measured on any single wiping material, when averaged over the surface smeared, may not exceed the contamination limits.

Are there different types of packaging?

There are essentially five categories of radioactive material packagings. Development of the technical criteria for each packaging category is correlated to certain general and performance requirements. The categories include:

- Excepted packaging; which includes "strong tight" packaging
- Type A packaging
- Type B packaging
- Industrial Packaging (IP-1, IP-2, IP-3)
- Fissile material packaging (Type AF, Type IF, and Type B(U)F and B(M)F)

What are the requirements for excepted packaging?

§173.425 "Table of Activity Limited Quantities, Instruments, and Articles" limits apply to instruments, articles and limited quantities which are subject to the exceptions in §§173.421 and 173.424. In this table, multiples of the A_1/A_2 values are used as the basis for defining the package activity limits. Packages containing materials within these quantity limits are excepted from specification packaging, marking, labeling, and shipping paper requirements. However, they are not exempt from regulation during transportation as would be materials having a specific activity of less than 70 Bq/gm ($0.002\mu\text{Ci}/\text{gram}$).

Excepted packages must meet the following criteria:

- Non-fixed contamination limits on package surfaces must not exceed the limits of §173.443(a)
- The radiation level at any point on the surface of the package must not exceed 0.005 mSv/hour (0.5 mrem/hour)

PROCEDURE NO: RPO-601	REVISION NO: 1	ATTACHMENT 4 PAGE NO: 5 OF 25
-----------------------	----------------	----------------------------------

Shipping and Transportation - Questions and Answers

- The outside of the inner packaging, or if there is no inner packaging, the outside of the package itself must bear the marking "RADIOACTIVE", except for instruments or article, or empty packaging
- For instruments or articles, the radiation level at four inches from any point on the surface of the unpackaged instrument or article must not exceed 0.1 mSv/hour (10 mrem/hour)
- In lieu of a specific shipping paper, a prescribed certification statement referencing the applicable exception paragraph must be included "in", "on", or "with" the package

The specific sections of 49 CFR for the various categories of excepted radioactive packages include:

§173.421 Excepted packages for limited quantities of Class 7 radioactive material

§173.422 Additional requirements for excepted packages containing Class 7 radioactive material

§173.423 Requirements for multiple hazard limited quantity Class 7 radioactive material

§173.424 Excepted packages for radioactive instruments and articles

§173.426 Excepted packages for articles containing natural uranium or thorium

§173.428 Empty Class 7 radioactive material packaging

Are there other types of exempt packaging?

Empty packages

The EMPTY package provision provides exceptions from certain requirements for a radioactive material packaging which has been emptied of its radioactive contents as far as practicable, but still contains residual radioactivity. This residual radioactivity limit, however, is not quantified or stated in terms of activity content, but rather in terms of internal contamination in units of activity per cm². Such internal contamination is limited to 100 times the removable (non-fixed) contamination limits for exterior package surfaces. Smear contamination sampling techniques are often not practical or feasible for the interior of the containment system of some radioactive material packages.

Postal shipments

Under USPS rules for "allowable radioactive matter", packages which meet the applicable 49 CFR requirements for excepted packages may also be mailed in the Postal system. However, there is a very important additional restriction, the amount of

Shipping and Transportation - Questions and Answers

radioactivity in a mailable package must be limited to one tenth of the values listed in the table in §173.425. Additional restrictions may apply to mailable radioactive packages, therefore, before mailing a radioactive material package, one should consult the U.S. Postal Publication # 6 requirements. For international postal shipments, the Postal requirements of the receiving country should also be reviewed, since certain nations do not allow postal shipments of radioactive matter. Also, international postal shipments of radioactive material require the exterior marking "RADIOACTIVE".

What are the requirements for type A packages?

Type A packaging must comply with the applicable general packaging requirements of §§173.24, 173.24(a), and 173.410, and the additional requirements of §§173.412, and 173.415. These packagings must prevent the loss or dispersal of the radioactive contents and maintain the radiation shielding properties during normal conditions of transportation, which include rough handling conditions, for which tests are specified in 49 CFR §173.465. These rough handling conditions include:

- Water Spray Test, which simulates the package having been left in the rain for a period of 30 minutes
- Drop Test of 4 feet onto a hard surface, in a most damaging orientation - simulating falling off a vehicle or loading platform
- Puncture Test with a 13 pound steel rod being dropped onto the damp package - simulating a loose object hitting the package
- Crush Test equal to a force of at least 5 times the weight of the package - simulating the damp package being at the bottom of a stack of packages

The performance requirements for type A packages containing liquids and gases are more stringent than the requirements for solids, because of the greater potential for materials spreading if the package containment system fails. The more stringent requirements relate to containment, and the height in the drop tests, and are found in §173.412 (k) and §173.466.

Essentially, the only authorized Type A package in the DOT regulations is the DOT specification 7A, which is based totally on performance test conditions rather than on hardware or design requirements. This provides the package designer with maximum latitude in the use of engineering creativity to produce optimally useful and economic designs. Using any of the methods authorized in §173.461, each shipper of a DOT-7A package must determine if the DOT-7A design meets the performance requirements in §§173.412 and 173.465, and then must document and maintain this evaluation or "self-certification" on file for at least one year after the last shipment. Consequently, each design must be specifically certified as meeting the DOT-7A requirements. Each time the contents change, or the packaging components change (i.e., content weight,

PROCEDURE NO: RPO-601	REVISION NO: 1	ATTACHMENT 4 PAGE NO: 7 OF 25
-----------------------	----------------	----------------------------------

Shipping and Transportation - Questions and Answers

material form, closure, etc.), the performance capability of the modified package must be re-evaluated with respect to the requirements before the Type A designation may be assigned.

DOT-7A designs do not require the approval of either DOT or NRC, for domestic shipment or for international transportation of non-fissile radioactive material.

What are the requirements for type B packages?

Type B packaging must meet the general packaging and performance standards for Type A packages and additionally must have the ability to survive serious accident damage tests (hypothetical accident conditions). After testing, there may be only a very limited loss of shielding capability and no loss of containment, as measured by leak-rate testing of the containment system of the package. The performance criteria which the package designer must use to assess his Type B package design against the established hypothetical accident conditions are prescribed in 10 CFR 71.73 of the NRC regulations and include the following sequential tests:

- A 30-foot free fall of the test package onto an unyielding surface
- If applicable, for certain contents and package density, subjecting the test specimen to a dynamic crush test by positioning the specimen on a flat unyielding horizontal surface so as to suffer maximum damage by the drop of a 500 kg. (1100 lbs.) steel plate mass from 9 meters (30 ft) onto the test package
- A puncture test as a free drop of the test package from a height of 1 m (40 in) onto a 15 cm (6 in) diameter vertical steel peg
- Exposure to a thermal environment of 800 °C (1475 °F) for 30 minutes
- Water immersion of the test package under at least 15 meters (50 ft.) depth
- For fissile packages where water in-leakage is not assumed in the criticality analysis, immersion of the test package under a head of water of at least 0.9 meters (3 ft)

Except for a few DOT Specification Type B packages described in § 178, such as the DOT-6M and the DOT-20WC (see also 10 CFR 71.14) the vast majority of other authorized Type B packages are designs certified by NRC. Each design is approved under a NRC Certificate of Compliance and General License issued pursuant to 10 CFR 71.12. The DOT authorization for use of NRC approved Type B packages is provided in §173.416(a) and the standard requirements applicable to their use are in §173.471. In addition, numerous Type B packages in current usage are those approved by the U.S. Department of Energy (DOE) pursuant to the authority provided by DOT in §173.7(d). Many of these DOE-certified packages are also certified by NRC.

Shipping and Transportation - Questions and Answers

What are the requirements for industrial packaging (IP-1, IP-2, AND IP-3)?

On September 28, 1995, RSPA published a final rule (Docket HM-169A) which added the new category "Industrial Packaging" (IP) to the HMR. IP's are used in certain shipments of LSA materials and SCO's which are usually categorized as nuclear waste. Three categories were established, IP-1, IP-2 and IP-3. The requirements for each IP category are in §173.411.

What are the requirements for fissile radioactive material packages and shipments?

As defined in §173.403, fissile material is defined as plutonium-238, plutonium-239, plutonium-241, uranium-233, uranium-235 or any combination of these radionuclides. Unirradiated natural uranium and depleted uranium, and natural uranium or depleted uranium that has been irradiated in thermal reactors, are NOT included in this definition.

Additional exceptions are provided in §173.453. All of these nuclides can fission, but in some cases, classification, shipping names, and packaging may be other than fissile. In addition to considerations for radioactive content (radiological safety), a shipper of fissile radioactive material must also take into account certain other requirements to insure against accidental nuclear criticality (nuclear safety). Most packagings for fissile radioactive material are either fissile Type A or fissile Type B, with very rare exceptions.

What are the general packaging requirements?

Unless excepted, all packages are subject to applicable general requirements in § 173 Subparts A and B, as well as §173.410 "General Design Requirements".

Can I ship radioactive material as LSA or SCO?

Historically, the transportation category of Low Specific Activity (LSA) has been one of the most frequently misunderstood areas of DOT/NRC regulations. With the HM-169A and 10 CFR 71 amendments of September 28, 1995, a previous inconsistency in the LSA requirements of the two agencies has been eliminated. LSA has been redefined, and grouped into three categories, LSA-I, LSA-II and LSA-III. A new or "sister" category, similar to LSA, has also been defined, and is termed "Surface Contaminated Objects" or "SCO", and is grouped into two categories, SCO-I and SCO-II.

LSA and SCO are extremely important radioactive material classifications with respect to shipments of low-to-medium level radioactive waste materials. The majority of shipments of such wastes originating from the nuclear fuel cycle facilities, and from all kinds of industrial, medical, research and academic communities are in the form of varying types of LSA materials. The new SCO category addresses solid wastes generated in the form of nonradioactive contaminated materials originating from cleanup, remediation and decontamination activities.

Shipping and Transportation - Questions and Answers

What is LSA?

All LSA materials have a characteristic of presenting limited radiation hazard, because of their relatively low concentration of radioactivity. The specific activity, in units of Bq/g (or Ci/g), are generally lowest in LSA-I and highest in LSA-III. When the specific activity of an LSA material is computed, the radioactivity is divided by the mass of material in which the radioactivity is distributed; the mass of the packaging that may surround the LSA is excluded from the calculation. The detailed description of the characteristics and limits for LSA-I, LSA-II, and LSA-III are indicated in §173.403 and 10 CFR 71.4, and they are unique for each LSA category.

LSA-I:

- ores containing only naturally occurring radionuclides, e.g., uranium, thorium, and uranium or thorium concentrates of such ores
- solid unirradiated natural uranium or depleted uranium or natural thorium or their solid or liquid compounds or mixtures
- radioactive material, other than fissile material, for which the A_2 value is unlimited
- mill tailings, contaminated earth, concrete, rubble, other debris, and activated material in which the radioactive material is essentially uniformly distributed and the average specific activity does not exceed $10^{-6} A_2/g$

LSA-II:

- water with tritium concentration up to 0.8 TBq/liter (20.0 Ci/liter)
- material in which the radioactive material is distributed throughout and the average specific activity does not exceed $10^{-4} A_2/g$ for solids and gases, and $10^{-5} A_2/g$ for liquids

LSA-III:

- solids, e.g., consolidated wastes and activated materials, that meet the leach test requirements of §173.468 and for which:
 - (i) the radioactive material is distributed throughout a solid or a collection of solid objects, or is essentially uniformly distributed in a solid compact binding agent, such as, concrete, bitumen, ceramic, etc.
 - (ii) the radioactive material is relatively insoluble, or it is intrinsically contained in a relatively insoluble material, so that, even under loss of packaging, the loss

Shipping and Transportation - Questions and Answers

of radioactive material per package by leaching when placed in water for seven days would not exceed $0.1 A_2$

- (iii) the average specific activity of the solid does not exceed $2 \times 10^{-3} A_2/g$

What is SCO?

Prior to Docket HM-169A, nonradioactive objects with contamination on their surfaces were regulated as LSA if the activity per square centimeter was within certain limits. The new regulations expanded the provisions for these materials and provided for their transportation as either SCO-I or SCO-II. The SCO-I and SCO-II contamination limits address both fixed and non-fixed contamination on both accessible surfaces and surfaces that are not accessible.

Problems in determining the proper classification for an object with surface contamination may involve methods of measuring the non-fixed and fixed contamination and determining whether the surfaces should be considered accessible or inaccessible.

What are the radiation level limits for unshielded LSA/SCO materials?

§173.427(a) imposes a very important additional condition for LSA and SCO. Simply stated, the quantity of LSA and SCO material in a single authorized package must be so restricted that the external radiation level from the unshielded material would not exceed 10 mSv/h (1 rem/h) at 3 meters.

This radiation dose rate limit restricts the permitted quantity of LSA and SCO materials in one package to the same external radiation hazard that is used for A_1 and A_2 values that apply to radioactive material that are not LSA or SCO. Essentially, the external radiation from unshielded LSA or SCO from one package will not exceed the dose rate that would result from a special form source if released from a Type A package. Compliance with this requirement is not possible by simply adding shielding to the packaging. The inherent property of the material must be so limited that even without any shielding, the dose rate would not exceed the limit of 1 rem/h at three meters. If it does, the material may no longer be considered LSA or SCO, and will require type B packaging.

What type of packaging is authorized for LSA/SCO?

DOT regulations authorize the following packages for shipment of LSA and SCO materials:

- For domestic transportation only, strong tight packaging [§173.427(b)(3)] when transported in an exclusive-use vehicle, not exceeding an A_2 quantity in each packaging

Shipping and Transportation - Questions and Answers

- For domestic transportation only, in DOT-7A Type A packaging [§§173.427(b)(2), 173.412 and 178.350], except that the requirements of §§173.412(a), (b), (c), and (k) do not apply
- The former "NRC certified Greater Than Type A Packages"
- IP-1, IP-2, and IP-3 packaging

What are the conveyance activity limits for LSA/SCO?

The regulations that became effective on April 1, 1996, added restrictions concerning the total activity of some LSA and all SCO materials transported in a conveyance. An activity restriction of 100 A₂ per conveyance applies to all SCO's and to LSA II and LSA III materials that are combustible solids, or are in liquid or gaseous form.

(See §173.427, Table 9)

Nature of Material	Activity Limit for Conveyances
LSA-I	No limit
LSA-II and LSA-III noncombustible solids	No limit
LSA-II and LSA-III combustible solids and liquids and gases	100 A ₂
SCO	100 A ₂

What are the 49 CFR Part 172 HAZMAT communications and related requirements?

Shippers have the greatest responsibility for compliance with the communication requirements of Part 172 of 49 CFR, but carriers are also subject to some of the requirements. Safe transportation of radioactive material requires correct communication of the specific hazards of the materials. Generally, an essential part of the total system for providing safety in transport of radioactive material is the requirement for communication of information on the specific hazards of the materials. The communication requirements of 49 CFR Part 172 are designed to complement the basic safety requirements for package activity limitation and package integrity. In recent years, additional subparts have been added to Part 172 to address emergency response information and hazmat employee training.

PROCEDURE NO: RPO-601	REVISION NO: 1	ATTACHMENT 4 PAGE NO: 12 OF 25
-----------------------	----------------	-----------------------------------

Shipping and Transportation - Questions and Answers

Where is the List of Hazardous Materials and Proper Shipping Names for Radioactive Materials?

Subpart A of Part 172 describes the applicability of the regulations to shippers and carriers. Subpart B contains the hazardous materials table. The Hazardous Materials Table (HMT) in §172.101 classifies those materials which DOT has designated as hazardous materials for purposes of transportation. The HMT prescribes the requirements for shipping papers, marking, labeling and transport vehicle placarding applicable to the shipment and transportation of those hazardous materials. For each listed material, the table identifies the hazard class, the UN identification number, and gives the proper shipping name or directs the user to the proper shipping name. In addition, the HMT specifies or references other regulatory requirements pertaining to labeling, packaging, quantity limits aboard aircraft and stowage of hazardous materials aboard vessels.

What are the most commonly used proper shipping names for radioactive material?

- Radioactive material, excepted package-articles manufactured from natural uranium or depleted uranium or natural thorium -- UN 2910
- Radioactive material, excepted package-empty package or empty packaging -- UN 2910
- Radioactive material, excepted package-instruments or articles -- UN 2910
- Radioactive material, excepted package-limited quantity of material -- UN 2910
- Radioactive material, surface contaminated object, n.o.s. or Radioactive material, SCO, n.o.s. -- UN 2913
- Radioactive material, low specific activity, n.o.s. or Radioactive material, LSA, n.o.s. -- UN 2912
- Radioactive material, special form, n.o.s. -- UN 2974
- Radioactive material, fissile, n.o.s. -- UN 2918
- Radioactive material, n.o.s. -- UN 2982

What are the shipping paper requirements?

As with other hazardous materials shipments, certain essential elements of information must be included on shipping papers. The availability of a complete and correct shipping paper description for a hazardous material shipment is vital not only to the

PROCEDURE NO: RPO-601

REVISION NO: 1

ATTACHMENT 4
PAGE NO: 13 OF 25

Shipping and Transportation - Questions and Answers

carrier and the consignee, but also to emergency response personnel in the event of an incident. (§172.200-172.205)

Basic Shipping Paper Requirements - The shipping paper description must basically include the following:

- The proper shipping name from §172.101
- The UN hazard class or division - radioactive material is hazard class 7
- The UN Identification number
- The net quantity of material by weight or volume

NOTE: For most radioactive material, it is not required to list the weight or volume, since the additional requirements of §172.203(d) provide better information, i.e., the radioactivity content in Becquerels (Curies). A listing of weight or volume is usually needed only with respect to establishing freight charges

- The letters "RQ", if the shipment is a "hazardous substance" [see §172.101, Appendix A, Table 2 for RQ values of radionuclides]
- Emergency response telephone number as prescribed in Subpart G, Part 172. A shipping paper may contain additional information concerning the material, provided it is not inconsistent with, and does not cause confusion with, the basic description. Unless otherwise specified, the additional information must be placed after the required basic description

Additional Shipping Paper Description - The shipping paper description for radioactive material must also include the following [§172.203(d)]:

- The words "radioactive material", unless these words are contained in the proper shipping name
- The name of each radionuclide in the material as listed in §173.435. For mixtures of radionuclides only the radionuclides that constitute 95% of the hazard of the mixture as described in §173.433(f) need be listed on shipping papers and package labels
- A description of the physical and chemical form of the material, unless the material is "special form". A generic description of the material, such as, protein, carbohydrate, enzyme, etc., is authorized if the exact chemical form is difficult to specify
- The activity contained in each package in the shipment in appropriate SI units, e.g., Becquerel, Terabecquerel, etc., or in terms of appropriate SI units followed by customary units, e.g., curies, millicuries, etc. Except for Pu-238, Pu-239 and Pu-

Shipping and Transportation - Questions and Answers

241, the weight in grams or kilograms of fissile radionuclides may be inserted instead of activity units. For Pu-238, Pu-239 and Pu-241, the weight in grams or kilograms may be inserted in addition to the activity units. If the package contains a "Highway Route Controlled Quantity", those words must also be shown with the basic description

- The category of RADIOACTIVE label applied to each package in the shipment
- The transport index assigned to each package in the shipment bearing a RADIOACTIVE-YELLOW II or RADIOACTIVE -YELLOW-III label
- For a shipment of fissile material, the additional information required in §172.203(d)(7), i.e., the words "Fissile Excepted", "Warning - Fissile material, controlled shipment," etc, as appropriate

NOTE: For a package containing a fissile nuclide having an activity content less than the definition of "radioactive material" (70 Bq/g or 0.002 μ Ci/g), the term "Fissile Excepted" need not be added, since materials having activity content less than the transport definition of radioactive material are not subject to transportation regulations.

- For a shipment required to be consigned as exclusive use, an indication that the shipment is consigned as exclusive use, along with any appropriate special instructions to the carrier relative to maintenance of exclusive use shipment controls
- For a shipment of LSA or SCO materials, the appropriate group notation, e.g., LSA-I, SCO-II, etc.
- The certificate identification marking required on the package must also be noted on the shipping papers if the package is one which is: (1) approved and certified by the NRC or DOE, or (2) is a package of foreign origin which has been revalidated by DOT

Other descriptive information is allowed, such as the functional description of the product, or the applicable regulatory citation under which the shipment is offered. This additional description must not confuse or detract from the required description.

What are the requirements for documentation of excepted packages?

Packages shipped according to the exceptions provided in §§173.421, 173.424, 173.426 and 173.428 (for Limited Quantity, Instruments or Articles, Articles Manufactured from Natural or Depleted Uranium or Natural Thorium, and empty radioactive material packaging) are excepted from the detailed shipping paper description requirements. Such excepted packages must, however have a certification statement or notice "in" or "on" the package or forwarded with the package. That notice

Shipping and Transportation - Questions and Answers

must include the name of the consignor or consignee and a specific statement which is selected on the basis of the proper shipping name for the package. (§173.424)

When is a Shipper's Certification required? (§172.204)

Unless excepted, a shipping paper must include a certification statement, signed by the person offering the package for transport. The certification must appear on the paper that lists the required shipping description. The following statement listed in 49 CFR 172.204(a)(1) (or an alternate statement listed in §172.204(a)(2)) must be used for all hazardous materials shipments except for those by air: "This is to certify that the above-named (or herein named) materials are properly classified, described, packaged, marked, and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation."

For air transportation, the following language may be included on shipping papers in place of the above statement: "I hereby certify that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and in proper condition for carriage by air according to applicable national governmental regulations." The requirements and limitations for carriage of radioactive materials aboard aircraft are prescribed in §175.75(a)(3) and 175.700 through 175.705.

When is it required to use the proper shipping names for Fissile Materials?

Shippers of fissile radionuclides are reminded of the specific requirements in §172.203(d)(7)(i). That section requires the addition of the words "fissile excepted" if the package contains a fissile radionuclide in such quantity or form that it is excepted from the specific requirements for fissile materials (§173.453). The following rules-of-thumb should be considered in selecting the correct proper shipping name for fissile radionuclides:

- If the radioactive material is neither fissile excepted nor satisfies the conditions for shipment in an excepted package, use the shipping name: "Radioactive material, fissile n.o.s., UN 2918"
- If a fissile excepted quantity is present and it also can be shipped in an excepted package, use the shipping name: "Radioactive material, excepted package-limited quantity of material, UN 2910" and add the words "fissile excepted"
- If the radioactive content does not satisfy the conditions for shipment in an excepted package, but the fissile content is excepted, use: "Radioactive material, n.o.s., UN 2982" and add the words: "fissile excepted"
- "Radioactive material LSA; n.o.s., UN 2912" or "Radioactive material, SCO, n.o.s., UN 2913"; or Radioactive material, special form, n.o.s., UN 2974, as appropriate

Shipping and Transportation - Questions and Answers

What markings are required?

Basic elements of information (other than required labels discussed below) are required as "marking". When the marking is required, it is sometimes referred to as "specification" marking, although this term is usually used with reference to "specification packaging". The required markings on non-bulk radioactive material packagings are prescribed in §172.301 and include:

- The proper shipping name and UN Identification number for the materials as shown in §172.101
- For exemption packagings, the words "DOT-E" followed by the applicable DOT exemption number assigned
- The name and address of the consignor or consignee
- "RQ", if a "hazardous substance" (See §172.324(b)) and Table 2, §172.101, Appendix A)

Each non-bulk packaging containing a liquid within its inner containment vessel must be packed with that vessel closure upward and must be legibly marked with the package orientation marking which conforms to ISO Standard 780-1985. Such marking must be on two opposite sides with the double arrows in the symbol pointing in the correct upright direction. Arrows for any other purposes may not be displayed on a package containing a liquid hazardous material. (§172.312)

Except for "excepted" packages, each radioactive material package must also be marked with: (§172.310)

- Its gross weight if it exceeds 50 kg (110 lbs.)
- "TYPE A" or "TYPE B", as applicable. This relates to the packaging design - not the radioactive content
- The applicable DOT Specification number, NRC or DOE package certificate identification number, as specified in the DOT specification or relevant Certificate, e.g., "USA-DOT-7A", USA/9166/B(U)-85, etc.
- For certain Type B packages, the trefoil radiation symbol which conforms to the standard of Appendix B, §172
- "IP-1", "IP-2", or "IP-3" as applicable, when such packages contain LSA or SCO materials. (This marking is recommended, but not presently required nor prohibited by §172.303)

Shipping and Transportation - Questions and Answers

Bulk packaging for a hazardous material is defined in §171.8. The concept of "bulk" packaging reflected in that definition is that the packaging may involve the vehicle itself, a freight container or other large closed receptacle in which the hazardous material is loaded with no intermediate form of containment. Bulk radioactive material packaging is required to be marked on its exterior with the applicable UN hazard identification number as specified in §172.101 [see §172.302]. When required for radioactive material, this identification number must be placed on an orange rectangular panel adjacent to the required RADIOACTIVE placard [see §172.332]. It may not be placed on the RADIOACTIVE placard in lieu of the word "RADIOACTIVE" for domestic shipments, according to §172.334(a).

What are the labeling requirements?

Each package of Class 7 (radioactive material), unless excepted, must be labeled on two opposite sides, with a distinctive warning label. Each of the three label categories, i.e., "RADIOACTIVE WHITE-I", "RADIOACTIVE YELLOW-II", or "RADIOACTIVE YELLOW-III", bears the unique trefoil symbol for radiation as prescribed in §172, Appendix B, [see §172.403 and §172.436-440].

The RADIOACTIVE labels alert persons, particularly the handlers, that the package contains radioactive material and that the package may require special handling and stowage distance/separation control.

For all labels, vertical bars on each label are in red. Each label is diamond-shaped, four inches (10 cm) on each side, and has a black solid-line border one-fourth inch from the edge. The background color of the upper half (within the black line) is white for the "I" label. It is yellow for the "II" and "III" labels. The regulatory provisions of §§172.403(f) and (g) that apply to the use of these labels are indicated below.

The following applicable items of information must be entered on the blank spaces of each label by legible printing (manual or mechanical) using a durable, weather-resistant means of marking:

"Contents" The name of the radionuclides as taken from the listing in §173.435 (Established radiation protection symbols are authorized). For mixtures of radionuclides, with consideration of space on the labels, list the radionuclides that represent 95% of the hazard present as determined by §173.433(f).

"Activity" Activity must be expressed in appropriate SI units, e.g., Becquerel (Bq), terabecquerels (TBq), etc., followed optionally by insertion of appropriate customary units (Curies (Ci), millicuries (mCi), microcuries (μ Ci), etc.) in brackets.

"Transport Index"

PROCEDURE NO: RPO-601	REVISION NO: 1	ATTACHMENT 4 PAGE NO: 18 OF 25
-----------------------	----------------	-----------------------------------

Shipping and Transportation - Questions and Answers

How is the label category determined?

Transport Index	Maximum radiation level at any point on the external surface	Label Category
NA	Not more than 0.005 mSv/h (0.5 mrem/h)	White – I
More than 0 but not more than 1	More than 0.005 mSv/h (0.5 mrem/h) but not more than 0.5 mSv/h (50 mrem/h)	Yellow – II
More than 1 but not more than 10	More than 0.5 mSv/h (50 mrem/h) but not more than 2 mSv/h (200 mrem/h)	Yellow – III
More than 10	More than 2 mSv/h (200 mrem/h) but not more than 10 mSv/h (1,000 mrem/h)	Yellow – III (Must be shipped under exclusive use provisions)

Any package containing a "Highway Route Controlled Quantity" (§173.403) must be labeled as RADIOACTIVE YELLOW - III.

What are the placarding requirements?

A carrier is required to placard the transport vehicle (rail or highway) if any radioactive material package bears the "RADIOACTIVE YELLOW-III" label (§172.440) or if the shipment includes LSA or SCO material required by §173.427 to be consigned as exclusive use (§172.504).

What are the placarding requirements for exclusive-use shipments of LSA and SCO?

Pursuant to the shipper requirements of §173.427(a)(6)(v), except for shipments of unconcentrated uranium or thorium ores, the transport vehicle must be placarded by the shipper with the RADIOACTIVE placard. This requirement differs from the customary placarding requirement wherein the carrier must placard on the basis of any RADIOACTIVE YELLOW-III packages being present. LSA or SCO packages consigned as exclusive use (domestic shipment only) are excepted from labeling requirements.

What are the emergency response information requirements?

PROCEDURE NO: RPO-601	REVISION NO: 1	ATTACHMENT 4 PAGE NO: 19 OF 25
-----------------------	----------------	-----------------------------------

Shipping and Transportation - Questions and Answers

49 CFR Part 172 requires shippers to provide emergency response information on hazardous materials shipments. The regulation applies to any shipment of a hazardous material which is required to have shipping papers. Shipments of excepted radioactive material packages (packages containing limited quantities, instruments or articles, or "Empty" packagings) are excepted from shipping paper requirements, and, therefore, are not subject to the emergency response information requirements.

Specific Requirements - At a minimum, the emergency response information must provide the basic description and technical name of the hazardous material, immediate hazards to health, immediate precautions to be taken in the event of an accident or incident, immediate methods for handling fires, immediate methods for handling spills or leaks in the absence of fire, and preliminary first aid measures. This information must be on a shipping paper or an associated document and kept on the vehicle and maintained at all locations where the shipment is handled. This required information is very similar to the information in the guide pages of the North American Emergency Response Guidebook (NAERG). In many cases, shippers satisfy this requirement by attaching to their shipping papers an appropriate guide page from the NAERG.

It should be recognized that there is a wide range of potential hazards for the many types of radioactive material that can be shipped under a given shipping name and guide number. If the product being shipped has properties that are either less hazardous or more hazardous than the description in the applicable guide in the NAERG, then the emergency actions could be more specific than those in the guide. In such cases, the shipper may wish to satisfy the technical information requirements from §172.602 (a)(1-7) by preparing statements that are appropriate to the product being shipped.

Shippers are required to provide an emergency response telephone number which must be monitored on a 24-hour basis while the shipment is in transportation. The number must be of a person or entity who is knowledgeable of mitigation information or has immediate access to such a person. The number may be of an agency which is capable of providing the information and agrees to do so.

Are there training requirements for individuals that ship radioactive material?

§§172.700-172.704 contain the requirements for training of "hazmat employees" involved in transportation of hazardous materials. Each "hazmat employer" must ensure that each hazmat employee receives the required training and testing in the following subjects:

- General awareness/familiarization with 49 CFR hazmat transportation requirements
- Function-specific training
- Safety training

PROCEDURE NO: RPO-601	REVISION NO: 1	ATTACHMENT 4 PAGE NO: 20 OF 25
-----------------------	----------------	-----------------------------------

Shipping and Transportation - Questions and Answers

Initial training is required within 90 days of employment on a specific job. The hazmat employee must have recurrent training every three years or within 90 days after assignment to a new job for which training has not already been provided.

Are there other regulatory requirements for shipping and transportation of radioactive materials?

Transportation requirements of NRC which apply to transport of NRC-licensed radioactive material are located in 10 CFR 71. Since 10 CFR part 71 is a matter of "compatibility" for regulatory programs of the NRC "Agreement States", effectively it is also applicable to activities of Agreement State licensees. Several other transport-related requirements are also in 10 CFR Parts 20 and 61. A brief overview of these follows:

10 CFR Part 71

In accordance with 10 CFR 71.5, each NRC licensee who transports licensed radioactive material outside the site of usage, as specified in the NRC license, or where transport is on a public highway, or who delivers licensed material to a carrier for transport, must comply with the applicable requirements of the DOT hazardous materials transport regulations. NRC inspects the radioactive material shipping practices of its licensees, and enforces licensee compliance with the DOT regulations. In addition, with the exception of DOT specification packages and packages approved by the U.S. Department of Energy (DOE), all packages used for domestic shipments of - non-LSA/SCO Type B quantities, - LSA/SCO Type B quantities for which the unshielded radiation level at 3 meters is greater than 10 mSv/hour, and - fissile material which exceeds a fissile exempt quantity, must be certified for use by the NRC. The user must register with the NRC and make all shipments in compliance with the terms of the package approval. The package approval standards and performance requirements are set out in 10 CFR 71.

Prior to the September 28, 1995, amendments, the NRC certified packages for LSA materials when contents exceeded A₂. After April 1, 1999, those packages may no longer be used for LSA material or SCO when the radiation dose rate from the unshielded material exceeds 10 mSv/hr (1 rem/hr) at 3 m.

10 CFR PART 20

This Part has only two transportation-related requirements: 10 CFR 20.1906 -This section requires that an NRC licensee who receives a radioactive package perform certain monitoring of the package, as follows:

- Except for packages containing gaseous or special form radioactive material, any package bearing either of the three categories of RADIOACTIVE labels must be monitored for external surface contamination

Shipping and Transportation - Questions and Answers

- The external surface of any package containing greater than a Type A quantity, i.e., a Type B quantity, must be monitored upon receipt for external radiation levels
- Monitoring for both surface contamination and external radiation levels must be performed on any package known to contain radioactive material, if there is evidence of degradation of package integrity
- Instances of surface contamination and/or external radiation levels exceeding the applicable limits must be reported to the appropriate NRC regional office

NOTE: NRC and agreement states regulate licensed shippers and receivers of radioactive material packages. DOT's authority applies to shippers and carriers, not to receivers.

10 CFR 20.1601(c)-Control of access to High Radiation Areas containing radioactive material packages. This Section reads as follows:

"Control is not required for each entrance or access point to a room or other area that is a high radiation area solely because of the presence of radioactive material prepared for transport and labeled in accordance with the regulations of the Department of Transportation provided that:

- The packages do not remain in the area longer than 3 days; and
- The dose rate at one meter from the external surface of any package does not exceed 0.1 mSv (0.01 rem) per hour".

10 CFR PART 61

10 CFR Part 61 contains regulations for the siting and operation of near surface low-level waste disposal sites, as well as requirements for the classification and form of material which may be transferred (including transport) for disposal at such a facility. The requirements for waste classification and waste form are not technically equivalent to DOT requirements for radioactive material classification and packaging for purposes of transportation. However, shippers of radioactive waste inevitably must keep these Part 61 requirements in mind when preparing such low level waste (usually LSA or SCO materials) for shipment to a shallow land burial facility. Part 61 also contains specific requirements for radwaste manifest information and format which are more rigorous and detailed than the DOT requirements for shipping papers in 49 CFR Part 172.

NOTE: On March 27, 1995, NRC significantly revised its requirements for preparation of radwaste manifests (see 60 FR 15649).

Two important facts relating to 10 CFR 61:

PROCEDURE NO: RPO-601	REVISION NO: 1	ATTACHMENT 4 PAGE NO: 22 OF 25
-----------------------	----------------	-----------------------------------

Shipping and Transportation - Questions and Answers

- The "Class A" and "Class B" waste designations pursuant to 10 CFR 61 are neither synonymous with nor the same as DOT's "Type A" and "Type B" package designations
- The term "high integrity container" or "HIC" is a Part 61-related term and not a transport regulation-related term

Are there different types of carriers and carrier requirements?

Common Carriers - Common and contract carriers are both "for hire" carriers serving the general public. Common carriers operate under procedures and charge rates that are established by carrier organizations. Contract carriers differ in that rates are usually agreed to between the shipper and carrier. A contract carrier serves only those shippers with whom he has a written contract. The authority of Federal and state agencies for issuing operating permits has been greatly reduced in recent years. Common and contract carriers do not own the property they transport for others and transportation of property for others is their principal business activity. Further, for radioactive material, common and contract carriers are exempt from the requirement to obtain a license from NRC or an Agreement State, to the extent that they transport licensed radioactive material for someone else. (10 CFR 30.13, 40.12 and 70.12).

Private Carriers - A private carrier generally owns the radioactive material which is being transported and transportation activities are incidental to their regular business activity. A private carrier is always licensed by the NRC or an agreement state to possess and transport the radioactive material.

All carriers, common and contract, as well as private carriers, are subject to the same safety requirements of 49 CFR. An exception from the requirement for certification of the shipping papers is provided to a private carrier.

The principal requirements which apply to all carriers are to:

- assure that the transport vehicle is properly placarded
- assure that shipper has properly certified the shipment
- maintain radiation control based on package transport index/separation table and the other transport requirements
- report to DOT hazmat incidents involving fire, accident, breakage or suspected radioactive contamination (49 CFR 171.15, 171.16, 174.750, 175.700(b), 176.710, and 177.861)
- provide training to "HAZMAT Employees"

Shipping and Transportation - Questions and Answers

- register with DOT and submit an annual fee when transporting certain radioactive material

What are the motor carrier safety requirements?

The Federal Motor Carrier Safety Regulations (FMCSR) are located in Parts 325- 399 of 49 CFR.

Commercial Drivers License "Commercial Driver's License" (CDL) means a license issued to an individual by a state or other jurisdiction, in accordance with the standards in 49 CFR 383, which authorizes that individual to operate a class of "commercial motor vehicle". For hazardous materials, a commercial vehicle may be of any size used in the transport of hazardous materials requiring vehicle placarding pursuant to 49 CFR 172. For radioactive material shipments the driver of a vehicle must have a CDL with a "hazardous materials endorsement" (49 CFR 383.93).

Hazardous Materials Driving/Parking Rules-§§49 CFR 397 Routing of radioactive material Shipments: Placarded shipments - A carrier or any person operating a motor vehicle that contains a class 7 (radioactive) material as defined in 49 CFR 173.403 for which placarding is required under 49 CFR Part 172 shall ensure that the motor vehicle is operated on routes that minimize radiological risk [49 CFR 397.101(a)]. HRCQ Shipments - A carrier or person operating a motor vehicle containing a HRCQ of Class 7 (radioactive) material, as defined in 49 CFR 173.403, shall operate the motor vehicle only over "preferred routes". A preferred route is the Interstate Highway system or a state-designated alternate route selected by a state agency pursuant to 49 CFR 397.103. Pursuant to 49 CFR 397.101(d)(3), the driver of a HRCQ vehicle must be provided with a written route plan and must have received specific training within two years prior to the shipment and must have in his possession during the shipment a certificate of such training.

What are the quality assurance/quality control requirements?

DOT Requirements - DOT requirements for quality control are located in 49 CFR 173.474 and 173.475. These are titled "Quality Control for Construction of Packaging" and "Quality Control Requirements prior to each shipment of radioactive material", respectively. (10 CFR Part 71 of NRC requirements contains essentially identical paragraphs as §§71.85 and 71.87, entitled "Preliminary Determinations" and "Routine Determinations", respectively). The DOT quality control requirement to survey packages of radioactive material prior to shipment is the provision found in §173.475(i), which states, "Before each shipment of any radioactive material package the offeror must ensure, by examination or appropriate tests, that: "External radiation and contamination levels are within the allowable limits specified in this subchapter."

PROCEDURE NO: RPO-601	REVISION NO: 1	ATTACHMENT 4 PAGE NO: 24 OF 25
-----------------------	----------------	-----------------------------------

Shipping and Transportation - Questions and Answers

NRC Requirements - In addition to the above-mentioned "generic" QC requirements of §§71.85 and 71.87, 10 CFR 71, Subpart H contains specific quality assurance requirements associated with the use of NRC-certified Type B and Fissile material transport packages used under the general licenses of §§71.12, 71.14 and 71.16. A major condition applying to the use of such NRC-certified packages is the requirement that each registered user of such a package must also have his quality assurance program associated with use of the package approved by NRC as having met applicable requirements of Subpart H, §§71.101-71.135.

Are you shipping uranium hexafluoride (UF⁶)?

Uranium hexafluoride is a unique material with respect to transportation requirements. It is a compound of hexavalent uranium and fluorine, which is used as the process gas in the gaseous diffusion plants to increase the concentration of the fissile isotope uranium-235 in the mixture of uranium isotopes found in naturally occurring uranium. During transportation, UF⁶ exists as a crystalline solid and is shipped in metal cylinders at slightly reduced atmospheric pressure. (These same cylinders are actually constructed so as to have very high pressure capability for purposes of the high temperature operations and processes involved with production of the UF⁶ in a gaseous state.) The material presents hazards due to its radioactivity, as well as to its corrosivity. Breach of a cylinder of solid UF⁶ would result in a reaction product of the material with moisture in the air to produce a highly corrosive, but moderately radioactive gaseous cloud of material.

Are there any DOT or NRC enforcement policies?

Violations of the regulations in 49 CFR and 10 CFR 71 may result in civil or criminal penalties, cease/desist orders, suspension orders, etc. Each Agency has published an enforcement policy which includes penalty guidelines.

DOT - DOT/RSPA hazardous materials transportation enforcement civil penalty guidelines are found in 49 CFR Part 107, Hazardous Material Program Procedures, Subpart D, Appendix A.

NRC - In July 1995, the NRC revised "General Statement of Policy and Procedures for NRC Enforcement Actions-Enforcement Policy", published by the NRC Office of Enforcement, NUREG 1600. Import and export shipments must be made in accordance with the international regulations that are cited in 49 CFR 171.11 and 171.12. When import shipments are found to be in violation of the international air and sea transport regulations (which are essentially the same as the IAEA regulations) enforcement action against the foreign shipper or carrier can be taken by DOT by citing the applicable requirements in the ICAO or IMO regulations. If violations are found in radioactive material shipments being exported under the IMO or ICAO, the shipper or carrier may be charged with violating both the domestic and the international regulations.

PROCEDURE NO: RPO-601	REVISION NO: 1	ATTACHMENT 4 PAGE NO: 25 OF 25
-----------------------	----------------	-----------------------------------



MACTEC, Inc.

Procedure No: RPO-602

Revision No: 0

Effective Date: 1/02/02

RADIOLOGICAL WASTE HANDLING

Authored By:

Michael P. McDonald
Radiological Engineer

12-14-01

Date

Reviewed By:

Jeffrey W. Lively
Health Physicist

12/20/01

Date

Approved By:

Steven D. Rima
Radiological Engineering Manager

12/21/01

Date

This page intentionally left blank.

RADIOLOGICAL WASTE HANDLING

1.0 PURPOSE

1.1 The purpose of this procedure is to provide guidance and instruction in the handling and storage of radiological waste.

2.0 APPLICABILITY

2.1 This procedure applies to MACTEC, Inc. management, supervisors, individuals and contractors that handle and store radiological waste, where their work assignment is controlled by MACTEC, Inc.

3.0 REFERENCES

3.1 10 CFR 20, "Standards for Protection Against Radiation."

3.2 10 CFR 835, "Occupational Radiation Protection."

3.3 RPO-101, "Radiation Protection Program Overview."

3.4 RPO-103, "Radiation Protection Audits, Assessments and Oversight."

3.5 RPO-105 "Special Nuclear Materials Accountability Transfer and Control."

3.6 RPO-301, "Radiological Surveys."

4.0 DEFINITIONS AND ABBREVIATIONS

4.1 See RPO Glossary.

5.0 GENERAL

5.1 EQUIPMENT

Not applicable

5.2 SAFETY CONSIDERATIONS

Not applicable

5.3 RESPONSIBILITIES

5.3.1 RSO (or designee):

- Implement this procedure.

- Ensure individuals are qualified to perform this procedure.

5.3.2 Health Physics Staff:

- Comply with this procedure.
- Exercise appropriate contamination control techniques in the performance of waste handling.
- Comply with area entry requirements.
- Operate radiological survey instrumentation in accordance with approved operating procedures.

5.4 PREREQUISITES

Not applicable

5.5 RECORDS

- 5.5.1 Radiological waste documents and/or records shall be stored, arranged, indexed, retained, retrieved, and disposed of in accordance with this procedure and all applicable document regulations and requirements.

5.6 PRECAUTIONS AND LIMITATIONS

- 5.6.1 All waste containing special nuclear material must be identified and accounted for in accordance with Reference 3.5.
- 5.6.2 Licensed material waste and FUSRAP waste shall not be placed or stored in the same waste container.
- 5.6.3 Radiological waste shall only be stored in authorized areas.

5.7 REVISIONS

- 5.7.1 This procedure shall be reviewed at least every two years, with documentation to support the completion of such review.

5.8 OTHER

Not applicable

5.9 ATTACHMENTS

Attachment 1 - Volumetric Sample Disposition Information

PROCEDURE NO: RPO-602	REVISION NO: 0	PAGE NO: 2 OF 6
-----------------------	----------------	-----------------

Attachment 2 - HEU Sample Storage Inventory Sheet

PROCEDURE NO: RPO-602

REVISION NO: 0

PAGE NO: 3 OF 6

6.0 PROCEDURE

6.1 RADIOACTIVE WASTE CLASSIFICATION

6.1.1 Radioactive waste is usually classified as either NRC licensed waste or legacy material (FUSRAP) waste from past operations.

- FUSRAP material is uranium enriched to >5% U-235.

6.2 GENERAL RADIOACTIVE WASTE HANDLING

6.2.1 The handling or movement of radioactive waste shall be performed under an approved RWP or by a qualified member of the Health Physics Staff.

6.2.2 All radioactive waste shall be properly packaged to ensure that there is no spread of contamination to individuals or the environment during transportation to designated storage areas on site.

6.2.3 Radiological waste generated at a job site shall be collected in containers approved (by the RSO) for radiological waste collection. Waste containers considered "pre-approved" for collection include:

- Properly labeled plastic bags.
- Properly labeled drums.
- Properly labeled B-25 (or equivalent) boxes.
- Properly labeled liquid holding containers.

6.2.4 All radioactive waste containers shall be labeled (as a minimum) with the words "Radioactive Material".

6.2.5 Radioactive waste (excluding FUSRAP waste) shall be collected in radiological waste containers inside facilities at locations designated by the RSO.

- If waste collection is required to be performed outside of a facility (building/structure), the RSO shall be contacted for guidance and approval.

6.2.6 Licensed waste (excluding FUSRAP waste) shall be transported to and stored in designated areas until removed for processing .

6.2.7 When FUSRAP waste is collected, it shall be collected in designated areas only, and transported to an area approved for storage by the RSO.

6.2.8 Prior to the movement of accumulated radioactive waste to the waste storage area, a contamination survey shall be performed on the outside of the waste container. If radioactive contamination is present:

- Decontaminate the outside of the waste container, or
- Repack the waste container in a clean waste container.

6.2.9 If the potential exists for the external radiation level of a waste container to exceed 50 $\mu\text{rem/hr}$, a radiation survey shall be performed prior to movement of the waste.

6.2.10 Radiological waste containers offered to waste brokers and/or shippers shall be surveyed for radiation and contamination prior to release.

6.2.11 All radioactive waste storage areas shall be properly identified and posted.

6.3 FUSRAP WASTE HANDLING

6.3.1 FUSRAP waste shall be collected at the work site and transferred to a designated waste storage container.

6.3.2 When the waste storage container is full, it shall be banded shut and transferred to the designated accountability area on site.

6.3.3 Samples and small amounts of laboratory waste may be temporarily stored in the Health Physics laboratory or other areas designated by the RSO.

6.3.4 When temporary containers are full, they shall be transferred to the designated accountability area on site..

6.3.5 FUSRAP and SNM waste shall be accounted for in accordance with Reference 3.5.

6.4 LIQUID WASTE HANDLING

6.4.1 Radioactive liquid waste generated shall be collected and stored in approved liquid holding containers.

6.4.2 In-use liquid waste containers shall be inspected daily for leaks, as part of the daily inspections requirements for waste storage areas.

6.5 MIXED WASTE

6.5.1 Mixed waste control, handling, and storage is outside the scope of this procedure. Contact the RSO or Health and Safety Manager if mixed waste requires control, handling, or storage.

6.6 WASTE ACTIVITY CALCULATIONS

6.6.1 Waste activity calculations shall be performed to determine waste container activity using an RSO approved method.

7.0 QUALITY ASSURANCE

7.1 This procedure and associated documents shall be made available as part of the annual Health Physics Audit program.

VOLUMETRIC SAMPLE DISPOSITION

This attachment establishes the requirements for disposal or storage of volumetric samples analyzed for radioactive material content.

NOTE: Special care must be taken to identify the potential presence of other non-radioactive contaminants (e.g. asbestos, lead, oil, chemicals etc.) prior to unconditionally releasing any sample. Contact the RSO should there be any question regarding testing and disposal requirements.

Non-Radioactive Samples

Non-radioactive samples are defined as samples that meet the free release criteria.

Environmental Samples:

Environmental samples (Soil, Asphalt, Water, Vegetation) shall be disposed of at the location from which they were taken.

Building Materials:

Building materials (concrete, wood, paint, insulation, general debris) shall be disposed of in general trash containers or containers set up for construction waste.

Sanitary Sewer Samples:

Sanitary sewer samples shall be returned to the sanitary sewer system.

Non-water liquids and solid chemicals:

Non-water liquid and chemical samples shall be returned to the original container from which the samples were obtained.

Radioactive Samples (HEU)

Environmental Samples:

Environmental samples (Soil, Asphalt, Vegetation) shall be transferred to the designated waste storage container. The grams of U-235 in the sample shall be calculated and recorded on the Sample Storage Inventory Sheet (Attachment 2)

Building Materials:

PROCEDURE NO: RPO-602	REVISION NO: 0	ATTACHMENT 1 PAGE NO: 1 OF 2
-----------------------	----------------	---------------------------------

VOLUMETRIC SAMPLE DISPOSITION

Building materials (concrete, wood, paint, insulation, general debris) shall be transferred to the designated waste storage container. The grams of U-235 in the sample shall be calculated and recorded on the Sample Storage Inventory Sheet (Attachment 2)

Water/non-water liquids and solid chemicals:

Non-water liquid and chemical samples shall be returned to the original container from which the samples were obtained. The RSO shall be notified and the entire container placed in an approved storage location.

Radioactive Samples (LEU, By-Product)

Sample results shall be reviewed for the presence of by-product material. Sample results shall be reviewed by the RSO if sample analysis indicates by-product activity greater than 0.1 pCi/g for Cs-137 or Co-60.

Samples with analyzed activity >5 pCi/g for total uranium, that were obtained from areas where it is probable that uranium is low enriched or depleted, shall be analyzed for percent enrichment. If it is determined that the enrichment is <10% the material will be classified as low enriched.

The RSO shall be notified if low enriched uranium or by-product material is identified during sample analysis.

PROCEDURE NO: RPO-602	REVISION NO: 0	ATTACHMENT 1 PAGE NO: 2 OF 2
-----------------------	----------------	---------------------------------



Procedure No: RPO-603

Revision No: 1

Effective Date: 9-1-02

ENVIRONMENTAL MONITORING

Authored By:

Michael P. McDonald
Radiological Engineer

6-14-02

Date

Reviewed By:

Jeffrey W. Lively
Health Physicist

8/16/02

Date

Approved By:

Steven D. Rima
Radiological Engineering Manager

8/16/02

Date

This page intentionally left blank.

ENVIRONMENTAL MONITORING

1.0 PURPOSE

- 1.1 The purpose of this procedure is to provide general guidance and instruction for the performance of environmental sampling and monitoring. This procedure does not provide detailed information regarding a sampling and monitoring program or plan for a specific site location or facility. This procedure does provide a general overview of the Environmental Monitoring Program, which includes a plan for the monitoring of external dose to members of the general public, monitoring of radiological releases to the environment, and the collection and analysis of both on-and offsite environmental samples. This procedure also provides instruction for the review and documentation of these monitoring and sampling activities.

2.0 APPLICABILITY

- 2.1 This procedure applies to MACTEC, Inc. management, supervisors, individuals and contractors that perform environmental monitoring and sampling where their work assignment is controlled by MACTEC, Inc.

3.0 REFERENCES

- 3.1 10 CFR 20, "Standards for Protection Against Radiation."
- 3.2 10 CFR 835, "Occupational Radiation Protection."
- 3.3 Various RPOs.
- 3.4 Regulatory Guide 4.15, "Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and The Environment."
- 3.5 Regulatory Guide 4.20, "Constraint on Releases of Airborne Radioactive Materials to The Environment For Licensees Other Than Power Reactors," December 1996.
- 3.6 Regulatory Guide 8.37, "ALARA Levels for Effluents From Materials Facilities," July 1993.
- 3.7 NUREG-1727, "NMSS Decommissioning Standard Review Plan," Sept. 2000.

4.0 DEFINITIONS AND ABBREVIATIONS

PROCEDURE NO: RPO-603

REVISION NO: 1

PAGE NO: 1 OF 8

4.1 See RPO Glossary.

5.0 GENERAL

5.1 EQUIPMENT

5.1.1 Various environmental monitoring and sampling equipment

5.1.2 Various sampling containers

5.1.3 Various Personnel Protective Clothing and equipment (as required)

5.2 SAFETY CONSIDERATIONS

Not applicable

5.3 RESPONSIBILITIES

5.3.1 RSO (or designee):

- Implement this procedure.
- Ensure that individuals are qualified to perform environmental sampling required by this procedure. Ensure that all survey documentation is reviewed in a timely manner.
- Determine the radiological instrumentation to be utilized to perform radiological surveys, if necessary.

5.3.2 Health Physics Staff:

- Comply with this procedure.
- Exercise appropriate contamination control techniques in the performance of environmental sampling and monitoring.
- Comply with entry requirements for the areas to be surveyed.

5.4 PREREQUISITES

Not applicable

5.5 RECORDS

PROCEDURE NO: RPO-603	REVISION NO: 1	PAGE NO: 2 OF 8
-----------------------	----------------	-----------------

5.5.1 Environmental monitoring documents and/or records shall be stored, arranged, indexed, retained, retrieved, and disposed of in accordance with all applicable NRC document regulations and requirements.

5.6 PRECAUTIONS AND LIMITATIONS

5.6.1 All sampling/monitoring data shall be documented in accordance with applicable procedures. If a governing procedure does not exist for the sampling/monitoring task, documentation shall be in accordance with this procedure.

5.7 REVISIONS

5.7.1 This procedure shall be reviewed at least every two years, with documentation to support the completion of such review.

5.8 OTHER

Not applicable

5.9 ATTACHMENTS

Attachment 1 - Environmental TLD Record

6.0 PROCEDURE

6.1 ENVIRONMENTAL MONITORING

6.1.1 Environmental monitoring shall be performed at a site to:

- Monitor doses to members of the general public from radiation/radioactive material resulting from the occupational use of licensed radioactive material.
- Monitor radiological releases to the environment.
- Identify increases in the radioactive content of soils, waters, and vegetation through the collection and analysis of on and off site environmental samples.

6.1.2 Environmental monitoring shall be performed at a site until site characteristic studies and survey results indicate monitoring is no longer required, and the appropriate regulatory approval has been obtained to terminate environmental monitoring, as necessary.

6.1.3 Environmental monitoring shall be conducted in a manner that is consistent with the site's environmental ALARA program, and in compliance with all applicable regulatory requirement.

6.1.4 As site conditions change (e.g., a building or structure is vacated or the building's operational status changes), evaluations/assessments shall be performed to determine if a change in the environmental monitoring/sampling requirements is necessary.

6.1.5 Environmental evaluations/assessments performed shall be forwarded to the Site and Corporate RSO for evaluation.

6.2 ENVIRONMENTAL ALARA

6.2.1 Normal site operations, as well as decommissioning and dismantlement activities, shall be conducted in a manner that is consistent with the site's environmental ALARA goals for effluent releases.

6.2.2 MACTEC, Inc. shall demonstrate a commitment to reducing unnecessary environmental exposures to members of the public.

6.2.3 MACTEC, Inc. schedulers, planners, and workers shall use sound, commonly accepted practices, established procedures, engineering controls, and process controls to achieve the environmental ALARA goals established.

6.2.4 Management should perform an annual review of the content and implementation of the Environmental Monitoring Program. This review shall include:

- Analysis of trends in release concentrations, environmental monitoring data, and radionuclide usage, as applicable.
- Determination of whether operational changes are needed to achieve the ALARA effluent goals.

6.2.5 A report of the results from the review shall be submitted to senior management, including any recommendations that are necessary to achieve the site's Environmental ALARA Goals.

6.3 SOIL, VEGETATION, AND WATER MONITORING

6.3.1 Soil, vegetation, and water monitoring shall be performed in accordance with the site's, environmental sampling program. If a sampling program has not been previously established for the site, or is not adequate for the work activities planned, a new or revised soil, vegetation, and water sampling plan will need to be developed.

6.3.2 Soil, vegetation, and water samples shall either be analyzed on-site, in accordance with approved procedures, or shipped to an approved off-site facility for analysis.

6.3.3 Environmental sampling result trending shall be performed in an effort to identify changes in environmental contaminant concentration and/or movement.

6.4 LIQUID EFFLUENT MONITORING

6.4.1 For all potentially contaminated liquid effluents, representative samples shall be taken at each release point for the determination of concentrations and quantities of radionuclides released to unrestricted areas, including discharges to sewage systems.

6.4.2 For batch liquid releases, a representative sample of each batch shall be collected and analyzed prior to release.

- 6.4.3 Liquid effluent samples shall be analyzed and documented in accordance with approved procedures, or shipped to an approved off-site facility for analysis.
- 6.4.4 Liquid effluents (including waste water) shall only be discharged into the sanitary sewer system.
- Disposal of liquid effluents to the ground, or other bodies of water at the site, is restricted.
- 6.4.5 The RSO shall authorize all liquid effluent releases made to the sanitary sewer system only after a review of the liquid effluent sampling results.

6.5 AIRBORNE EFFLUENT MONITORING

- 6.5.1 For continuous airborne releases (e.g., building exhaust ventilation systems), airborne effluent stack monitoring shall be performed by isokinetic stack samplers with fixed sample pumps.
- 6.5.2 When in use, fixed sample pump collection media used for effluent monitoring of stacks with HEPA filter systems shall be collected and analyzed weekly.
- 6.5.3 For airborne releases that are classified as batch release, a representative sample shall be collected and analyzed.
- 6.5.4 During facility decontamination and decommissioning activities, general area air sampling and monitoring of NON-HEPA filtered stacks shall be performed.
- 6.5.5 The RSO shall be notified of any air sample result with an activity greater than the LLD values.
- 6.5.6 When used for effluent monitoring, sample pump flow meters shall be calibrated at least every six months.

6.6 BOUNDARY DOSE MONITORING

- 6.6.1 External dose monitoring shall normally be accomplished through the use of Thermoluminescent Dosimeters "TLDs".
- The TLDs used shall be certified by a NAVLAP/DOELAP accredited vendor as acceptable for environmental monitoring.

- TLD's shall be capable of accurately measuring the radiation energies present and be able to measure an accumulated dose of 10 mrem over a period of one quarter year of gamma radiation.
- TLD's shall be used to monitor any area accessible to members of the general public where, if continually present for a year, would receive a dose ≥ 50 millirem.

6.6.2 Environmental TLDs shall be protected from the elements as much as possible.

6.6.3 TLDs shall be placed approximately 1 meter above the ground level.

6.6.4 TLDs shall be oriented such that the front face of the TLD is facing outward when placed against a solid object.

6.6.5 TLDs shall be changed on a quarterly basis, or as required by the RSO.

- A leeway period of +/- two weeks is acceptable for the quarterly TLD change.

6.6.6 A background control TLD shall be placed at the site background monitoring location at the same time monitoring TLDs are changed.

6.7 BOUNDARY DOSE MONITORING DOCUMENTATION

6.7.1 TLD information shall be recorded on the Environmental TLD Record sheet (Attachment 1).

6.7.2 The individual hanging the TLDs shall record the TLD number, date hung, time hung, and initial the entries on the Environmental TLD Record sheet.

- The Environmental TLD Record will be placed in the designated active Environmental TLD file.
- When TLDs are pulled, the individual shall record the date pulled, time pulled, and initial the entries on the same Environmental TLD Record sheet the TLDs were issued under.
- The Environmental TLD Record and TLDs shall be given to the RSO.

6.7.3 The RSO will ensure the TLDs are properly packaged and delivered to the vendor for processing.

PROCEDURE NO: RPO-603	REVISION NO: 1	PAGE NO: 7 OF 8
-----------------------	----------------	-----------------

6.7.4 When the dose report is received, the RSO shall review the report and enter the following information on the Environmental TLD Record:

- The total dose adjusted for the monitoring quarter.
- A corrected total quarterly dose will be calculated by subtracting the background dose from the environmental monitors.

6.7.5 Background corrections may be performed by the TLD vendor. If the vendor performs this task, enter "vendor corrected" in the total dose column and enter the vendor reported dose in the corrected dose column.

6.7.6 The RSO shall review and sign the TLD Report highlighting any total quarterly dose >10 mrem.

6.7.7 The RSO shall perform a final review and sign the Environmental TLD Report. The TLD Report and the Environmental TLD Record shall be placed in the completed Environmental TLD file.

6.8 ENVIRONMENTAL MONITORING RESULTS EVALUATION

6.8.1 Environmental monitoring sample results shall be reviewed and evaluated against previous sampling results by the Corporate RSO, or designee.

6.8.2 Quality assurance aspects of environmental monitoring and sampling, along with the review and evaluation of sampling results, shall be consistent with the guidance provided in procedure Reference 3.4.

7.0 QUALITY ASSURANCE

7.1 The TLD monitoring program and results will be audited on an annual basis. The audit shall consist of a review of dose reports to insure completeness and compliance with dose limits for members of the general public.

7.2 A review of surveys of posted areas shall be performed to insure that TLDs are placed in locations that will accurately determine general and maximum area dose rates.

7.3 Air monitoring effluent results and sample values shall be reviewed monthly by the RSO, or designee.

ENVIRONMENTAL TLD RECORD

Location	TLD #	Date Hung	Time Hung	Hung By	Date Pulled	Time Pulled	Pulled By	Avg. Dose*	Quarterly Dose **	Total Dose ***
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
Background										

* Average Dose = average of 4 zones from each TLD ** Calculated dose for actual quarter *** Total Dose = Quarterly dose adjusted for background
 All dose is reported in mrem.

Prepared By: _____ Date: _____

Reviewed By: _____ Date: _____

RSO

Form RPO-603-01-1

PROCEDURE NO: RPO-603

REVISION NO: 1

ATTACHMENT 1
PAGE NO: 1 OF 1



Procedure No: RPO-610

Revision No: 1

Effective Date: 9-1-02

PROCUREMENT, RECEIPT, AND CONTROL OF RADIOACTIVE MATERIAL

Authored By:

Michael P. McDonald
Radiological Engineer

6-14-02
Date

Reviewed By:

Jeffrey W. Lively
Health Physicist

8/16/02
Date

Approved By:

Steven D. Rima
Radiological Engineering Manager

8/16/02
Date

This page intentionally left blank.

PROCUREMENT, RECEIPT, AND CONTROL OF RADIOACTIVE MATERIAL

1.0 PURPOSE

- 1.1 The purpose of this procedure is to provide instruction for the procurement, receipt, and control of radioactive material controlled under the MACTEC, Inc. NRC license.

2.0 APPLICABILITY

- 2.1 This procedure applies to MACTEC, Inc. management, supervisors, individuals and contractors that procure, receive, and/or control radioactive material, where their work assignment is controlled by MACTEC, Inc. This procedure is not applicable to special nuclear material.

3.0 REFERENCES

- 3.1 10 CFR 20, "Standards for Protection Against Radiation."
3.2 10 CFR 835, "Occupational Radiation Protection."
3.3 49 CFR 100 - 185, "Transportation."
3.4 RPO-101, "Radiation Protection Program Overview."
3.5 RPO-103, "Radiation Protection Audits, Assessments and Oversight."
3.6 RPO-106, "Radiological Training and Qualification."
3.7 RPO-201, "Operation of Portable Radiological Survey Instruments."
3.8 RPO-204, "Calibration and Quality Control of Portable Radiological Survey Instruments."
3.9 RPO-404, "Sealed Source Accountability and Leak Checks."
3.10 RPO-501, "Radiological Incident Response."

4.0 DEFINITIONS AND ABBREVIATIONS

- 4.1 See RPO Glossary.
- 4.2 Radioactive Material - A term used specifically in this procedure to describe material that is radioactive or has radioactive contamination located on its surface or internal to its surface, above regulatory activity limits (See Appendix C |

of 10 CFR 20 or the applicable regulatory limits.) When there is a question of whether or not a material is radioactive, clarification shall be obtained from the RSO or Radiological Engineer.

5.0 GENERAL

5.1 EQUIPMENT

5.1.1 Radiological survey and counting equipment.

5.1.2 Smear/wipe media.

5.1.3 Radioactive material labels, tags, and/or posting material(s).

5.1.4 Computer operated data base software and computer.

5.2 SAFETY CONSIDERATIONS

5.2.1 Treat all incoming radioactive shipments as if they are a source of radiation and contamination, until proven otherwise.

5.3 RESPONSIBILITIES

5.3.1 Corporate RSO:

- Implement this procedure.
- Approve all purchases/orders/requests for radioactive sources or equipment containing licensable quantities of radioactive material.
- Maintain accountability of licensed radioactive material under the control of MACTEC, Inc. and all subsidiary MACTEC companies.

5.3.2 Site RSO (or designee):

- Implement this procedure.
- Ensure individuals are qualified to perform this procedure.
- Determine the radiological instrumentation to be utilized to perform radiological surveys, if necessary.
- Approve all purchases/orders/requests for radioactive sources or equipment containing licensable quantities of radioactive material.

5.3.3 Health Physics Staff:

- Comply with this procedure.
- Exercise appropriate contamination control techniques while handling radioactive material.
- Comply with all radiological entry requirements if access to radiological areas is necessary.
- Operate radiological survey instrumentation in accordance with approved operating procedures.

5.4 PREREQUISITES

- 5.4.1 Select and operate properly calibrated portable radiation survey instruments in accordance with applicable RPOs and manufacturer's operating manuals.

5.5 RECORDS

- 5.5.1 Related documents and/or records shall be stored, arranged, indexed, retained, retrieved, and disposed of in accordance with this procedure and all applicable document regulations and requirements.

- 5.5.2 Related documents and/or records, showing the results of radiological surveys and instrument calibrations, shall be maintained as required by 10 CFR 20.

5.6 PRECAUTIONS AND LIMITATIONS

- 5.6.1 All radiological surveys shall be performed in accordance with corporate policies, practices, and procedures.

- 5.6.3 Immediately report any abnormal radiological conditions encountered to the RSO and if necessary, implement the appropriate actions from Reference 3.10, Radiological Incident Response.

- 5.6.4 Procurement of radioactive material by any means (lease, purchase, obtain for free, etc.) shall be performed in accordance with this procedure. Radioactive material shall not be obtained/received without the approval of the Corporate RSO.

5.7 REVISIONS

- 5.7.1 This procedure shall be reviewed at least every two years, with documentation to support the completion of such review.

5.8 OTHER

PROCEDURE NO: RPO-610	REVISION NO: 1	PAGE NO: 3 OF 9
-----------------------	----------------	-----------------

Not applicable

5.9 ATTACHMENTS

Attachment 1 - Radioactive Material Procurement and Control

Attachment 2 - Radioactive Material Inventory

6.0 PROCEDURE

6.1 GENERAL REQUIREMENTS

6.1.1 Only individuals authorized by the Corporate RSO or the MACTEC, Inc. Materials License (NRC license) shall be allowed to receive radioactive material.

6.1.2 All radioactive material shall be properly controlled to prevent mishandling or loss of material. The use of radioactive material shall be controlled by authorized individuals.

6.1.3 When not in use, radioactive material shall be properly secured to prevent unauthorized access or use.

6.2 RADIOACTIVE MATERIAL SECURITY

6.2.1 Radioactive material shall be controlled by the authorized individual at all times.

6.2.2 When radioactive material is not in transit or use, it shall be secured in one of the following manners:

- locked in a safe
- locked in a suitable container
- in a properly posted radiologically controlled/restricted area
- securely attached to the equipment it was manufactured for
- placed in a properly labeled radioactive waste container
- (for environmental type radioactive material) left undisturbed in place

6.2.3 If radioactive material is lost, stolen, or unaccounted for, notify the Site RSO immediately and carry out the required actions of RPO-501, Radiological Incident Response.

6.3 PROCUREMENT OF RADIOACTIVE MATERIAL

NOTE: Procurement of radioactive material by any means (leased, purchased, obtained for free, etc.) shall be performed in accordance with this procedure. Radioactive material shall NOT be obtained without the approval of the Corporate RSO.

6.3.1 Obtain a Radioactive Material Procurement and Control form (Attachment 1).

6.3.2 Complete the Material Request section of the form. Ensure that:

- All applicable blanks in this section are completed.
- Proper units of activity are used (e.g., Ci, mCi, μ Ci, nCi).
- The reason for the request is listed.

6.3.3 Submit completed form to the Corporate RSO for review and approval.

6.4 RECEIPT OF RADIOACTIVE MATERIAL

6.4.1 If radioactive material has been purchased or leased, verify receipt invoice with procurement request paperwork to ensure correct material has been received.

6.4.2 Verify applicable paper work accompanying radioactive material to ensure correct material has been received.

6.4.3 If greater than Type A quantity radioactive material (per 10 CFR 71.4) is being received:

- Notify the Site RSO of the arrival.
- Verify material labeling is consistent with shipping paper work.

6.4.4 Visually inspect radioactive material package. If the package appears damaged/moisture stained:

- Do not open the package.
- Contact the Site RSO immediately.
- Initiate the appropriate step(s) of RPO-501, Radiological Incident Response, as necessary.

6.4.5 Perform a radiation and contamination survey on packages containing radioactive material within three (3) hours of receipt of the package during normal working hours or within three (3) hours from the beginning of the next scheduled work day if received after scheduled working hours. If abnormal radiological conditions are identified:

- Do not open the package.
- Contact the Site RSO immediately.

- Initiate the appropriate step(s) of RPO-501, Radiological Incident Response, as necessary.
- 6.4.6 Immediately notify the Site RSO, final delivery carrier, and the Regional NRC office if:
- External radiation levels exceed 200 mrem/hr at any point on the external surface of the package (49 CFR 173.441) unless specifically shipped as an exclusive-use shipment.
 - Removable radioactive surface contamination on the package exceeds ten (10) times the limits, as specified in 49 CFR 173.443.
- 6.4.7 Log receipt of the radioactive material (source, equipment, etc.) on a Radioactive Material Procurement and Control form (Attachment 1) in the Material Control section. Complete all applicable blanks in this section. Obtain an inventory control number from the Corporate RSO.
- 6.4.8 If material received is an accountable radioactive source, verify that a source leak test has been performed within the last three months and the paper work is provided with the source, or perform a source leak check in accordance with Reference 3.9. Log receipt of radioactive source in accordance with Reference 3.9.
- 6.4.9 Submit completed Radioactive Material Procurement and Control form to the Corporate RSO for signature.
- 6.4.10 Corporate RSO shall enter radioactive material information in to the Radioactive Material Inventory (Attachment 2), sign and date the Radioactive Material Procurement and Control form, return a signed copy of the form to the material owner, and file the original form.

6.5 CONTROL OF RADIOACTIVE MATERIAL

- 6.5.1 If radioactive material will be used/stored (other than temporarily) in a location different than originally listed in the Material Control section of the Radioactive Material Procurement and Control form:
- Contact the Corporate RSO for movement authorization.
 - Submit a new Radioactive Material Procurement and Control form (in accordance with Section 6.4) indicating the new use/storage location of the radioactive material.
 - Cancel the original form (in accordance with Section 6.6).

PROCEDURE NO: RPO-610	REVISION NO: 1	PAGE NO: 7 OF 9
-----------------------	----------------	-----------------

6.5.2 If radioactive material will be divided in to separate, individual items of radioactive material, (other than temporarily):

- Contact the Corporate RSO for authorization.
- Submit a new Radioactive Material Procurement and Control form (in accordance with Section 6.4) for each newly created item of radioactive material, indicating the new use/storage location of each item of radioactive material.
- Cancel the original form (in accordance with Section 6.6).

6.5.3 If multiple radioactive material items will be combined in to a single item (other than temporarily):

- Contact the Corporate RSO for authorization.
- Submit a new Radioactive Material Procurement and Control form (in accordance with Section 6.4) for the newly created item indicating the new use/stored location of the material.
- Cancel the original forms (in accordance with Section 6.6).

6.6 DISPOSITION OF RADIOACTIVE MATERIAL

6.6.1 Obtain a copy of the current Radioactive Material Procurement and Control form for the radioactive material being removed from the license. This form can be obtained from the Corporate RSO.

6.6.2 Complete the Material Disposition section of the form. Complete all applicable blanks in this section.

6.6.3 Indicate the removal mechanism for material disposition. Clarify, as needed, the methodology and technique used in the disposition process.

6.6.4 If only a portion of the material is being dispositioned:

- Check the Partial Box and indicate the activity being removed from the license.
- Indicate the removal mechanism for the portion removed.
- Submit a new Radioactive Material Procurement and Control form (Section 6.4) indicating the new lesser activity of the material and continue the

process to cancel the original form. Reference the old ICN in the Material Disposition section of the form.

- 6.6.5 Sign and date the form in the Material Disposition section.
- 6.6.6 Submit completed Radioactive Material Procurement and Control form to the Corporate RSO for termination signature.
- 6.6.7 Corporate RSO shall enter radioactive material information in to the Radioactive Material Inventory form, sign and date the Radioactive Material Procurement and Control form in the Termination Review area, and file the original form as terminated.

6.7 RADIOACTIVE MATERIAL INVENTORY

NOTE: The Corporate RSO shall maintain an inventory of all radioactive material(s) controlled by MACTEC, Inc.

- 6.7.1 Log receipt of all radioactive material (source, equipment, etc.) on Attachment 2. Radioactive material information should be obtained from Attachment 1, Radioactive Material Procurement and Control, with the exception of the Inventory Control Number (ICN)
- 6.7.2 Initiate a new Inventory Control Number (ICN) using the following format YYMMDD-001 where:
 - YYMMDD = Numerical date the material was received
 - 001 - Sequential number, if more than one radioactive material was identified or received on that date.
- 6.7.3 Record the ICN on Attachment 1, as needed.

7.0 QUALITY ASSURANCE

- 7.1 Documents generated during the performance of this procedure shall be audited in accordance with Reference 3.5.
- 7.2 The Corporate RSO shall verify, at least quarterly, that total activity controlled by MACTEC, Inc. is less than that allowed by MACTEC, Inc.'s Material License.
- 7.3 Radioactive source inventory shall be performed in accordance with RPO-404, Sealed Source Accountability and Leak Checks. Radioactive material other than sealed sources shall be inventoried and verified against Attachment 2, Radioactive Material Inventory or similar data base, at least yearly.

RADIOACTIVE MATERIAL PROCUREMENT and CONTROL

This form shall be used for the procurement and control of radioactive material. Please complete all applicable information and submit to the Corporate RSO for review. Complete a separate Radioactive Material Procurement and Control form for each item/source requested/controlled.

Material Request:

Radioactive Source Contaminated Equipment Activated Equipment Other: _____

Reason: _____

Date Requested: _____ Date Needed: _____ Radionuclide: _____ Activity: _____

Physical/Chemical Make-up: _____ NIST Traceable: YES NO Exempt Non-exempt

Requested By: _____
Printed Name and Signature _____ Date _____

Material Request: Approved Rejected

MACTEC, Inc. Corporate RSO _____
Date _____

Material Control:

Inventory Control Number (ICN): _____ (Obtain from CRSO)

Date Received: _____ Radionuclide: _____ Present Activity: _____

Physical/Chemical Make-up: _____ Manufacturer: _____ Model #: _____

Material Type: _____ Serial #: _____ Assay Date: _____ Survey #: _____

Location (used/stored): _____

Material Owner: _____ Phone #: _____

Data Entry By: _____
Printed Name and Signature _____ Date _____

Material Disposition:

Date Removed: _____ Activity Removed: _____ Activity Quantity: Total Partial
(If partial activity removed, create new form with remaining activity. Reference old ICN below.)

Removal Mechanism: waste transfer decay lost other _____

(Identify person, organization, facility, license #, or circumstance surrounding material disposition)

Dispositioned By: _____
Printed Name and Signature _____ Date _____

Data Entry By: _____
Printed Name and Signature _____ Date _____

Termination Review By: _____
MACTEC, Inc. Corporate RSO _____ Date _____

Form RPO-610-01-1

PROCEDURE NO: RP0-610

REVISION NO: 1

ATTACHMENT 1
PAGE NO: 1 OF 1

RADIOACTIVE MATERIAL INVENTORY

Date Entered	ICN	BP/S and ID	Activity (Ci)	Date Removed
Owner				
Description				
Location				

Date Entered	ICN	BP/S and ID	Activity (Ci)	Date Removed
Owner				
Description				
Location				

Date Entered	ICN	BP/S and ID	Activity (Ci)	Date Removed
Owner				
Description				
Location				

Date Entered	ICN	BP/S and ID	Activity (Ci)	Date Removed
Owner				
Description				
Location				

Form RPO-610-02-1





MACTEC, Inc.

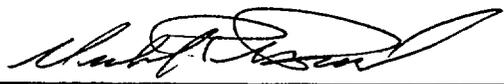
Procedure No: RPP-101

Revision No: 0

Effective Date: 9-1-02

ALARA PROGRAM

Authored By:  8-23-02
Date
Jeff A. Thompson
Project Radiological Engineering Manager

Reviewed By:  8-26-02
Date
Michael P. McDonald
Radiological Engineer

Approved By:  8/26/02
Date
Steven D. Rima
Radiological Engineering Manager

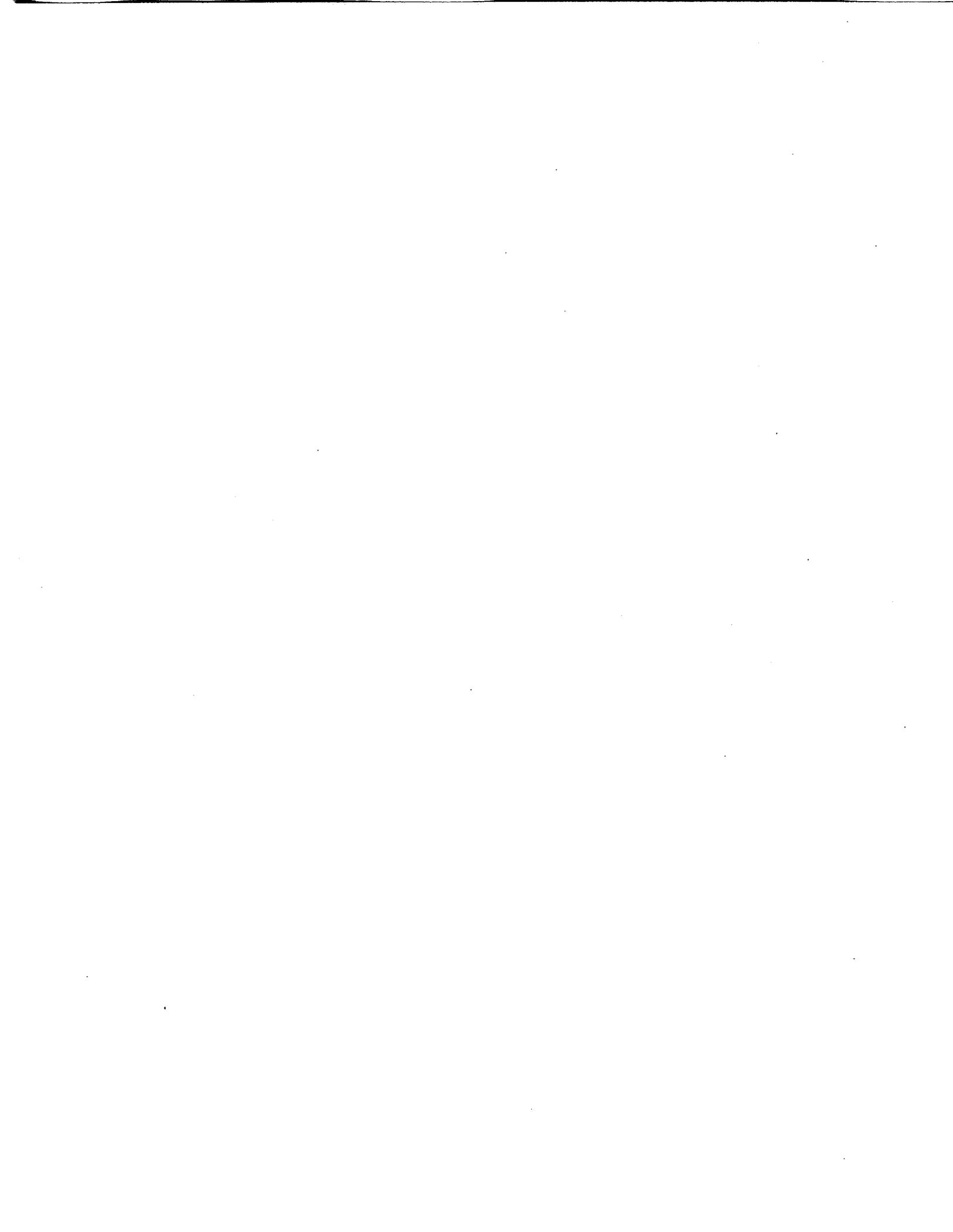


Table of Contents

1.0	PURPOSE	1
2.0	SCOPE	1
3.0	OVERVIEW	2
4.0	DEFINITIONS	2
5.0	REQUIREMENTS	4
6.0	PROGRAM ELEMENTS	5
6.1	MANAGEMENT COMMITMENT	5
6.2	ASSIGNMENT OF RESPONSIBILITIES	5
6.2.1	MACTEC Project Manager	5
6.2.2	ALARA Committee Chairperson.....	6
6.2.3	ALARA Committee (AC).....	6
6.2.4	ALARA Committee Members	7
6.2.5	Team Leaders	7
6.2.6	Management	7
6.2.7	Radiation Safety Officer (RSO).....	8
6.2.8	Health Physicist (HP).....	8
6.2.9	Radiological Control Technician and Health Physics Technician.....	9
6.2.10	Design Engineers, Programmers, and Schedulers	9
6.2.11	Training Instructors/Developers.....	9
6.2.12	Radiological Workers.....	10
6.3	ADMINISTRATIVE CONTROL LEVELS (ACLs).....	10
6.3.1	Lifetime Control Level	10
6.3.2	Visitor Dose Limits	10
6.3.3	Embryo/Fetus Dose Limits	10
6.3.4	Special Exposure Controls.....	11
6.4	PERFORMANCE GOALS	11
6.4.1	ALARA Goals.....	11
6.4.2	ALARA Performance Indicators	12
6.5	ALARA TRAINING.....	13

6.6	PROGRAMS AND PROCEDURES	14
6.7	INTERNAL REVIEWS/AUDITS	14
6.8	OPTIMIZATION METHODOLOGY.....	14
6.9	RADIOLOGICAL DESIGN REVIEW	15
6.10	RADIOLOGICAL WORK/EXPERIMENT PROGRAMMING	16
6.11	RECORDS	17
7.0	DOSE REDUCTION METHODS.....	17
7.1	DOSE TRACKING.....	18
7.2	EMPLOYEE SUGGESTIONS.....	18
8.0	WASTE MINIMIZATION	18
9.0	REFERENCES	19

1.0 PURPOSE

MACTEC, Inc. (MACTEC) ALARA Program describes how MACTEC will maintain radiation doses to MACTEC workers and the public and releases of radioactive material to the environment to levels that are below regulatory limits and requirements and as low as reasonably achievable (ALARA), taking into account social, technical, economic, practical, and public policy considerations.

This Program implements, on the programmatic level, the requirements of Title 10, Code of Federal Regulations, Part 20, "Standards for Protection Against Radiation"; Part 835, "Occupational Radiation Protection" (10 CFR 835) and Department of Energy (DOE) Order 5400.5, "Radiation Protection of the Public and the Environment," and incorporates guidance from other regulatory directives, as appropriate.

2.0 SCOPE

The requirements of the ALARA Program described in this document apply to all personnel working for MACTEC, including subcontractors and oversight personnel. This Program establishes the process by which MACTEC shall conduct operations so that radiation exposure to employees and subcontractors and releases of radioactive materials to the environment are kept ALARA.

The following program elements are addressed in this ALARA Program:

- Policy and Management Commitment
- Assignment of Responsibilities
- Administrative Control Levels
- Radiological Performance Goals
- ALARA Training
- Programs and Procedures
- Internal Reviews/Audits
- Optimization Methodology
- Radiological Design Review
- Radiological Work/Experiment Programming

- Records

The following topics are also included:

- Dose Reduction Methods
- Waste Minimization

3.0 OVERVIEW

For the purposes of radiological protection, MACTEC operates under the assumption that exposure to ionizing radiation may involve some health risk. It is further assumed that this risk decreases as the radiation dose decreases, and that it is therefore prudent to take reasonable efforts to reduce radiation exposure to workers, the public, and the environment. The MACTEC ALARA Program, described in this document, implements this philosophy of dose minimization.

This Program provides direction and guidance and defines responsibilities in addressing the ALARA issues of MACTEC. Eleven basic program elements comprise the body of this Program. In addition, policies, procedures and instructions will be used together with this document to implement MACTEC ALARA Program.

4.0 DEFINITIONS

Administrative Control Level (ACL) The level of radiation exposure established by management to ensure that individual and collective radiation dose to workers is maintained well below regulatory limits.

Airborne Radioactivity Area Any area where the measured concentration of airborne radioactivity, above natural background, exceeds or is likely to exceed 10 percent of the derived air concentration (DAC) values listed in the appropriate regulation.

ALARA The approach to radiation protection for the management and control of exposures (both individual and collective) to the work force and to the general public to levels as low as is reasonable, taking into account social, technical, economic, practical, and public policy considerations. ALARA is not a dose limit but a process that has the objective of attaining doses as far below the applicable limits and as is reasonably achievable.

ALARA Committee (AC) An independent group that is appointed by, and reports to, MACTEC Project Manager on matters pertaining to the elements of the ALARA

PROCEDURE NO: RPP-101	REVISION NO: 0	PAGE NO: 2 OF 19
-----------------------	----------------	------------------

Program. The Chairperson shall be the Project Manager or an individual appointed by, and reporting directly to the Project Manager. The Committee should consist of the Radiation Safety Officer and a representative of management, line supervisors, and workers.

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. ALI is the smaller value of intake of a given radionuclide in a year by the reference man (as defined by International Commission on Radiological Protection, Publication 23) that would result in a committed effective dose equivalent of 5 rem (0.05 sievert) or a committed dose equivalent of 50 rem (0.5 sievert) to any individual organ or tissue.

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 Effective Dose Equivalent (CEDE) The sum of the committed dose equivalents to various tissues in the body, each multiplied by the appropriate weighting factor. Committed effective dose equivalent is expressed in units of rem (or sievert).

Derived Air Concentration (DAC) The airborne concentration that equals the ALI divided by the volume of air breathed by an average worker for a working year of 2000 hours (assuming a breathing volume of 2400 m³).

Dose Equivalent The product of absorbed dose in rad (or gray) in tissue, a quality factor, and other necessary modifying factors. Dose equivalent is expressed in units of rem (or sievert) (1 rem = 0.01 sievert).

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

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.

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

Radiological Area (RA) Any area within a controlled area which must be posted as a "radiation area," "high radiation area," "very high radiation area," "contamination area,"

PROCEDURE NO: RPP-101	REVISION NO: 0	PAGE NO: 3 OF 19
-----------------------	----------------	------------------

"high contamination area," or "airborne radioactivity area" in accordance with the applicable regulation.

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

Radiological Control Hold Point A cautionary step in a technical work document requiring the Radiation Protection Organization to perform some action or verification. The Radiological Control Hold Point requirements shall be satisfactorily completed before the work is continued.

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

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

Total Effective Dose Equivalent (TEDE) The sum of the effective dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

Very High Radiation Areas 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 1 hour at 1 meter from a radiation source or from any surface that the radiation penetrates.

Weighting Factor The fraction of the overall health risk, resulting from uniform, whole body irradiation, attributable to specific tissue. The dose equivalent to tissue is multiplied by the appropriate weighting factor to obtain the effective dose equivalent contribution from that tissue.

5.0 REQUIREMENTS

Radiation dose limits to workers, the public and the environment, as specified in the appropriate regulatory driver, shall not be exceeded as a result of MACTEC activities. ACLs for workers are established below the regulatory limits to ensure that exposures to individuals are maintained below the regulatory limits.

6.0 PROGRAM ELEMENTS

6.1 Management Commitment

The commitment and support of MACTEC management to the ALARA Program are demonstrated by the following policy statement, quoted from the MACTEC Corporate Radiation Protection Program:

It is the policy of MACTEC, Inc. to conduct its radiological operations in a manner that ensures the health and safety of all its employees, contractors, and the general public. In achieving this objective, MACTEC, Inc. shall ensure that radiation exposures to its workers, general public and releases of radioactivity to the environment are maintained below regulatory limits. Deliberate efforts shall be taken to further reduce exposures and releases As Low As Reasonably Achievable (ALARA). The company is fully committed to implementing a radiological control program of the highest quality that consistently reflects this policy.

Management commitment and support are demonstrated in the personnel and other resources dedicated to implementation of the ALARA Program described in the remainder of this document. MACTEC Radiological Protection Organization is comprised of the Radiation Safety Officer, Health Physicist, Radiological Control Technicians, and the ALARA Committee. MACTEC line management shall be responsible for strictly adhering to the ALARA policy and philosophy. Senior and line management shall demonstrate support of the Program through direct communication, instruction, and inspection of the workplace. All MACTEC personnel shall be made aware of management's commitment and shall be instructed on their responsibility to comply.

6.2 Assignment of Responsibilities

Organizational responsibilities have been established to ensure an effective implementation of the ALARA Program. This section pertains to those organizations/positions specifically associated with ALARA Program implementation.

6.2.1 MACTEC Project Manager

MACTEC Project Manager is responsible for the safety and health of MACTEC's employees and subcontractors. To meet this requirement, the Project Manager is responsible for the following activities regarding the MACTEC ALARA Program:

PROCEDURE NO: RPP-101	REVISION NO: 0	PAGE NO: 5 OF 19
-----------------------	----------------	------------------

- Establishes the Radiological Health and Safety Policy committing MACTEC to adherence to the ALARA Program.
- Ensures that appropriate authority, commitment, support, and resources are assigned to all levels of the organization to implement the ALARA Program and to achieve the approved goals.
- Appoints a chairperson for the ALARA Committee.
- Appoints members of the ALARA Committee.
- Approves or disapproves the implementation of recommendations forwarded by the ALARA Committee.

6.2.2 ALARA Committee Chairperson

- Reports directly to the Project Manager.
- Presides over the meetings, stimulates discussion, resolves conflicts, and has signature authority for the Committee.
- Consolidates ALARA goals from each work team leader to prepare the annual ALARA goals for MACTEC.
- Advises the Project Manager of the effectiveness of the ALARA Program based on overseeing and assessing Program implementation. Ensures that records are maintained on meetings and other formal discussions involving radiological safety issues.
- Votes in the event of a tie of the Committee.

6.2.3 ALARA Committee (AC)

- Provides ALARA oversight, assessment, and evaluation of work activities by active participation on the ALARA Committee.
- Approves or disapproves work activities that meet the review criteria of section 6.10.
- Establishes ALARA goals and indicators.
- Includes, the Radiation Safety Officer and a representative of management, line supervisors, and workers.
- Assesses and advises the Project Manager of the effectiveness of the ALARA efforts through committee involvement.

PROCEDURE NO: RPP-101	REVISION NO: 0	PAGE NO: 6 OF 19
-----------------------	----------------	------------------

- Makes recommendations to strengthen the ALARA Program.
- Meets quarterly, or as determined by the AC Chairperson, to review the status of the ALARA Program.

6.2.4 ALARA Committee Members

- Attends Committee meetings.
- Performs functions as assigned by the AC Chairperson.
- Specifies an alternate if the member is unable to attend a meeting. The alternate shall be responsible for performing the member's duties.
- Elicits support for the ALARA Program from all employees.
- Supports line and technical managers in effective implementation of the ALARA Program.
- Discusses work experiences, observations, and safety concerns at committee meetings.
- Requests special committee meeting when necessary.
- Makes recommendations to improve ALARA program.

6.2.5 Team Leaders

- Support and implement the ALARA program throughout their work assignment.
- Ensure that adequate resources are requested to support the ALARA Program within their work assignment.
- Establish ALARA goals for their work assignment.
- Encourage employee input into the ALARA Program.
- Pursue achievement of ALARA goals at the work assignment level programming work activities, reviewing personnel exposure against work performed, and incorporating ALARA principles in work activities.

6.2.6 Management

- Supports and implements the ALARA Program by encouraging participation in the Program by all MACTEC personnel.

- Initiates development of any necessary Programs or procedures for the implementation of ALARA Program Elements.
- Ensures that adequate resources are requested to support the ALARA Program within their management area.

6.2.7 Radiation Safety Officer (RSO)

- Maintains the authority and overall responsibility for the ALARA Program.
- Provides approval of special control levels and other administrative radiological controls, as appropriate.
- Coordinates the development, implementation, and documentation of the ALARA Program.
- Provides technical support and assistance to the AC and management for the implementation and documentation of the programmatic elements of the ALARA Program.
- Assesses the programmatic elements as promulgated in the ALARA Program.
- Informs the AC of the effectiveness of the program through review of incidents, dose reports, skin contaminations, and uptakes.
- Reviews quarterly dosimetry reports and initiates an evaluation of work activities when personnel doses exceed 10% of the occupational exposure limits.
- Performs ALARA review of each work package to include review of job safety analysis and instruction, type and level of contamination, likelihood of airborne radioactivity, contamination control, air flow and ventilation, need for air monitoring, respiratory protection, down draft units, and containment, PPE requirements, and any other radiological safety concern.
- Reviews and signs work package safety checklist.

6.2.8 Health Physicist (HP)

- Provides technical support and assistance to team leaders, programmers, and design engineers for the implementation and documentation of the radiological design and control elements of the ALARA Program.

- Provides support and technical direction through ALARA Program documents, ALARA Design Reviews, ALARA Job Reviews, and ALARA briefings.
- Prepares the ALARA Program assessment results for review by the AC.
- Encourages facility management and engineers to review available technology and develop new technology to minimize radiation dose and prevent the spread of radioactive contamination.
- Performs radiological surveillance as deemed necessary and establishes exposure/contamination controls in the work area.
- Prescribes protective requirements during radiological work to reduce occupational and public exposures and to prevent the spread of radioactive contamination and release of radioactive materials to the environment.

6.2.9 Radiological Control Technician (RCT) and Health Physics Technician (HPT)

- Assists program, facility, and service workers with implementing the compliance requirements specified in this Plan and its supplements.
- Fulfills the posting and monitoring requirements of this Plan.
- Informs workers and supervisors of actions or operations that are inconsistent with procedures or best management practices.
- Responds to radiological alarms, spills, accidents, and emergencies.

6.2.10 Design Engineers, Programmers, and Schedulers

- Incorporate radiological design considerations into designs for new nuclear facilities and for modifications to existing facilities to reduce exposure, prevent the spread of radioactive contamination, and to prevent a release of radioactive materials to the environment.
- Initiate ALARA Design Reviews if the potential radiological conditions exceed the trigger points for review.

6.2.11 Training Instructors/Developers

- Develops, maintains, and provides appropriate training courses to support the effective implementation of the ALARA Program.
- Develops and maintains a program for determining training requirements for employees with respect to ALARA Program implementation.

6.2.12 Radiological Workers

- Evaluate their work assignments and make recommendations for improvements to the ALARA Program.
- Minimize personal radiation exposure and the spread of radioactive contamination by adhering to all radiological safety requirements, reporting any radiological problems, and following established good work practices.
- Maintain the authority to prevent unsafe practices, to stop work, and to communicate to appropriate level of management any unsafe conditions and associated corrective actions.
- Notify the RSO or HP of diagnostic radiopharmaceutical and therapeutic medical radiation exposure.

6.3 Administrative Control Levels (ACLs)

The initial MACTEC ACL is established at 500 mrem (total effective dose equivalent) per year per person. A review of past performance, scheduled work, projected radiation dose levels, etc. shall be performed annually. Based on the results of this review, an ACL shall be established and approved by the AC and the Project Manager. Approval to exceed the MACTEC ACL requires the approval of the AC and the Project Manager. A record of the approval to exceed any ACL shall be included in the individual Radiological worker's radiation dose record file.

6.3.1 Lifetime Control Level

To administratively control a worker's lifetime occupational radiation exposure, a lifetime control level of N rem shall be established where N is the age of the person in years. Special consideration shall be made for those individuals who are already at their lifetime control level.

6.3.2 Visitor Dose Limits

Visitors shall be limited to an annual radiation dose of 0.100 rem TEDE, unless they qualify as trained radiological workers.

6.3.3 Embryo/Fetus Dose Limits

When a radiological worker voluntarily notifies her employer in writing that she is pregnant, then she is considered a Declared Pregnant Worker.

For the declared pregnant worker who decides to continue working as a radiological worker:

- The dose limit to the embryo/fetus for the entire gestation period is 0.500 rem TEDE.
- Efforts by management and the employee shall be made to avoid exceeding 0.050 rem/month TEDE.

If the dose to the embryo/fetus has already exceeded the 0.500 rem limit by the time declaration of the pregnancy has been made, then the worker shall not be assigned to tasks where additional occupational radiation exposure is likely during the remainder of the pregnancy.

The team leader may provide the option of a mutually agreeable assignment of work tasks without loss of pay or promotional opportunity, so that further radiation exposure is unlikely.

6.3.4 Special Exposure Controls

There may be situations in which exposure control levels should be lowered for certain individuals. The Project Manager should obtain advice concerning special exposure control levels from professionals in other organizations, as well as recommendations from the Radiation Safety Officer, medical, human resources, and legal personnel. A radiological health advisory group may be established.

Employees may have a special circumstance in which the establishment of special control levels is appropriate. A special control level for annual occupational exposure shall be established for each person with a lifetime occupational dose exceeding N rem, where N is the age of the person in years. A special control level shall not exceed 1 rem and should allow the person's lifetime occupational dose to approach N rem as additional occupational exposure is received. Background and therapeutic and diagnostic medical exposures shall not be included in either personnel radiation dose records or assessment of dose; however, a radiological worker undergoing radiation therapy may be considered for application of a special control level.

6.4 Performance Goals

6.4.1 ALARA Goals

ALARA goals and MACTEC success in achieving them are one measure of the effectiveness of the ALARA Program. Goals are established each year and should reflect past performance, the current year's workload, and projected radiation levels. Management should solicit employee input into developing these goals. Goals should be specific and measurable and should lead to thorough implementation.

PROCEDURE NO: RPP-101	REVISION NO: 0	PAGE NO: 11 OF 19
-----------------------	----------------	-------------------

These goals are prepared by the team leaders, consolidated by the AC Chairperson and shall be reviewed by the AC. The Project Manager has final approval authority for MACTEC's goals.

The following annual goal categories should be considered for inclusion as ALARA goals by the AC and the Project Manager:

- Annual collective effective dose equivalent (deep dose equivalent)
- Annual collective effective dose equivalent by work team (deep dose equivalent)
- Average worker annual effective dose equivalent (deep dose equivalent)
- Maximum annual effective dose equivalent to a worker (deep dose equivalent)
- Number of un-programmed exposures above the ACLs
- Number of positive bioassays
- Number of skin/clothing contaminations
- Number of area contaminations
- Volume and activity of radioactive waste generated in cubic feet and curies, respectively
- Number of radiological occurrence reports
- Activity of airborne radioactivity discharges in curies

6.4.2 ALARA Performance Indicators

Another method of evaluating the ALARA Program is to establish and monitor ALARA Performance Indicators.

The following radiological performance indicators should be considered by the AC annual tracking methods:

- Number of dose assessments for lost, damaged, or late returned dosimeters
- Number of airborne events
- Number of alarms on airborne monitors (actual and false)

- Number of Airborne Radioactivity Areas
- Area of Airborne Radioactivity Areas in square feet
- Number of Contamination and High Contamination Areas
- Area of Contamination Areas in square feet
- Area of High Contamination Areas in square feet
- Number of spills
- Number of cubic feet of radioactive waste not subject to volume reduction by compaction or other means
- Percentage of facility's square footage contaminated
- Radiological Deficiency Reports evaluated for trending purposes

6.5 ALARA Training

ALARA training and retraining shall be developed, documented, and conducted to ensure effective participation in implementing the ALARA Program. The objectives and content of the courses or modules shall be specific to the individual's job assignment, for example, radiological worker, RCT or HPT, design engineer and Programmer, and manager and team leader.

The focus of these training programs shall be to heighten individual awareness of ALARA and to inform personnel of their responsibilities with respect to the Program's implementation.

- All general employees who may enter a controlled area shall receive an orientation in radiation safety and ALARA philosophy within a month of their initial assignment to and prior to potential exposure to radiation at that facility. Retraining shall be provided when there is a significant change to radiation protection policies and procedures that affect general employees and shall be conducted at intervals not to exceed two years.
- Radiological worker training programs and retraining shall be established and conducted at intervals not to exceed two years to familiarize the worker with the fundamentals of radiation protection and the ALARA process.
- RCT and HPT training programs shall be established and conducted at intervals not to exceed two years to familiarize technicians with the

fundamentals of radiation protection and the proper procedures for maintain exposures ALARA.

- Specialized/mock-up training shall be provided for individuals performing work having high dose/contamination potential, non-routine operations, or work in areas with significantly changing radiological conditions. This is to ensure that problems are identified early and resolved, and that time is efficiently used in the radiation/contamination area.
- ALARA training shall be provided for engineering, scheduling, and procedure writing personnel to ensure ALARA considerations are included in the design, selection, placement, and modification of site activities.
- Radiological support personnel who are responsible for implementing the site ALARA program shall receive ALARA training.
- Management training shall be provided with emphasis on demonstrating the importance of each group's activities in establishing and managing ALARA Program goals. A thorough understanding of the MACTEC ALARA commitment and each employer's specific responsibilities is required of all management employees.

6.6 Programs and Procedures

In addition to this Program, formal procedures for applying the ALARA Program shall be developed and maintained when required. Operating procedures with radiological implications shall be reviewed in accordance with the procedure review process.

6.7 Internal Reviews/Audits

Internal audits of the ALARA Program shall be conducted at least once every three years. Audits shall be performed by Quality Assurance, and the results of the audits shall be directed to the AC for actions as appropriate.

6.8 Optimization Methodology

Decisions to expend resources that affect radiation dose and contamination reduction should optimize the costs and benefits in relation to social, technical, economic, practical, and public policy considerations. The optimization principle, including cost-benefit analysis, should be utilized in developing justification for various alternatives to reduce radiation dose and the spread of radioactivity. The level of effort involved in documenting ALARA decisions should be commensurate with the costs and potential dose savings to be realized.

Pre-programming of tasks having the potential for higher doses provides an opportunity to modify the task to provide maximum value from an ALARA perspective.

ALARA dose reduction proposals that are delayed shall be submitted to the AC for review and disposition.

6.9 Radiological Design Review

Modifications to existing nuclear facilities and design of new nuclear facilities shall incorporate features to reduce radiation dose and the spread of radioactive contamination to levels that are ALARA. All design work and work programming that could affect radiological conditions shall be reviewed by the RSO to ensure ALARA considerations have been factored into the work. The most cost-effective method of incorporating ALARA into new facilities and facility modifications is to include ALARA in the pre-programming efforts as described in the Work Control Process.

Minimization and control of internal and external exposure shall employ physical design features (e.g., confinement, ventilation, remote handling, and shielding) as the primary method of minimizing radiation exposure to workers and the public and releases of radioactive material to the environment.

For specific activities where use of physical design features is demonstrated to be impractical, administrative controls and procedural requirements shall be used to maintain radiation exposures ALARA.

During the design of new facilities or modification of old facilities, the following objectives shall be adopted:

- Optimization methods shall be used to assure that occupational exposure is maintained ALARA in developing and justifying facility design and physical controls.
- The design objective for controlling personnel exposure from external sources of radiation in areas of continuous occupational occupancy (2000 hours per year) shall be to maintain exposure levels below an average of 0.5 mrem per hour and as far below this average as is reasonably achievable. The design objectives for exposure rates for potential exposure to a radiological worker where occupancy differs from the above shall be ALARA and shall not exceed 20 percent of the applicable standards.
- Regarding the control of airborne radioactive material, the design objective shall be, under normal conditions, to avoid releases to the workplace atmosphere and in any situation, to control the inhalation of such material by workers to levels that are ALARA; confinement and ventilation shall normally be used.

- The design or modification of a facility and the selection of materials shall include features that facilitate operations, maintenance, decontamination, and decommissioning.

6.10 Radiological Work/Experiment Programming

All programmed work activities to be performed in Radiological Areas shall consider ALARA principles to ensure that radiation dose and the spread of radioactive contamination is minimized. The amount of review varies and is based upon the severity of risk. For this reason, a graded approach for performing job reviews is required:

- Radiological activities have an associated work package and work permit generated and reviewed by the ES&H organization, which specifies the radiological control requirements to safely perform that activity ALARA.
- ALARA concerns and issues shall be addressed and discussed with the work team by the RSO or HP for each work package.
- A safety-briefing checklist shall be annotated and signed by the RSO.
- Approval by the AC is required if, during development of the work package:
 - Individual dose estimate exceeds 100 mrem; Collective dose estimate exceeds 1 rem; Removable uranium contamination exceeds 150,000 dpm/100 cm²; Removable transuranic contamination exceeds 2,000 dpm/100 cm²; or Review is requested by the RSO or HP.
- For work activities that require approval by the AC, ongoing and post-job reviews are performed to assure proper implementation of the agreed upon ALARA controls, an evaluation of their effectiveness, and recommendations for further dose savings.

RCTs, HPTs, line supervision, and workers have the authority and responsibility to stop unsafe radiological work activities. Stoppage of work must be justified and exercised in a responsible manner. Radiological work activities may be stopped when radiological controls are inadequate, are not being implemented, or when a Radiological Control Point is not being satisfied.

Resumption of radiological work requires the approval of the Radiation Safety Officer or designee. The proper radiological controls must be reestablished.

PROCEDURE NO: RPP-101	REVISION NO: 0	PAGE NO: 16 OF 19
-----------------------	----------------	-------------------

6.11 Records

Records of ALARA goals/programs shall be maintained to demonstrate the adequacy of the ALARA Program. A formal radiological records management program shall be implemented for ALARA records. This program is to ensure that auditable records/reports are controlled.

7.0 DOSE REDUCTION METHODS

As part of the ALARA Program, radiation dose reduction techniques shall be incorporated into all aspects of normal Project operations. These methods shall provide a constant awareness of exposure to radiation sources and mechanisms to maintain continuous dose reduction.

Efforts in this area include the following:

- Work Permits, job briefings, radiological postings, Project/task specific Health and Safety Programs, and administrative controls will be used to minimize the time spent and the number of personnel entering controlled areas
- Work Permits are required for all activities performed inside an RA. Conflicts found between the work permit and any other written or verbal direction shall be resolved prior to starting or continuing with the work.
- Shielding may be utilized in various forms to provide a reduction of radiation exposure with minimal impact on worker productivity.
- Decontamination of Project areas and systems shall be an ongoing effort, which is aggressively pursued and closely monitored.
- Prefabrication and/or work relocation shall be used where practical to reduce time spent in radiation areas.
- Engineering controls to limit loose surface and airborne contamination at the source shall be used where practical to allow for improved work environments so that work in radiation areas can progress in a timely manner.
- The use of PPE or clothing beyond that prescribed by the RWP detracts from work performance and is contrary to ALARA principles and waste minimization practices.

- Radiological Incident Reports shall be used to internally document and track potential problems and will be used for trending purposes.

7.1 Dose Tracking

Individuals are responsible for knowing and minimizing their own radiation dose. Thermoluminescent dosimeters (TLDs), when issued, shall be processed quarterly for MACTEC employees. TLD results shall be provided to each employee. Tracking of personnel dose and comparing the dose to MACTEC ACL shall provide management and employees with the information necessary to make an assessment on activity programming.

7.2 Employee Suggestions

Radiological workers who perform the actual tasks are closest to the process and often have the best input on reducing radiation exposure. Employees are urged to submit suggestions to their management for dose minimization.

8.0 WASTE MINIMIZATION

A radioactive waste minimization program shall be in effect to reduce the generation of radioactive waste.

9.0 REFERENCES

10 CFR 20, Standards for Protection Against Radiation, January 1, 2001.

10 CFR 835, Occupational Radiation Protection, December 14, 1993.

U. S. Department of Energy Radiological Control Manual (DOE/EH-0256T), Rev. 1, April 1994.

DOE 5400.5, Radiation Protection of the Public and the Environment, February 8, 1990.

Implementation Guide for Use With Title 10, Code of Federal Regulations, Part 835, Occupational Radiation Protection, Occupational ALARA Program, G-10 CFR 835/B2-Rev. 1, November 1994.

International Commission on Radiological Protection, Publication 23, *Reference Man*.



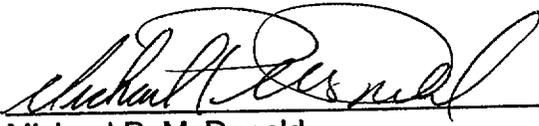


Procedure No: RPT-01

Issue No: 0

Effective Date: 1/02/02

RADIATION PROTECTION TRAINING OVERVIEW

Authored By:  12-13-01
Michael P. McDonald
Radiological Engineer
Date

Reviewed By:  12/20/01
Jeffrey W. Lively
Health Physicist
Date

Approved By:  12/21/01
Steven D. Rima
Radiological Engineering Manager
Date

This page intentionally left blank.

RADIATION PROTECTION TRAINING OVERVIEW

1.0 PURPOSE

- 1.1 This procedure provides an overview of the MACTEC Radiation Protection Training program, including its performance objectives, project activities, and training staff qualification requirements.

2.0 APPLICABILITY

- 2.1 This procedure applies to MACTEC, Inc. management, supervisors, individuals and contractors that develop, implement, and maintain the Radiation Protection Training program.

3.0 REFERENCES

- 3.1 MACTEC, Inc., "Corporate Radiation Protection Program Document."
3.2 10 CFR 20, "Standards for Protection Against Radiation."
3.3 10 CFR 835, "Occupational Radiation Protection."

4.0 DEFINITIONS AND ABBREVIATIONS

Not applicable

5.0 GENERAL

5.1 EQUIPMENT

Not applicable

5.2 SAFETY CONSIDERATIONS

Not applicable

5.3 RESPONSIBILITIES

5.3.1 Radiological Engineering Manager (or designee):

- Implement this procedure.
- Develop and implement a Radiological Training Program for Radiological and non-Radiological Workers.
- Allocate adequate staffing, budget, and space for radiological training activities.

- Review and approve radiological training materials.
- Ensure that non-radiological workers complete General Radiological Worker Training (GERT), as applicable.
- Ensure that radiological workers complete Radiological Worker Training (RWT).
- Ensure that radiological workers and Health Physics Staff receive appropriate job-specific radiological training, as applicable.

5.3.2 Radiological Training Specialist/Radiological Engineer

- Developing Radiological Worker Training course material, including examinations, lesson plans, etc.
- Conduct assigned Radiation Protection Training classes.

5.3.3 Health Physics Staff

- Complete required training and qualifications.
- Maintain HPT qualifications while performing work as an HPT.

5.3.4 Radiological Workers

- Complete required radiological worker training as prescribed by this procedure and as required by the RSO.
- Have a current radiological worker qualification card while performing work in radiologically controlled areas.

5.3.4 Non-radiological Workers

- Complete General Radiological Worker Training (GERT), as applicable.

5.4 PREREQUISITES

Not applicable

5.5 RECORDS

Not applicable

5.6 PRECAUTIONS AND LIMITATIONS

Not applicable

PROCEDURE NO: RPT-01	REVISION NO: 0	PAGE NO: 2 OF 5
----------------------	----------------	-----------------

5.7 REVISIONS

5.7.1 This procedure shall be reviewed at least every two years, with documentation to support the completion of such review.

5.8 OTHER

Not applicable

5.9 ATTACHMENTS

Attachment 1 - Radiation Protection Training Charter

6.0 PROCEDURE

6.1 PERFORMANCE OBJECTIVES

- 6.1.1 The primary training performance objective of the MACTEC, Inc. Radiological Engineering Department is to implement a high quality Radiation Protection Training program that not only meets the requirements established by our regulators, but also enhances worker safety and awareness at all MACTEC work locations and complements the overall Radiation Protection program.
- 6.1.2 Radiation Protection Training (RPT) courses and materials are to be developed with the student in mind; courses should both challenge and enlighten students, and should enhance overall job performance.
- 6.1.3 All activities performed and decisions/commitments made by the Radiological Engineering Department are to be evaluated for appropriateness and consistency with the Radiation Protection Training Charter, Mission, Vision, and Values statements (Attachment 1).

6.2 PROJECT ACTIVITIES

- 6.2.1 MACTEC's Radiological Engineering Department is responsible for the development, maintenance, and conduct of radiological training courses required to ensure compliance with regulatory requirements. These radiological training courses include:

- General Employee Radiological Training (GERT)
- Radiological Worker Training (RWT)
- Health Physics Technician (HPT)/Radiological Control Technician (RCT) Training & Qualification

NOTE: Training and qualification of contractor personnel (e.g., radiation monitor type personnel hired to perform routine, rudimentary, low risk tasks) on the performance of specific/limited tasks to be performed, and the related procedures and instruments to be used, may be provided by the respective contractor companies, provided that their training is consistent with all applicable MACTEC, Inc. Radiation Protection Training procedures.

- 6.2.2 MACTEC's Radiological Engineering Department develops, implements, and maintains additional radiological training courses (as needed, or required) on a variety of radiation safety topics. Examples of such courses include:

- Portable Survey Instrument Training;
- Radiation-Generating Device Safety Training

6.3 TRAINING STAFF QUALIFICATIONS

6.3.1 The Radiological Engineering Manager should have formal training and experience in the design/development of training materials, as well as in the conduct of training. The Radiological Engineering Manager should complete at least 40 hours of health physics (or related) continuing education each year.

6.3.2 The Radiological Training Specialist/Radiological Engineer should have formal training and experience in the design/development of training materials, as well as in the conduct of training. The Radiological Training Specialist/Radiological Engineer should complete at least 40 hours of health physics (or related) continuing education each year.

RADIATION PROTECTION TRAINING CHARTER

MISSION: To provide effective, quality radiation protection training through teamwork and integrity.

VISION: To be recognized as a provider of quality radiation protection training in the industry.

VALUES: Quality

- Exceed customer requirements for performance, cost, and schedule
- Plan for and achieve continuous improvement

Leadership

- Anticipate radiation protection training needs of the customer
- Execute innovative and integrated radiological training solutions; encourage creativity, innovation, and initiative among all participants
- Have the courage to challenge established norms
- Display the attributes of an organization driven to provide the best; have a passion for excellence and success in all endeavors

Respect for the Individual

- Trust and empower the individual
- Value individuality and diversity
- Expect, encourage, and reward accomplishment

Teamwork

- Create an environment of mutual benefits and respect
- Establish an atmosphere of open, honest, and constructive communication

Integrity

- Foster an environment of: Honesty, Objectivity, Fairness, Dependability, Candor, and Ethical conduct.



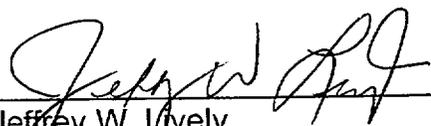
Procedure No: RPT-02

Issue No: 1

Effective Date: 9-1-02

RADIOLOGICAL WORKER TRAINING

Authorized By:  8-19-02
Michael P. McDonald Date
Radiological Engineer

Reviewed By:  8/20/02
Jeffrey W. Lively Date
Health Physicist

Approved By:  *CHP* 8/20/02
Steven D. Rima Date
Radiological Engineering Manager

This page intentionally left blank.

RADIOLOGICAL WORKER TRAINING

1.0 PURPOSE

1.1 The purpose of this procedure is to implement the requirements of the Radiological Worker Training Program. This procedure describes how MACTEC, Inc. radiological workers are to be trained and retrained in the fundamentals of radiation protection and the ALARA process. Radiological Worker Training consists of two components: General Employee Radiological Training (GERT) and Radiological Worker Training (RWT).

2.0 APPLICABILITY

2.1 This procedure applies to MACTEC, Inc. management, supervisors, individuals and contractors that work in radiologically controlled areas, handle radioactive materials, or may be exposed to ionizing radiation where their work assignment is controlled by MACTEC, Inc.

3.0 REFERENCES

- 3.1 MACTEC, Inc., "Corporate Radiation Protection Program Document."
- 3.2 MACTEC, Inc., RPT-05 "Administration and Control of Radiation Protection Training Examinations."
- 3.3 10 CFR 20, "Standards for Protection Against Radiation."
- 3.4 10 CFR 835, "Occupational Radiation Protection."

4.0 DEFINITIONS AND ABBREVIATIONS

- 4.1 Radiologically Controlled Area - Any area to which access is controlled for the protection of individuals from exposure to radiation and radioactive materials.
- 4.2 Radioactive Material Area - Any area or room in which there is used or stored an amount of licensed material exceeding 10x the amount specified in Appendix C of 10 CFR 20.

5.0 GENERAL

5.1 EQUIPMENT

- 5.1.1 Personnel protective clothing, tape, bags, etc. (for demonstration purposes)
- 5.1.2 Simulated contamination and related detection devices

PROCEDURE NO: RPT-02	REVISION NO: 1	PAGE NO: 1 OF 14
----------------------	----------------	------------------

- 5.1.3 Simulated radiation and related detection devices
- 5.1.4 Various personnel dosimeters (for demonstration purposes)
- 5.1.5 Miscellaneous classroom training materials (e.g., lesson plans, computer, desktop projector, student handouts)

5.2 SAFETY CONSIDERATIONS

Not applicable

5.3 RESPONSIBILITIES

5.3.1 The Radiological Engineering Manager, or designee, shall be responsible:

- a. for the development and implementation of RWT;
- b. for the day-to-day conduct, oversight, and coordination of RWT;
- c. to ensure instructors used for the presentation of RWT are appropriately qualified; and
- d. for the review and approval of Radiation Protection Training materials.

5.3.2 Radiological Training Specialists/Radiological Engineers shall be responsible for developing Radiological Worker Training course material, including examinations, lesson plans, etc. Radiological Training Specialists/Radiological Engineers shall also be responsible for conducting assigned Radiation Protection Training classes.

5.4 PREREQUISITES

5.4.1 Students should be proficient in written and verbal English, as most radiological hazard postings and labels are presented in English. Training material and training instruction is normally presented in English as well. When a student is not proficient in English (written and verbal), special arrangements will need to be made prior to training participation.

5.5 RECORDS

- 5.5.1 Radiation Protection Training records are generated during the process of implementing this procedure. The original copy of the records is the record copy. The record copy shall be stored, arranged, indexed, retained, retrieved, and disposed of in accordance with this procedure and all applicable regulatory requirements.
- 5.5.2 All RWT student records (including class rosters, completed examinations, examination scores, and practical exercise evaluations) shall be maintained by MACTEC, Inc.
- 5.5.3 Radiological Worker Qualification Card shall be issued to those students who complete all required training for qualification.
- 5.5.4 Copies of the training records may be made for information purposes only.

5.6 PRECAUTIONS AND LIMITATIONS

Not applicable

5.7 REVISIONS

- 5.7.1 This procedure shall be reviewed at least every two years, with documentation to support the completion of such review.

5.8 OTHER

Not applicable

5.9 ATTACHMENTS

Attachment 1 - Radiological Worker Applied Training Evaluation Form

Attachment 2 - Procedure-Specific Training Completion Record

Attachment 3 - Radiological Training Requirements List

Attachment 4 - Radiological Worker Qualification Card

Attachment 5 - Regulatory Guide 8.13, Instruction Concerning Prenatal Radiation Exposure

Attachment 6 - Declaration of Pregnancy Letter

6.0 PROCEDURE

6.1 GENERAL REQUIREMENTS

6.1.1 Radiological Workers shall complete RWT prior to:

- a. unescorted access to radiologically controlled areas;
- b. occupational exposure to ionizing radiation;
- c. performing unescorted assignments as Radiological Workers.

6.1.2 RWT course material shall include:

- a. standardized GERT material;
- b. standardized RWT material; and
- c. applicable specific training material (e.g., site radiological emergency response procedures).

6.1.3 All training requirements commensurate with the hazard(s) within posted radiologically controlled areas shall be completed before personnel are allowed unescorted access to radiologically controlled areas.

6.1.4 RWT shall consist of a classroom-based (i.e., instructor-lead) or computer-based academic portion and an applied (i.e., hands-on, performance-based training) portion.

6.1.5 Personnel shall successfully complete an examination at the conclusion of the academic training portion. Personnel shall then successfully complete the applied (hands-on training) portion to become qualified as a Radiological Worker and obtain a Radiological Worker Qualification Card (Attachment 4).

6.1.6 Personnel who have not successfully completed RWT, or who fail to maintain their training qualifications, shall be restricted from all activities, tasks, or duties involving radiological hazards or requiring unescorted access to radiologically controlled areas.

6.1.7 Remedial actions for individuals failing to meet passing standards for either portion of RWT include re-taking the examination, repeating the training program, and/or being restricted from radiological work duties.

6.1.8 All unescorted radiological workers shall complete appropriate job-specific radiological training. This training shall include, as a minimum, reading all technical work documents applicable to work assignments.

6.1.9 RWT may be waived provided that:

- a. the training has been received at another comparable site or facility within the past 2 years;
- b. there is provision of proof-of-training in the form of a certification document containing the individual's name, date of training, and specific topics covered; and
- c. the Radiological Engineering Manager, (or designee) has certified the training of the individual, and granted qualification.

6.1.10 Due to the fact that most radiological hazard postings and labels are created using English, all MACTEC, Inc. Radiation Protection Training materials (e.g., viewgraphs, student handouts, examinations) should be written/presented in English as well.

6.1.11 Personnel who hold current qualifications as either a Health Physics Technician or a Radiological Control Technician satisfy the training requirements for both GERT and RWT.

6.2 RADIOLOGICAL WORKER TRAINING

6.2.1 RWT is required for personnel:

- a. that use, or work with, radioactive material;
- b. that operate or use of devices, equipment, etc., that contain accessible radioactive material;
- c. whose job assignments involve the transport of radioactive material;
- d. whose job assignments require receiving more than 100 mrem in a year from occupational exposure;
- e. directly involved with the modification of, or invasive maintenance on, equipment containing normally inaccessible radioactive material;
- f. whose work involves direct contact with radioactive material that could result in contamination of the worker or property; and/or
- g. whose job assignments require unescorted access to radiologically controlled areas (Attachment 3).

6.2.2 The minimum core topics to be addressed in MACTEC's RWT course shall include:

PROCEDURE NO: RPT-02	REVISION NO: 1	PAGE NO: 5 OF 14
----------------------	----------------	------------------

a. Radiological Fundamentals:

- Identify the three basic parts of an atom;
- Define the terms ionization, ionizing radiation, radioactive material, and radioactive contamination;
- Distinguish between ionizing radiation and non-ionizing radiation;
- Define the terms radioactivity and radioactive half-life;
- Identify the characteristics of the four major types of radiation;
- Identify the units used to measure radiation and radioactivity;
- Convert rem to millirem, and millirem to rem; and
- Identify some typical sources of ionizing radiation.

b. Biological Effects of Radiation:

- Identify the average annual dose equivalent received by the general population from natural background and man-made sources;
- Identify the major sources of natural background and man-made radiation;
- State the method by which radiation causes damage to cells;
- Identify the possible effects of radiation on cells;
- Define the terms "Acute Dose" and "Chronic Dose";
- State examples of Chronic Radiation Dose;
- Define the terms "Somatic Effect" and "Heritable Effect";
- State the potential effects associated with prenatal radiation doses; and
- Compare the biological risks from chronic radiation doses to health risks workers are subjected to in industry and daily life.

c. Radiation Limits:

- Identify the applicable radiation dose limits and administrative control levels;

- State MACTEC's policy concerning prenatal exposure to radiation;
- Identify the employee's responsibilities concerning radiation dose limits and administrative control levels; and
- Describe the actions a worker should take if he/she suspects that dose limits or administrative control levels are being approached or exceeded.

d. ALARA Program:

- State the ALARA concept;
- State the MACTEC management policy regarding the ALARA program;
- Identify the responsibilities of the MACTEC Radiological Engineering Department;
- Identify the responsibilities of management, radiological control personnel and the Radiological Worker regarding the MACTEC ALARA program;
- Identify the basic protective measures of time, distance, and shielding;
- Identify methods for reducing external and internal radiation dose;
- State the pathways through which radioactive material can enter the body; and
- Identify methods a Radiological Worker can use to minimize radioactive waste.

e. Personnel Monitoring Programs:

- State the purpose of each of the personnel dosimetry devices used;
- Identify the correct use of each of the personnel dosimetry devices used;
- State the purpose of each type of internal monitoring method used;
- Identify worker responsibilities concerning the internal dosimetry program;
- State the method for obtaining radiation dose records; and

PROCEDURE NO: RPT-02	REVISION NO: 1	PAGE NO: 7 OF 14
----------------------	----------------	------------------

- Identify worker responsibilities for reporting dose received at other sites and from medical applications.
 - Identify worker responsibilities for requesting dose records.
- f. Radiological Postings and Controls:
- State the purpose of and information found on Radiological Work Permits (RWPs);
 - Identify the individual's responsibilities in using RWPs;
 - Identify the colors/symbols used on radiological postings, signs, and labels;
 - Define all types of Radiation, Contamination, Airborne Radioactivity, and Radioactive Material Areas;
 - State the requirements for entry into, working within, and exiting from each area controlled for radiological purposes;
 - State the radiological and disciplinary consequences of disregarding radiological postings, signs, or labels;
 - State the radiological and disciplinary consequences of unauthorized removal or relocation of radiological postings, signs, or labels; and
 - Explain the purpose and use of personnel contamination monitors.
- g. Contamination Controls:
- Define fixed, removable, and airborne contamination;
 - State sources of radioactive contamination;
 - State the appropriate response to indicators of potential area contamination or personnel contamination alarms;
 - Identify methods used to control radioactive contamination;
 - Identify the proper use of protective clothing;
 - Explain the purpose and use of personnel contamination monitors;
 - Identify the normal methods used for decontamination;
- h. High Radiation Area Controls:

PROCEDURE NO: RPT-02	REVISION NO: 1	PAGE NO: 8 OF 14
----------------------	----------------	------------------

- Identify the signs and postings used for High and Very High Radiation Areas;
 - Identify site-specific sources and locations that may produce High and Very High Radiation Areas;
 - State the requirements for entering, working in, and exiting from High and Very High Radiation Areas;
 - State the administrative and physical controls for access to High and Very High Radiation Areas;
 - Identify the correct responses to emergencies and/or alarms within High and Very High Radiation Areas; and
 - Identify the correct methods for interpreting radiation surveys.
- i. Radiological Emergencies:
- State the purpose(s) and type(s) of emergency alarms;
 - Identify the correct responses to emergencies and/or alarms;
 - State the possible consequences of disregarding radiological alarms; and
 - State the administrative occupational emergency radiation dose equivalent limits, as applicable.
- j. Site-specific information provided in RWT should include (as applicable):
- Sources of radiation;
 - Sources of radioactive materials or contamination;
 - Contamination monitoring equipment;
 - Radiation protection policies and procedures;
 - Radiation safety practices; and
 - Proper response to radiological alarms and abnormal conditions.

6.2.3 Additional site-specific radiological worker training, required by the individual's department manager and presented in-house, shall be recorded on Attachment 2.

PROCEDURE NO: RPT-02	REVISION NO: 1	PAGE NO: 9 OF 14
----------------------	----------------	------------------

6.3 APPLIED TRAINING

- 6.3.1 Upon successful completion of the academic portion of RWT (either classroom or computer-based), personnel shall complete applied ("hands-on") training.
- 6.3.2 Applied training should be structured to be as realistic as possible to situations and radiological conditions that could be encountered in radiologically controlled areas. Every effort should be made to provide an area, equipment, tools, instruments, etc., that will enhance the realism of the exercise.
- 6.3.3 Applied training shall include the following specific performance measures, as a minimum:

- a. Reviewing a Radiological Work Permit (RWP).

NOTE: RWPs shall be supplied to students prior to the start of their exercises, and shall be appropriate for the selected area(s) and task(s).

- b. Recording appropriate information on the RWP.
- c. Selecting and donning required protective clothing and/or dosimeter(s), as appropriate.
- d. Performing operational checks of radiation survey instruments, as appropriate.
- e. Entering the simulated area(s), and demonstrating ALARA techniques and contamination control practices, as appropriate, while performing an assigned task;

NOTE: Based on the area(s) being used for the exercise, available equipment, RWP requirements, and the normal work assignments of the student(s), the instructor should direct the student(s) to perform activities in the exercise area commensurate with normal job duties.

- f. Responding to a simulated abnormal condition, as appropriate;
- g. Responding to a simulated or actual radiological alarm, as appropriate; and
- h. Removing protective clothing and monitoring for contamination, as appropriate.

NOTE: Upon completion of simulated work activities, the students shall remove protective clothing and dosimeter(s) and exit the area using techniques taught in class. Upon exiting, self-frisking for contamination shall be performed as required by the RWP. This monitoring may be done

using simulated instrument readings from the instructor, or some form of artificial radioactive contamination and appropriate detection instruments.

WARNING: In no case shall actual radioactive contamination be used for the purposes of this exercise.

6.4 STUDENT EVALUATIONS

6.4.1 Academic Training

- a. Personnel must successfully complete a written and/or computer-based examination at the conclusion of their academic training prior to performing the applied training exercise.
- b. Examinations shall test for comprehension and shall cover both core course material and site-specific information.
- c. All core topic objectives shall be tested.
- d. Examinations should address both normal and abnormal situations in radiological control.
- e. The minimum passing score for the examination shall be 80%. Individuals that score < 80%, but $\geq 70\%$ may re-take the examination. Individuals that score < 70% must re-take the class.
- f. Examinations shall be conducted in accordance with Reference 3.2.

6.4.2 Applied Training

- a. Instructor observation and evaluation shall be used to determine a student's successful completion of the applied portion of each course. The minimum passing score shall be 80%.
- b. Applied Training Exercise Evaluation form (Attachment 1) shall be used to document the instructors' evaluations of applied training exercise.
- c. A separate evaluation form shall be used for each student performing the applied training exercise.
- d. During the evaluation phase, the instructor/evaluator (or trainee) is only permitted to answer (or ask) questions related to actual learning objectives that require this type of action.

- e. Even though the evaluation is broken into steps, the instructor should evaluate the entire applied training exercise as a whole. This permits the student to correct any mistakes in a reasonable time frame.
- f. The following category shall be used to determine unacceptable actions (i.e., mistakes). A significant mistake is one that involves:
- violating instructions in such a manner that would lead to unnecessary radiation dose received by a worker;
 - violating instructions in such a manner that contamination would spread to personnel or outside of boundaries; and/or
 - jeopardizing radiological safety and/or creating a radiological hazard.
- g. An automatic failure shall be recorded if a significant mistake is made that is NOT identified by the student.
- h. The instructor/evaluator shall observe the student's actions and record points applicable to each item on the evaluation form. The following guidelines should be used to determine point scoring:
- Full credit shall be given for actions performed properly;
 - Full credit shall be given if a non-significant mistake is committed and is identified by the student;
 - No credit shall be given if a non-significant mistake is committed and not identified by the student;
 - No credit shall be given if a significant mistake is committed and is identified by the student; and

NOTE: If a significant mistake is committed and is not identified by the student, an automatic failure shall be recorded. In this case the exercise should proceed to completion in order to give the student practice even though a failure of the practical factor exercise will be recorded.

- i. Upon completion of the applied training exercise, the instructor/evaluator shall inform the student of the point score obtained. The instructor/evaluator should review the actual evaluation form with the student, paying particular attention to the item(s) that the student completed unsatisfactorily. The student should be given the opportunity to ask questions about the exercise.

- j. Both the student and the instructor/evaluator should sign and date the evaluation form upon completion of the applied training exercise.
- k. Personnel who score < 80% on the applied training exercise shall be required to re-take the applied portion, or be restricted from radiological work duties until remedial actions have been completed.

6.5 CHALLENGE EXAMINATIONS

6.5.1 Radiological workers may challenge the standardized, core knowledge requirements of RWT by passing an appropriate comprehensive examination.

- a. Challenge examinations may be given based upon previous RWT, and/or education/experience in radiological protection.
- b. Challenge examinations may be more difficult or longer than regular class examinations, since classroom attendance provides learning comprehension that challenge examinations can not.
- c. Challenge examinations should vary from examinations used during classroom instruction.

6.5.2 If a candidate is unsuccessful in one attempt at taking the challenge examination, the entire RWT course shall be completed.

6.5.3 Challenges do not apply to site-specific academic training portions.

6.6 RETRAINING

6.6.1 After completion of initial RWT, Radiological Workers shall be required to complete a retraining program every 2 years (maximum) to maintain qualification. Successful completion of initial RWT may be substituted for retraining.

6.6.2 Retraining should include selected fundamentals of the initial training with emphasis on seldom-used knowledge and skills.

6.6.3 Retraining should include the initial core course material, and be tailored to subjects for which trainee evaluations, experience, or other evidence indicate that special emphasis and depth of coverage is needed.

6.6.4 Radiological Worker Retraining shall include a written and/or computer-based examination similar in detail to initial training, and an appropriate applied training exercise.

PROCEDURE NO: RPT-02	REVISION NO: 1	PAGE NO: 13 OF 14
----------------------	----------------	-------------------

6.6.5 Examinations should stress frequently used information, rather than infrequently used theoretical knowledge, and should test for retention of important site-specific information.

6.7 USE OF ESCORTS IN LIEU OF TRAINING

6.7.1 Under certain conditions and restrictions, constant escort by a suitably trained individual may be used in lieu of training (e.g., for contractors, roving personnel, visitors, and tours) for access to radiologically controlled areas, as well as for the performance of some radiological work activities.

6.7.2 MACTEC managers/supervisors may choose to use escorts in lieu of training for contractors, roving personnel, visitors, and tours under the following conditions:

- a. Personnel with GERT training may access radiation areas without RWT provided that they are under full-time escort by personnel with appropriate RWT, and provided that the access does not require the worker to perform radiological work.
- b. Personnel without GERT or RWT training qualifications may use escorts in lieu of training provided that the manager/supervisor obtains concurrence by the MACTEC Radiological Engineering Manager (or representative RSO/Radiological Engineer).

6.7.3 When an escort is used in lieu of training, the escort shall:

- a. Complete all radiological training requirements applicable to the area(s) to be entered and the work to be performed.
- b. Ensure that all escorted individuals comply with all RWP requirements.

6.7.4 Escorting, in lieu of training shall only be used when:

- a. escorted individuals will enter the areas for a short period of time (i.e., a few hours).
- b. the presence of an escort will provide for an adequate level of safety.
- c. the presence of an escort will be consistent with the ALARA philosophy.

RADIOLOGICAL WORKER APPLIED TRAINING EVALUATION FORM

Name: _____ SSN: _____ Date: _____

Item Evaluated	Pt. Value	Score	Comments
Stated Purpose of Entry	3		
Stated Radiation Level(s) in Area with Correct Units	3		
Stated Contamination Level(s) in Area with Correct Units	3		
Stated Special Instructions Listed on the RWP	3		
Selected Protective Clothing per the RWP	3		
Donned Protective Clothing Properly	5		
Dosimetry Worn Properly	5		
Signed in on RWP Prior to Entry	3		
Entered only Areas Allowed by RWP and/or Postings*	10		
Avoided Hot Spots/High Dose Rate Areas	3		
Completed Task as per RWP	3		
Demonstrated Appropriate Actions for Radiological Alarms*	10		
Removed Dosimetry; Placed on SOP	2		
Removed Protective Clothing*	10		
Removed Shoe Covers; Stepping on SOP Only	2		
Placed Protective Clothing into Proper Collection Receptacles	2		
Verified Frisker Operation	3		
Maintained Proper Speed and Distance During Frisking*	10		
Returned Frisker Probe to Proper Position	2		
Re-surveyed Area When Count Rate Increased (if applicable)	2		
Took Proper Actions if Frisker Alarmed (if applicable)*	10		
Signed out on RWP	3		
An Unidentified Significant Mistake is an action that violates instructions leading to spread of contamination outside of area or to personnel, to unnecessary radiation exposure to worker, jeopardizing personnel safety, or creating a radiological hazard. DEDUCT 21 PTS	Maximum Possible Score: 100	Actual Score	PASS FAIL (circle one)
Additional Written Comments: (comments are required for any significant mistake, or a failure)			
By my signature I verify that I was instructed on the proper performance of any item(s) completed unsatisfactorily, I had the opportunity to ask questions about the practical exercise and I understand my final score.			
Student Signature: _____		Date: _____	
Instructor Signature: _____		Date: _____	

NOTE: If any step is not applicable, note N/A in the Score column and award the full points for that item. Note in the comments section the reason for the item's non-applicability.

* items indicate automatic failure if a mistake is made and not caught by student.

Form RPT-02-1-1

RADIOLOGICAL TRAINING REQUIREMENTS LIST

Affected Personnel/Activity	Minimum Training Required
Access to Radiologically Controlled Areas	GERT
Access to Radioactive Material Areas	GERT
Access to Radiation Areas	RWT
Access to High Radiation and Very High Radiation Areas	RWT
Access to Contamination Areas	RWT
Access to Airborne Radioactivity Areas	RWT
Access to Fixed Contamination Areas to perform work that disturbs fixed contamination	RWT
Radiological emergency response team members	RWT
Users of radioactive sources or material: <ul style="list-style-type: none"> • Accessible radioactive material • Inaccessible radioactive material 	RWT GERT
Personnel who transport radioactive material:	RWT

RADIOLOGICAL WORKER QUALIFICATION CARD

Front of Card

R W T	 MACTEC, Inc.	Expires on:
	Jane Smith 522-02-1234	07
	Approved By: _____	30
Date Issued: 8/19/2002		03

PROCEDURE NO: RPT-02

ISSUE NO: 1

ATTACHMENT 4
PAGE NO: 1 OF 1

Regulatory Guide 8.13
Instruction Concerning Prenatal Radiation Exposure

(Draft issued as DG-8014)

1

A. INTRODUCTION

The Code of Federal Regulations in 10 CFR Part 19, "Notices, Instructions and Reports to Workers: Inspection and Investigations," in Section 19.12, "Instructions to Workers," requires instruction in "the health protection problems associated with exposure to radiation and/or radioactive material, in precautions or procedures to minimize exposure, and in the purposes and functions of protective devices employed." The instructions must be "commensurate with potential radiological health protection problems present in the work place."

The Nuclear Regulatory Commission's (NRC's) regulations on radiation protection are specified in 10 CFR Part 20, "Standards for Protection Against Radiation"; and Section 20.1208, "Dose to an Embryo/Fetus," requires licensees to "ensure that the dose to an embryo/fetus during the entire pregnancy, due to occupational exposure of a declared pregnant woman, does not exceed 0.5 rem (5 mSv)." Section 20.1208 also requires licensees to "make efforts to avoid substantial variation above a uniform monthly exposure rate to a declared pregnant woman." A declared pregnant woman is defined in 10 CFR 20.1003 as a woman who has voluntarily informed her employer, in writing, of her pregnancy and the estimated date of conception.

This regulatory guide is intended to provide information to pregnant women, and other personnel, to help them make decisions regarding radiation exposure during pregnancy. This Regulatory Guide 8.13 supplements Regulatory Guide 8.29, "Instruction Concerning Risks from Occupational Radiation Exposure" (Ref. 1), which contains a broad discussion of the risks from exposure to ionizing radiation.

Other sections of the NRC's regulations also specify requirements for monitoring external and internal occupational dose to a declared pregnant woman. In 10 CFR 20.1502, "Conditions Requiring Individual Monitoring of External and Internal Occupational Dose," licensees are required to monitor the occupational dose to a declared pregnant woman, using an individual monitoring device, if it is likely that the declared pregnant woman will receive, from external sources, a deep dose equivalent in excess of 0.1 rem (1 mSv). According to Paragraph (e) of 10 CFR 20.2106, "Records of Individual Monitoring Results," the licensee must maintain records of dose to an embryo/fetus if monitoring was required, and the records of dose to the embryo/fetus must be kept with the records of dose to the declared pregnant woman. The declaration of pregnancy must be kept on file, but may be maintained separately from the dose records. The licensee must retain the required form or record until the Commission terminates each pertinent license requiring the record.

PROCEDURE NO: RPT-02	ISSUE NO: 1	ATTACHMENT 5 PAGE NO: 1 OF 9
----------------------	-------------	---------------------------------

The information collections in this regulatory guide are covered by the requirements of 10 CFR Parts 19 or 20, which were approved by the Office of Management and Budget, approval numbers 3150-0044 and 3150-0014, respectively. The NRC may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

B. DISCUSSION

As discussed in Regulatory Guide 8.29 (Ref. 1), exposure to any level of radiation is assumed to carry with it a certain amount of risk. In the absence of scientific certainty regarding the relationship between low dose exposure and health effects, and as a conservative assumption for radiation protection purposes, the scientific community generally assumes that any exposure to ionizing radiation may cause undesirable biological effects and that the likelihood of these effects increases as the dose increases. At the occupational dose limit for the whole body of 5 rem (50 mSv) per year, the risk is believed to be very low.

The magnitude of risk of childhood cancer following in utero exposure is uncertain in that both negative and positive studies have been reported. The data from these studies "are consistent with a lifetime cancer risk resulting from exposure during gestation which is two to three times that for the adult" (NCRP Report No. 116, Ref. 2). The NRC has reviewed the available scientific literature and has concluded that the 0.5 rem (5 mSv) limit specified in 10 CFR 20.1208 provides an adequate margin of protection for the embryo/fetus. This dose limit reflects the desire to limit the total lifetime risk of leukemia and other cancers associated with radiation exposure during pregnancy.

In order for a pregnant worker to take advantage of the lower exposure limit and dose monitoring provisions specified in 10 CFR Part 20, the woman must declare her pregnancy in writing to the licensee. A form letter for declaring pregnancy is provided in this guide or the licensee may use its own form letter for declaring pregnancy. A separate written declaration should be submitted for each pregnancy.

C. REGULATORY POSITION

1. Who Should Receive Instruction

Female workers who require training under 10 CFR 19.12 should be provided with the information contained in this guide. In addition to the information contained in Regulatory Guide 8.29 (Ref. 1), this information may be included as part of the training required under 10 CFR 19.12.

2. Providing Instruction

The occupational worker may be given a copy of this guide with its Appendix, an explanation of the contents of the guide, and an opportunity to ask questions and request additional information. The information in this guide and Appendix should also be provided to any worker or supervisor who may be affected by a declaration of pregnancy or who may have to take some action in response to such a declaration. Classroom instruction may supplement the written information. If the licensee provides classroom instruction, the instructor should have some knowledge of the biological effects of radiation to be able to answer questions that may go beyond the information provided in this guide. Videotaped presentations may be used for classroom instruction. Regardless of whether the licensee provides classroom training, the licensee should

PROCEDURE NO: RPT-02	ISSUE NO: 1	ATTACHMENT 5 PAGE NO: 2 OF 9
----------------------	-------------	---------------------------------

give workers the opportunity to ask questions about information contained in this Regulatory Guide 8.13. The licensee may take credit for instruction that the worker has received within the past year at other licensed facilities or in other courses or training.

3. Licensee's Policy on Declared Pregnant Women

The instruction provided should describe the licensee's specific policy on declared pregnant women, including how those policies may affect a woman's work situation. In particular, the instruction should include a description of the licensee's policies, if any, that may affect the declared pregnant woman's work situation after she has filed a written declaration of pregnancy consistent with 10 CFR 20.1208.

The instruction should also identify who to contact for additional information as well as identify who should receive the written declaration of pregnancy. The recipient of the woman's declaration may be identified by name (e.g., John Smith), position (e.g., immediate supervisor, the radiation safety officer), or department (e.g., the personnel department).

4. Duration of Lower Dose Limits for the Embryo/Fetus

The lower dose limit for the embryo/fetus should remain in effect until the woman withdraws the declaration in writing or the woman is no longer pregnant. If a declaration of pregnancy is withdrawn, the dose limit for the embryo/fetus would apply only to the time from the estimated date of conception until the time the declaration is withdrawn. If the declaration is not withdrawn, the written declaration may be considered expired one year after submission.

5. Substantial Variations Above a Uniform Monthly Dose Rate

According to 10 CFR 20.1208(b), "The licensee shall make efforts to avoid substantial variation above a uniform monthly exposure rate to a declared pregnant woman so as to satisfy the limit in paragraph (a) of this section," that is, 0.5 rem (5 mSv) to the embryo/fetus. The National Council on Radiation Protection and Measurements (NCRP) recommends a monthly equivalent dose limit of 0.05 rem (0.5 mSv) to the embryo/fetus once the pregnancy is known (Ref. 2). In view of the NCRP recommendation, any monthly dose of less than 0.1 rem (1 mSv) may be considered as not a substantial variation above a uniform monthly dose rate and as such will not require licensee justification. However, a monthly dose greater than 0.1 rem (1 mSv) should be justified by the licensee.

D. IMPLEMENTATION

The purpose of this section is to provide information to licensees and applicants regarding the NRC staff's plans for using this regulatory guide.

Unless a licensee or an applicant proposes an acceptable alternative method for complying with the specified portions of the NRC's regulations, the methods described in this guide will be used by the NRC staff in the evaluation of instructions to workers on the radiation exposure of pregnant women.

REFERENCES

1. USNRC, "Instruction Concerning Risks from Occupational Radiation Exposure," Regulatory Guide 8.29, Revision 1, February 1996.

PROCEDURE NO: RPT-02	ISSUE NO: 1	ATTACHMENT 5 PAGE NO: 3 OF 9
----------------------	-------------	---------------------------------

2. National Council on Radiation Protection and Measurements, *Limitation of Exposure to Ionizing Radiation*, NCRP Report No. 116, Bethesda, MD, 1993.

PROCEDURE NO: RPT-02	ISSUE NO: 1	ATTACHMENT 5 PAGE NO: 4 OF 9
----------------------	-------------	---------------------------------

APPENDIX: QUESTIONS AND ANSWERS CONCERNING PRENATAL RADIATION EXPOSURE

1. Why am I receiving this information?

The NRC's regulations (in 10 CFR 19.12, "Instructions to Workers") require that licensees instruct individuals working with licensed radioactive materials in radiation protection as appropriate for the situation. The instruction below describes information that occupational workers and their supervisors should know about the radiation exposure of the embryo/fetus of pregnant women.

The regulations allow a pregnant woman to decide whether she wants to formally declare her pregnancy to take advantage of lower dose limits for the embryo/fetus. This instruction provides information to help women make an informed decision whether to declare a pregnancy.

2. If I become pregnant, am I required to declare my pregnancy?

No. The choice whether to declare your pregnancy is completely voluntary. If you choose to declare your pregnancy, you must do so in writing and a lower radiation dose limit will apply to your embryo/fetus. If you choose not to declare your pregnancy, you and your embryo/fetus will continue to be subject to the same radiation dose limits that apply to other occupational workers.

3. If I declare my pregnancy in writing, what happens?

If you choose to declare your pregnancy in writing, the licensee must take measures to limit the dose to your embryo/fetus to 0.5 rem (5 millisievert) during the entire pregnancy. This is one-tenth of the dose that an occupational worker may receive in a year. If you have already received a dose exceeding 0.5 rem (5 mSv) in the period between conception and the declaration of your pregnancy, an additional dose of 0.05 rem (0.5 mSv) is allowed during the remainder of the pregnancy. In addition, 10 CFR 20.1208, "Dose to an Embryo/Fetus," requires licensees to make efforts to avoid substantial variation above a uniform monthly dose rate so that all the 0.5 rem (5 mSv) allowed dose does not occur in a short period during the pregnancy.

This may mean that, if you declare your pregnancy, the licensee may not permit you to do some of your normal job functions if those functions would have allowed you to receive more than 0.5 rem, and you may not be able to have some emergency response responsibilities.

4. Why do the regulations have a lower dose limit for the embryo/fetus of a declared pregnant woman than for a pregnant worker who has not declared?

A lower dose limit for the embryo/fetus of a declared pregnant woman is based on a consideration of greater sensitivity to radiation of the embryo/fetus and the involuntary nature of the exposure. Several scientific advisory groups have recommended (References 1 and 2) that the dose to the embryo/fetus be limited to a fraction of the occupational dose limit.

5. What are the potentially harmful effects of radiation exposure to my embryo/fetus?

The occurrence and severity of health effects caused by ionizing radiation are dependent upon the type and total dose of radiation received, as well as the time

PROCEDURE NO: RPT-02	ISSUE NO: 1	ATTACHMENT 5 PAGE NO: 5 OF 9
----------------------	-------------	---------------------------------

period over which the exposure was received. See Regulatory Guide 8.29, "Instruction Concerning Risks from Occupational Exposure" (Ref. 3), for more information. The main concern is embryo/fetal susceptibility to the harmful effects of radiation such as cancer.

6. Are there any risks of genetic defects?

Although radiation injury has been induced experimentally in rodents and insects, and in the experiments was transmitted and became manifest as hereditary disorders in their offspring, radiation has not been identified as a cause of such effect in humans. Therefore, the risk of genetic effects attributable to radiation exposure is speculative. For example, no genetic effects have been documented in any of the Japanese atomic bomb survivors, their children, or their grandchildren.

7. What if I decide that I do not want any radiation exposure at all during my pregnancy?

You may ask your employer for a job that does not involve any exposure at all to occupational radiation dose, but your employer is not obligated to provide you with a job involving no radiation exposure. Even if you receive no occupational exposure at all, your embryo/fetus will receive some radiation dose (on average 75 mrem (0.75 mSv)) during your pregnancy from natural background radiation.

The NRC has reviewed the available scientific literature and concluded that the 0.5 rem (5 mSv) limit provides an adequate margin of protection for the embryo/fetus. This dose limit reflects the desire to limit the total lifetime risk of leukemia and other cancers. If this dose limit is exceeded, the total lifetime risk of cancer to the embryo/fetus may increase incrementally. However, the decision on what level of risk to accept is yours. More detailed information on potential risk to the embryo/fetus from radiation exposure can be found in References 2-10.

8. What effect will formally declaring my pregnancy have on my job status?

Only the licensee can tell you what effect a written declaration of pregnancy will have on your job status. As part of your radiation safety training, the licensee should tell you the company's policies with respect to the job status of declared pregnant women. In addition, before you declare your pregnancy, you may want to talk to your supervisor or your radiation safety officer and ask what a declaration of pregnancy would mean specifically for you and your job status.

In many cases you can continue in your present job with no change and still meet the dose limit for the embryo/fetus. For example, most commercial power reactor workers (approximately 93%) receive, in 12 months, occupational radiation doses that are less than 0.5 rem (5 mSv) (Ref. 11). The licensee may also consider the likelihood of increased radiation exposures from accidents and abnormal events before making a decision to allow you to continue in your present job.

If your current work might cause the dose to your embryo/fetus to exceed 0.5 rem (5 mSv), the licensee has various options. It is possible that the licensee can and will make a reasonable accommodation that will allow you to continue performing your current job, for example, by having another qualified employee do a small part of the job that accounts for some of your radiation exposure.

9. What information must I provide in my written declaration of pregnancy?

PROCEDURE NO: RPT-02	ISSUE NO: 1	ATTACHMENT 5 PAGE NO: 6 OF 9
----------------------	-------------	---------------------------------

You should provide, in writing, your name, a declaration that you are pregnant, the estimated date of conception (only the month and year need be given), and the date that you give the letter to the licensee. A form letter that you can use is included at the end of these questions and answers. You may use that letter, use a form letter the licensee has provided to you, or write your own letter.

10. To declare my pregnancy, do I have to have documented medical proof that I am pregnant?

NRC regulations do not require that you provide medical proof of your pregnancy. However, NRC regulations do not preclude the licensee from requesting medical documentation of your pregnancy, especially if a change in your duties is necessary in order to comply with the 0.5 rem (5 mSv) dose limit.

11. Can I tell the licensee orally rather than in writing that I am pregnant?

No. The regulations require that the declaration must be in writing.

12. If I have not declared my pregnancy in writing, but the licensee suspects that I am pregnant, do the lower dose limits apply?

No. The lower dose limits for pregnant women apply only if you have declared your pregnancy in writing. The United States Supreme Court has ruled (in *United Automobile Workers International Union v. Johnson Controls, Inc.*, 1991) that "Decisions about the welfare of future children must be left to the parents who conceive, bear, support, and raise them rather than to the employers who hire those parents" (Reference 7). The Supreme Court also ruled that your employer may not restrict you from a specific job "because of concerns about the next generation." Thus, the lower limits apply only if you choose to declare your pregnancy in writing.

13. If I am planning to become pregnant but am not yet pregnant and I inform the licensee of that in writing, do the lower dose limits apply?

No. The requirement for lower limits applies only if you declare in writing that you are already pregnant.

14. What if I have a miscarriage or find out that I am not pregnant?

If you have declared your pregnancy in writing, you should promptly inform the licensee in writing that you are no longer pregnant. However, if you have not formally declared your pregnancy in writing, you need not inform the licensee of your nonpregnant status.

15. How long is the lower dose limit in effect?

The dose to the embryo/fetus must be limited until you withdraw your declaration in writing or you inform the licensee in writing that you are no longer pregnant. If the declaration is not withdrawn, the written declaration may be considered expired one year after submission.

16. If I have declared my pregnancy in writing, can I revoke my declaration of pregnancy even if I am still pregnant?

Yes, you may. The choice is entirely yours. If you revoke your declaration of pregnancy, the lower dose limit for the embryo/fetus no longer applies.

17. What if I work under contract at a licensed facility?

The regulations state that you should formally declare your pregnancy to the licensee

PROCEDURE NO: RPT-02	ISSUE NO: 1	ATTACHMENT 5 PAGE NO: 7 OF 9
----------------------	-------------	---------------------------------

in writing. The licensee has the responsibility to limit the dose to the embryo/fetus.

18. Where can I get additional information?

The references to this Appendix contain helpful information, especially Reference 3, NRC's Regulatory Guide 8.29, "Instruction Concerning Risks from Occupational Radiation Exposure," for general information on radiation risks. The licensee should be able to give this document to you.

For information on legal aspects, see Reference 7, "The Rock and the Hard Place: Employer Liability to Fertile or Pregnant Employees and Their Unborn Children--What Can the Employer Do?" which is an article in the journal *Radiation Protection Management*.

You may telephone the NRC Headquarters at (301) 415-7000. Legal questions should be directed to the Office of the General Counsel, and technical questions should be directed to the Division of Industrial and Medical Nuclear Safety.

You may also telephone the NRC Regional Offices at the following numbers: Region I, (610) 337-5000; Region II, (404) 562-4400; Region III, (630) 829-9500; and Region IV, (817) 860-8100. Legal questions should be directed to the Regional Counsel, and technical questions should be directed to the Division of Nuclear Materials Safety.

REFERENCES FOR APPENDIX

1. National Council on Radiation Protection and Measurements, *Limitation of Exposure to Ionizing Radiation*, NCRP Report No. 116, Bethesda, MD, 1993.
2. International Commission on Radiological Protection, *1990 Recommendations of the International Commission on Radiological Protection*, ICRP Publication 60, Ann. ICRP 21: No. 1-3, Pergamon Press, Oxford, UK, 1991.
3. USNRC, "Instruction Concerning Risks from Occupational Radiation Exposure," Regulatory Guide 8.29, Revision 1, February 1996.⁽¹⁾ (Electronically available at www.nrc.gov/NRC/REG/index.html)
4. Committee on the Biological Effects of Ionizing Radiations, National Research Council, *Health Effects of Exposure to Low Levels of Ionizing Radiation (BEIR V)*, National Academy Press, Washington, DC, 1990.
5. United Nations Scientific Committee on the Effects of Atomic Radiation, *Sources and Effects of Ionizing Radiation*, United Nations, New York, 1993.
6. R. Doll and R. Wakeford, "Risk of Childhood Cancer from Fetal Irradiation," *The British Journal of Radiology*, 70, 130-139, 1997.
7. David Wiedis, Donald E. Jose, and Timm O. Phoebe, "The Rock and the Hard Place: Employer Liability to Fertile or Pregnant Employees and Their Unborn Children--What Can the Employer Do?" *Radiation Protection Management*, 11, 41-49, January/February 1994.
8. National Council on Radiation Protection and Measurements, *Considerations Regarding the Unintended Radiation Exposure of the Embryo, Fetus, or Nursing Child*, NCRP Commentary No. 9, Bethesda, MD, 1994.
9. National Council on Radiation Protection and Measurements, *Risk Estimates for*

Radiation Protection, NCRP Report No. 115, Bethesda, MD, 1993.

10. National Radiological Protection Board, *Advice on Exposure to Ionizing Radiation During Pregnancy*, National Radiological Protection Board, Chilton, Didcot, UK, 1998.
11. M.L. Thomas and D. Hagemeyer, "Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities, 1996," Twenty-Ninth Annual Report, NUREG-0713, Vol. 18, USNRC, 1998.⁽²⁾

PROCEDURE NO: RPT-02	ISSUE NO: 1	ATTACHMENT 5 PAGE NO: 9 OF 9
----------------------	-------------	---------------------------------

LETTER FOR DECLARING PREGNANCY

This letter is provided for your convenience. To make your written declaration of pregnancy, you may fill in the blanks in this letter, you may use a letter the licensee has provided to you, or you may write your own letter.

DECLARATION OF PREGNANCY

To: _____

In accordance with the NRC's regulations at 10 CFR 20.1208, "Dose to an Embryo/Fetus," I am declaring that I am pregnant. I believe I became pregnant in _____ (only the month and year need be provided).

I understand the radiation dose to my embryo/fetus during my entire pregnancy will not be allowed to exceed 0.5 rem (5 millisievert) (unless that dose has already been exceeded between the time of conception and submitting this letter). I also understand that meeting the lower dose limit may require a change in job or job responsibilities during my pregnancy.

(Your Signature)

(Your Name Printed)

(Date)

Form RPT-02-1-6

PROCEDURE NO: RPT-02	ISSUE NO: 1	ATTACHMENT 6 PAGE NO: 1 OF 1
----------------------	-------------	---------------------------------



MACTEC, Inc.

Procedure No: RPT-03

Issue No: 1

Effective Date: 9-1-02

GENERAL EMPLOYEE RADIOLOGICAL TRAINING

Authored By:

Michael P. McDonald
Radiological Engineer

8-19-02

Date

Reviewed By:

Jeffrey W. Lively
Health Physicist

8/20/02

Date

Approved By:

Steven D. Kima
Radiological Engineering Manager

8/20/02

Date

This page intentionally left blank.

GENERAL EMPLOYEE RADIOLOGICAL TRAINING

1.0 PURPOSE

- 1.1 The purpose of this procedure is to implement the requirements of the General Employee Radiological Training Program. This procedure describes how MACTEC, Inc. non-radiological workers, including both general employees and contractor personnel, are to be trained in the fundamentals of radiation protection and the ALARA process.

2.0 APPLICABILITY

- 2.1 This procedure applies to the training of MACTEC, Inc. non-radiological workers where their work assignment is controlled by MACTEC, Inc., at nuclear facilities.

3.0 REFERENCES

- 3.1 MACTEC, Inc., "Corporate Radiation Protection Program Document."
- 3.2 MACTEC, Inc., RPT-05 "Administration and Control of Radiation Protection Training Examinations."
- 3.3 10 CFR 20, "Standards for Protection Against Radiation."
- 3.4 10 CFR 835, "Occupational Radiation Protection."

4.0 DEFINITIONS AND ABBREVIATIONS

Not applicable

5.0 GENERAL

5.1 EQUIPMENT

- 5.1.1 GERT workbook/study guides.

5.2 SAFETY CONSIDERATIONS

Not applicable

5.3 RESPONSIBILITIES

- 5.3.1 The Radiological Engineering Manager, or designee, shall be responsible:
- a. for the development and implementation of GERT;

- b. for the day-to-day conduct, oversight, and coordination of GERT;
- c. to ensure instructors used for the presentation of GERT are appropriately qualified; and
- d. for the review and approval of GERT training materials.

5.3.2 Radiological Training Specialists/Radiological Engineers shall be responsible for developing GERT course material, including examinations, lesson plans, etc. Radiological Training Specialists/Radiological Engineers shall also be responsible for conducting assigned Radiation Protection Training classes.

5.4 PREREQUISITES

5.4.1 Students should be proficient in written and verbal English, as most radiological hazard postings and labels are presented in English. Training material and training instruction is normally presented in English as well. When a student is not proficient in English (written and verbal), special arrangements will need to be made prior to training participation.

5.5 RECORDS

5.5.1 Radiation Protection Training records are generated during the process of implementing this procedure. The original copy of the records is the record copy. The record copy shall be stored, arranged, indexed, retained, retrieved, and disposed of in accordance with this procedure and all applicable regulatory requirements.

5.5.2 All GERT student records (including class rosters, completed examinations, examination scores, and GERT Completion Forms) shall be maintained by MACTEC, Inc.

5.5.3 Copies of the training records may be made for information purposes only.

5.6 PRECAUTIONS AND LIMITATIONS

Not applicable

5.7 REVISIONS

5.7.1 This procedure shall be reviewed at least every two years, with documentation to support the completion of such review.

5.8 OTHER

PROCEDURE NO: RPT-03	REVISION NO: 1	PAGE NO: 2 OF 7
----------------------	----------------	-----------------

Not applicable

5.9 ATTACHMENTS

Attachment 1 - GERT Qualification Card

PROCEDURE NO: RPT-03	REVISION NO: 1	PAGE NO: 3 OF 7
----------------------	----------------	-----------------

6.0 PROCEDURE

6.1 GENERAL REQUIREMENTS

6.1.1 Non-radiological workers who require unescorted access to radiologically controlled areas shall complete GERT prior to occupational exposure to ionizing radiation. GERT shall include:

- a. standardized GERT material; and
- b. applicable site-specific training material, including radiological emergency response procedures.

6.1.2 GERT shall include the following topics:

- a. Sources of radiation;
- b. Non-ionizing and ionizing radiation;
- c. Risks in perspective;
- d. ALARA concept;
- e. Radiological controls;
- f. Monitoring/dosimetry;
- g. Emergency procedures; and
- h. Employee responsibilities.

6.1.3 GERT should include the following site-specific information:

- a. Policies on control of exposure of the embryo/fetus to ionizing radiation;
- b. Escort and visitor policies;
- c. Radiological area access and egress requirements;
- d. Warning signs or barriers;
- e. Protective clothing policies;
- f. Types of radiation /radioactivity encountered on-site; and
- g. Radiation protection policies.

- 6.1.4 The GERT workbook/study guide shall normally be used for conducting GERT.
- 6.1.5 Due to the fact that most radiological hazard postings and labels are created using English, all MACTEC, Inc. Radiation Protection Training materials (e.g., viewgraphs, student handouts, examinations) should be written/presented in English as well.
- 6.1.6 Personnel who hold current qualifications as either a Health Physics Technician/ Radiological Control Technician or Radiation Worker (RWT) satisfy the training requirements for GERT.
- 6.1.7 GERT may be waived provided that:
- a. the training has been received at another comparable site or facility within the past 2 years;
 - b. there is provision of proof-of-training in the form of a certification document containing the individual's name, date of training, and specific topics covered; and
 - c. the Radiological Engineering Manager, (or designee) has certified the training of the individual, and granted qualification.

6.2 REQUIREMENTS FOR AREA ACCESS

- 6.2.1 Managers may authorize nonradiological workers, who have completed GERT, unescorted access to some radiologically controlled areas if the following conditions are met (as applicable):
- a. Recent radiological surveys have demonstrated that there is no contamination in the work area.
 - b. No intrusive work will be performed.
 - c. GERT-trained personnel requiring access will not:
 - Handle radioactive material;
 - Operate a radiation-generating device that requires a higher level of radiological training; or
 - Receive more than 100 mrem in a year.
- 6.2.2 Visitors who require unescorted access to radiologically controlled areas shall complete GERT, as a minimum. Visitors who will be escorted into radiologically

controlled areas for periods exceeding 10 consecutive work days shall also complete GERT. Visitor escorts shall be current in GERT, as a minimum.

6.3 REQUIREMENTS FOR ACTIVITIES AUTHORIZATION

6.3.1 Nonradiological workers who have completed GERT may be authorized to:

- a. Operate "Unattended" radiation-generating devices, as well as "Exempt Shielded" radiation-generating devices that are classified as either "Inherently Safe" or "Certified Cabinet."
- b. Operate/use devices, equipment, etc., that contain inaccessible radioactive material.

6.4 USE OF ESCORTS IN LIEU OF TRAINING

6.4.1 Under certain conditions and restrictions, constant escort by a suitably trained individual may be used in lieu of training (e.g., for contractors, roving personnel, visitors, and tours) for access to radiologically controlled areas, as well as for the performance of some radiological work activities.

6.4.2 The requirements and limitations related to the use of escorts in lieu of training are determined on a case-by case basis. Contact the Radiological Engineering Manager (or designee) for authorization for access to and the performance of radiological work activities.

6.5 STUDENT EVALUATIONS

6.5.1 Following completion of instruction, an examination shall be administered.

6.5.2 The minimum passing score for the examination shall be 80%. Individuals that score < 80%, but \geq 70% may re-take the examination. Individuals that score < 70% must re-take the class.

6.5.3 Due to content layout/format of GERT, challenge examinations shall not be made available.

6.5.4 Examinations shall be conducted in accordance with Reference 3.2.

6.5.5 Upon successful completion of the initial GERT training, issue the GERT qualification card to the individual (Attachment 1).

6.6 GERT RETRAINING

- 6.6.1 Nonradiological workers shall complete radiation safety retraining at intervals not to exceed 24 months, and when there are significant changes to radiation protection policies and procedures that may affect the individual.
- 6.6.2 Radiation safety retraining for nonradiological workers should normally be accomplished by requiring the appropriate personnel to repeat initial GERT program.
- 6.6.3 Upon successful completion of GERT training, issue the GERT qualification card to the individual (Attachment 1).

GERT QUALIFICATION CARD

Front of Card

G E R T	 MACTEC, Inc.	Expires on:
	Jane Smith	07
	522-02-1234	30
	Approved By: _____	03
Date Issued: 8/19/2002		

PROCEDURE NO: RPT-03

REVISION NO: 1

ATTACHMENT 1
PAGE NO: 1 OF 1



MACTEC, Inc.

Procedure No: RPT-05

Issue No: 1

Effective Date: 9-10-02

**ADMINISTRATION AND CONTROL OF RADIATION PROTECTION
TRAINING EXAMINATIONS**

Authored By:

Michael P. McDonald
Radiological Engineer

8-19-02

Date

Reviewed By:

Jeffrey W. Lively
Health Physicist

8/20/02

Date

Approved By:

Steven D. Rima
Radiological Engineering Manager

8/20/02

Date

This page intentionally left blank.

ADMINISTRATION AND CONTROL OF RADIATION PROTECTION TRAINING EXAMINATIONS

1.0 PURPOSE

- 1.1 The purpose of this procedure is to provide direction for the control and administration of Radiation Protection Training examinations, quizzes, and question and answer banks.

2.0 APPLICABILITY

- 2.1 This procedure applies to MACTEC, Inc. management, supervisors, individuals and contractors within the Radiological Engineering Department who author, control, administer, review, or approve examinations, quizzes, and/or examination banks.

3.0 REFERENCES

- 3.1 MACTEC, Inc., Corporate Radiation Protection Program Document.
- 3.2 10 CFR 20, "Standards for Protection Against Radiation."
- 3.3 10 CFR 835, "Occupational Radiation Protection."

4.0 DEFINITIONS AND ABBREVIATIONS

Not applicable

5.0 GENERAL

5.1 EQUIPMENT

Not applicable

5.2 SAFETY CONSIDERATIONS

Not applicable

5.3 RESPONSIBILITIES

- 5.3.1 The Radiological Engineering Manager, or designee, shall be responsible for:
- implementation of this procedure by members MACTEC Inc., within the Radiological Engineering Department; and

- b. review and approval of all examination materials used for Radiological Worker Training.

5.3.2 Radiological Training Specialists/Radiological Engineers shall be responsible for:

- a. developing Radiological Worker Training course examinations; and
- b. the administration and control of all Radiological Worker Training course examination materials in accordance with this procedure.

5.4 PREREQUISITES

Not applicable.

5.5 RECORDS

5.5.1 Radiation Protection Training records are generated during the process of implementing this procedure. The original copy of the records is the record copy. The record copy shall be stored, arranged, indexed, retained, retrieved, and disposed of in accordance with this procedure and all applicable regulatory requirements.

5.5.2 All Radiological Worker student records (including class rosters, completed examinations, examination scores, and practical exercise evaluations) shall be maintained by MACTEC, Inc.

5.5.3 Copies of the training records may be made for information purposes only.

5.6 PRECAUTIONS AND LIMITATIONS

Not applicable

5.7 REVISIONS

5.7.1 This procedure shall be reviewed at least every two years, with documentation to support the completion of such review.

5.8 OTHER

Not applicable

5.9 ATTACHMENTS

Attachment 1 - Student Examination Cover Sheet

6.0 PROCEDURE

6.1 GENERAL REQUIREMENTS

6.1.1 Written examinations and quizzes used to evaluate students and establish passing or failing criteria shall be controlled in accordance with this procedure.

6.2 CONTROL AND STORAGE OF EXAMINATION MATERIALS

6.2.1 Only those personnel approved by the Radiological Engineering Manager shall have access to examination materials and records.

6.2.2 All examination banks, examinations, and examination keys shall be maintained in a locked file except when in the actual possession of authorized training personnel for immediate use.

6.2.3 Examination materials shall not be left unattended at any time.

6.2.4 Any individual having custody of examination materials shall be directly responsible for maintaining the integrity of the materials while in their possession. This includes the development, review, and approval processes; and while being administered and scored.

6.2.5 All examination materials shall be returned to the locked storage location when not in use.

6.2.6 All RP examination files, located within a computer's electronic storage system (e.g., hard drive) shall also have an electronic media backup file located in a locked storage location when not in use.

6.2.7 Examination materials kept on a computer shall be password protected.

6.2.8 Completed examination answer sheets shall be considered as exam materials and controlled as such.

6.3 ADMINISTRATION OF WRITTEN EXAMINATIONS

6.3.1 Examinations shall be administered by authorized MACTEC personnel only. Examination proctor assistance may be provided by any MACTEC personnel.

6.3.2 Prior to the distribution of exams, students shall be directed to remove all materials from desks, other than those required to take the examination.

6.3.3 After exam materials have been distributed, students shall be directed to complete the top portion of the Exam Cover Sheet (Attachment 1), including signing to indicate that they have read and understand the guidelines and rules.

NOTE: Attachment 1 is a suggested exam cover sheet format. Different exam cover sheet formats are permitted so long as the same information is recorded on the cover sheet.

6.3.4 During the examination, students should follow the following rules:

- a. No talking among the students;
- b. No exchanging of papers among the students;
- c. No more than one student may leave the room at any time; and
- d. No outside materials except as allowed by the proctor.

6.3.5 When done with the exam, each student should turn in all materials provided by the proctor and leave the room until all students have completed the exam. As an alternative, students completing the exam may remain in the room if they do so quietly and do not disturb or assist those still taking the exam.

6.3.6 Prior to releasing the students, the proctor shall ensure that all materials have been turned in and are accounted for.

6.4 EXAM INTEGRITY AND CHEATING

6.4.1 Unproctored exams and/or take-home quizzes allow opportunity for compromise and shall not be used to document individual performance as satisfactory or unsatisfactory.

6.4.2 Open-book format exams are allowed only when the learning objectives permit.

6.4.3 If cheating is observed during an exam, the proctor shall immediately remove the student(s) from the room (in a discrete manner) and inform the individual(s) of what was observed. The exam shall also be taken from the student.

NOTE: If a distraction to the class or embarrassment to the student would be caused by removing the student from the classroom setting immediately, the proctor may wait until the exam is completed, at which time the student shall be informed.

6.4.4 If cheating is observed, the student's exam and a written explanation of what was observed shall be forwarded to the Radiological Engineering Manager, or designee, in a timely manner.



MACTEC, Inc.

STUDENT EXAMINATION COVER SHEET

NAME: _____ DATE: _____
 SSN: _____ EXAM ID: _____
 TITLE: _____ EXAM REV: _____
 TOTAL POINTS SCORED: _____ GRADED BY: _____
 POINTS AVAILABLE: _____ EXAM SCORE: _____

EXAMINATION GUIDELINES AND RULES

1. Read each question carefully and thoroughly. If you have any questions, ask the instructor for clarification.
2. Answer the questions you know first. Pace yourself to allow a set time for harder questions. Allow time to check your answers.
3. A minimum score of 80% is required to satisfactorily complete this exam.
4. Cheating is a demonstration of unsatisfactory conduct, subject to disciplinary action, and will not be tolerated. No talking is allowed during the examination. Do not disturb the class. Raise your hand if you have a question. Do your own work. No copying allowed.
5. No notes or texts are allowed unless specifically granted by the instructor.
6. Only one student may leave the room at a time during the exam. Ask the instructor for permission.
7. For multiple choice questions, there is only one correct answer unless otherwise noted.

I have read and understand the above guidelines and rules.

 Student Signature Date

I have had the opportunity to review my exam with an instructor and ask any questions I may have regarding my exam.

 Student Signature Date

Form RPT-05-1-1

PROCEDURE NO: RPT-05	ISSUE NO: 1	ATTACHMENT 1 PAGE NO: 1 OF 1
----------------------	-------------	---------------------------------



MACTEC, Inc.

Procedure No: RPT-06

Issue No: 1

Effective Date: 9-1-02

CONDUCTING RADIOLOGICAL TRAINING

Authored By:

Michael P. McDonald
Radiological Engineer

8-19-02

Date

Reviewed By:

Jeffrey W. Lively
Health Physicist

8/20/02

Date

Approved By:

Steven D. Rima
Radiological Engineering Manager

8/20/02

Date

This page intentionally left blank.

CONDUCTING RADIOLOGICAL TRAINING

1.0 PURPOSE

- 1.1 The purpose of this procedure is to provide instruction and guidance to individuals presenting radiological training.

2.0 APPLICABILITY

- 2.1 This procedure applies to MACTEC, Inc. management, supervisors, individuals and contractors within the Radiological Engineering Department who present radiological training.

3.0 REFERENCES

- 3.1 MACTEC, Inc., Corporate Radiation Protection Program Document.
- 3.2 10 CFR 20, "Standards for Protection Against Radiation."
- 3.3 10 CFR 835, "Occupational Radiation Protection."

4.0 DEFINITIONS AND ABBREVIATIONS

Not applicable

5.0 GENERAL

5.1 EQUIPMENT

Not applicable

5.2 SAFETY CONSIDERATIONS

Not applicable

5.3 RESPONSIBILITIES

- 5.3.1 The Radiological Engineering Manager, or designee, shall be responsible for:

a. implementation of this procedure by members MACTEC Inc., within the Radiological Engineering Department.

- 5.3.2 Radiological Training Specialists/Radiological Engineers shall be responsible for:

PROCEDURE NO: RPT-06	REVISION NO: 1	PAGE NO: 1 OF 4
----------------------	----------------	-----------------

- a. presenting Radiological Worker Training course in accordance with this procedure.

5.4 PREREQUISITES

- 5.4.1 Students should be proficient in written and verbal English, as most radiological hazard postings and labels are presented in English. Training material and training instruction is normally presented in English as well. When a student is not proficient in English (written and verbal), special arrangements will need to be made prior to training participation.

5.5 RECORDS

- 5.5.1 Radiation Protection Training records are generated during the process of implementing this procedure. The original copy of the records is the record copy. The record copy shall be stored, arranged, indexed, retained, retrieved, and disposed of in accordance with this procedure and all applicable regulatory requirements.
- 5.5.2 All Radiological Worker student records (including class rosters, completed examinations, examination scores, and practical exercise evaluations) shall be maintained by MACTEC, Inc.
- 5.5.3 Copies of the training records may be made for information purposes only.

5.6 PRECAUTIONS AND LIMITATIONS

Not applicable

5.7 REVISIONS

- 5.7.1 This procedure shall be reviewed at least every two years, with documentation to support the completion of such review.

5.8 OTHER

Not applicable

5.9 ATTACHMENTS

Attachment 1 - Radiological Training Sign-in Sheet

PROCEDURE NO: RPT-06	REVISION NO: 1	PAGE NO: 2 OF 4
----------------------	----------------	-----------------

6.0 PROCEDURE

6.1 GENERAL REQUIREMENTS

- 6.1.1 Radiological training course materials shall be developed based on industry standardized training models, when practical. Radiological training course materials may be customized to meet customer needs.
- 6.1.2 The classroom-based academic portion of Radiological Worker Training shall be conducted by a qualified instructor.
- 6.1.3 All MACTEC radiological training courses presented, either classroom lead or computer-based training (CBT), shall be documented using the MACTEC Radiological Training Attendance Roster (Attachment 1). Ensure all course participants supply the appropriate information on the roster.

6.2 CLASSROOM-BASED PRESENTATION

- 6.2.1 Course introduction should include information on the course, instructor, schedule, and facility information (including emergency evacuation information).
- 6.2.2 Viewgraphs should be presented using a laptop computer and desktop projector. Overhead transparency slides may be used in the event that the computer or projection system is not available.
- 6.2.3 Whiteboards or paper charts should be used to illustrate difficult concepts that the viewgraphs do not adequately illustrate.
- 6.2.4 Training equipment and material (dosimeters, radiation detection devices, personal protective equipment, etc.) should be used to further illustrate basic radiation or contamination concepts.

6.3 END-OF-COURSE REVIEWS

- 6.3.1 End-of-course reviews should be presented at the conclusion of the course lecture.
- 6.3.2 Reviews should be based upon the needs of the students as well as the time remaining for the course.
- 6.3.3 End-of-course reviews should reiterate and emphasize the material presented to meet the training objectives of the course. Actual examination questions shall NOT be used during the review process.

6.4 COMPUTER-BASED TRAINING PRESENTATION

PROCEDURE NO: RPT-06	REVISION NO: 1	PAGE NO: 3 OF 4
----------------------	----------------	-----------------

- 6.4.1 CBT can either be presented in a classroom based training setting or on the participant's personal computer. The preference is to present CBT in a controlled environment so that participants can be monitored and assistance provided, as necessary.
- 6.4.2 A CBT facilitator/instructor should be available during user training course start-up to answer any questions.
- 6.4.3 At the completion of CBT, the CBT facilitator/instructor shall print a copy of the test results and attach the test results to the Radiological Training Attendance Roster.

6.5 TESTING

- 6.5.1 A multiple-choice examination should be used to verify student knowledge.
- 6.5.2 An appropriate amount of time should be allowed to take the written exams, using 30 minutes per 25 questions as a guide.
- 6.5.3 A student that receives between 70% and 79% should be allowed to either schedule with the instructor to study and retake a different exam, or to repeat the entire course.
- 6.5.4 A student that receives a score of 69%, or lower, should be required to retake the entire academic portion (either classroom-based or computer-based).

6.6 APPLIED TRAINING

- 6.6.1 The applied ("hands-on") training should normally be completed immediately after the successful completion the academic portion of the training.
- 6.6.2 If the applied (or "hands-on") training is not available, or the student can not attend the applied training immediately following their academic training completion, they should schedule with the instructor to attend the applied training session at a later date.
- 6.6.3 The applied training should be completed within 20 working days after completion of their academic training.

PROCEDURE NO: RPT-06	REVISION NO: 1	PAGE NO: 4 OF 4
----------------------	----------------	-----------------

