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# Selection and Use of Radiological Protective Clothing

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**Revision 1**

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## 1.0 PURPOSE AND SCOPE

### 1.1 Purpose

This procedure provides guidance for the selection of radiological protective (anti-contamination) clothing and the proper sequence for donning and removing protective clothing.

### 1.2 Scope

This procedure is for the exclusive use of EnergySolutions' Commercial Services Division and contractors at field project sites where EnergySolutions has the primary role in controlling exposures to on-site personnel. Requirements herein are applicable to no other operational entities of EnergySolutions.

This procedure applies to all work activities which require radiological protective clothing performed by project personnel operating under the Commercial Services' Radiation Protection Program (RPP).

## 2.0 REFERENCES

- 2.1 US NRC 10 CFR 20, *Standards for Protection Against Radiation*
- 2.2 29 CFR 1910 and 1926, *Occupational Health and Safety Regulations*
- 2.3 EnergySolutions, LLC, CS-RS-PG-001, *Commercial Services Radiation Protection Program*
- 2.4 EnergySolutions, LLC, CS-RS-PR-PR-013, *Selection and Use of Respiratory Protection Equipment*

## 3.0 GENERAL

### 3.1 Definitions

- 3.1.1. *Contamination Area* - Any area accessible to personnel with loose surface activity greater than 1000 dpm/100 cm<sup>2</sup> β/γ or 20 dpm/100 cm<sup>2</sup> α, or loose surface radioactivity greater than or equal to the site's regulatory guideline values.
- 3.1.2. *Airborne Radioactivity Area* – A room, enclosure or area in which airborne radioactive materials composed wholly or partially of licensed material exists in concentrations in excess of the Derived Air Concentration (DAC) as specified in 10CFR20 Appendix B, Table 1 **OR** such that an individual present in the area without respiratory protection equipment, during the hours an individual is present in a week, could exceed an intake of 0.6 percent of the Annual Limit on Intake (ALI) or 12 DAC-hrs (Reference 2.1).

**Note:** Assuming an individual works in an area for 40 hours a week without respiratory protection, the posting limit for an Airborne Radioactivity Area would be equivalent to 0.3 DAC (i.e., 12 DAC-hrs/40 hrs).

- 3.1.3. *Hazard Assessment* - The determination of the degree of risk based on all aspects of an exposure situation; including the characteristics of the chemical(s) or radiation to which individuals will be exposed and the conditions that determine the degree of exposure.
- 3.1.4. *Protective Clothing* - Any material or combination of materials used to isolate parts of the body from direct contact with a potentially hazardous chemical or radiological contaminant.
- 3.1.5. *Radiation Work Permit (RWP)* – A document or series of documents prepared by the RPS to inform workers of the radiological and hazardous conditions which exist in the work area and the radiological requirements for the job.

### **3.2 Responsibilities**

#### 3.2.1. Commercial Services Radiation Safety Officer

The Commercial Services Radiation Safety Officer (RSO) maintains and oversees implementation of the CS radiation protection program (RPP). The Commercial Services RSO shall ensure that radiation safety, radioactive materials management, and radiological operations procedures and programs are kept up to date such that they comply with current regulations and incorporate current and relevant industry practices and regulatory guidance.

#### 3.2.2. Project Manager

The Project Manager (PM) is responsible for ensuring that the proper procedures and programs are implemented on the project site as required by customer agreements and contracts. The PM is responsible for ensuring that these programs and procedures are properly incorporated into project specific plans and procedures. The PM is responsible for ensuring that Commercial Services and/or client programs/procedures are available for use by field personnel.

#### 3.2.3. Radiation Protection Supervisor

The Radiation Protection Supervisor (RPS) is responsible for implementing the Commercial Services RPP and the project specific radiological requirements at the field project location. The RPS manages and oversees the technicians performing radiation protection surveys and radiological site monitoring.

#### 3.2.4. Project Health Physicist

The Project Health Physicist (PHP) is responsible for assisting the Commercial Services RSO in providing health physics support to the PM and the RPS. This includes technical support to ensure procedural and regulatory compliance.

3.2.5. Project Personnel

All project personnel are responsible for complying with the requirements of this procedure and all applicable radiation work permits (RWP).

**3.3 Precautions and Limitations**

- 3.3.1. This procedure does not address protective clothing for non-radiological radiological hazards such as exposures to chemicals or heat.
- 3.3.2. Protective devices such as respirators and engineering controls are addressed in Reference 2.3 and 2.4.
- 3.3.3. Use of protective clothing in hot working environments can contribute to heat stress concerns.
- 3.3.4. Engineering controls shall be considered and implemented, to the extent practical, to minimize Personal Protective Equipment (PPE) requirements.  
Ensure consideration that the type of protective clothing does not increase the risk of exposure to hazardous materials or jeopardize personnel safety.

**3.4 Records**

None

**4.0 REQUIREMENTS AND GUIDANCE**

**4.1 Discussion**

Protective clothing may include cloth, Tyvek® and paper coveralls; latex, PVC or cloth booties; chemical-resistant gloves; hoods and plastic suits. Protective clothing is primarily employed to protect workers from becoming contaminated with radioactive materials or chemicals.

Protective clothing shall be provided for personnel working in contaminated areas as specified on the RWPs. Protective clothing requirements shall be based on known and expected contamination levels and/or hazard assessments of the work area, and the expected working conditions.

Instructions for the proper donning and removal of protective clothing are normally addressed as part of initial Radiation Worker Training.

This procedure does not address the use of respiratory protection with the exception of donning and doffing, or the use of engineering controls.

**4.2 Selection of Protective Clothing**

- 4.2.1. Protective clothing should only be used when other means of contamination control are not available or sufficient.
- 4.2.2. The following factors should be considered when specifying protective clothing:
  - 1) The levels and types of radiological and hazardous material contamination present or expected in the work area.

- 2) The physical matrix of the contamination (i.e., dry, wet, oily).
  - 3) The work to be performed or work in progress.
  - 4) The location of the contamination such as floor, walls, overhead, in systems.
  - 5) The physical configuration of the work area (close or congested areas may require more protective clothing than open areas).
  - 6) Environmental conditions such as heat and humidity.
  - 7) Exposure situation (vapor, pressured splash, liquid splash, intermittent liquid contact, and continuous liquid contact).
  - 8) Toxicity of the radioactive materials and/or chemical(s) (i.e., ability to permeate the skin and systemic toxicity).
  - 9) Physical properties of the contaminant chemicals (for example, vapor pressure, molecular weight, and polarity).
  - 10) Functional requirements of the task (for example, dexterity, thermal protection, fire protection, and mechanical durability requirements).
  - 11) Properties of the protective clothing that are relevant to the radiological, physical and chemical hazards are also functional requirements. These properties are determined through appropriate testing techniques and include permeation resistance, degradation resistance and penetration resistance. These specifications are generally available from the manufacturer.
- 4.2.3. Attachment 5.1, Guide for the Selection of Radiological Protective Clothing, provides guidance for the selection of protective clothing when only radiological hazards are present or suspected.
- 4.2.4. The guidelines specified in Attachment 5.1 for protective clothing selection may be modified by the RPS or designee on a case-by-case basis. The following are case examples:
- 1) Wet areas - Where splashing water or spray is present, use rain suits in addition to the protective clothing listed in Attachment 5.1. A second set of coveralls may not be necessary when a rain suit is worn.
  - 2) Standing water - In addition to the clothing requirements for wet areas, use hip boots or waders for standing water areas.
  - 3) Face shields - When there is significant beta radiation, grinding or welding operations, or a likelihood of water splashing **AND** respirators are not required, use face shields.
  - 4) High temperature areas - Consult with the Safety and Health Officer or designee.

### 4.3 Donning Protective Clothing

**Note: Personnel must be Radiation Worker qualified prior to donning protective clothing.**

- 4.3.1. Determine the protective clothing requirements from the RWP.
- 4.3.2. Inspect the clothing for holes, tears, or other indications of damage.
  - 1) Do not wear damaged protective clothing.
  - 2) Dispose of torn rubber goods in either a radioactive waste bag or in another clean waste bag for damaged clothing that will be rendered unrecognizable.
- 4.3.3. If required by the RWP, remove all personal clothing except shoes, socks and modesty clothing (i.e., scrubs, gym shorts, t shirts, or bathing suits).
- 4.3.4. **IF** the work area temperature is such that extra warmth is needed, **THEN** additional Personal clothing may be allowed at the discretion of the RPS or Health and Safety personnel.
- 4.3.5. Don any required special dosimetry (e.g., finger rings) prior to donning protective clothing unless otherwise specified by the RWP.

**Note: The following dress sequence does not have to be followed in the given order provided the clothing is properly worn upon completion of dress out.**

- 4.3.6. Don the first pair of booties and tape.
- 4.3.7. Don glove liners.
- 4.3.8. Don coveralls and secure closure, which may be a zipper, drawstring, snaps, or buttons. The coveralls should fit loosely so that they can be easily removed without cross contaminating the skin.
- 4.3.9. **IF** "taped openings" is specified on the RWP, **THEN**:
  - 1) Tape over the coverall closure starting at the crotch.
  - 2) Tape the bottom of the coverall legs to the booties; allow enough slack in the coverall legs to facilitate stooping and bending.

**CAUTION: Plastic shoe covers may present a slipping hazard.**

- 4.3.10. Don rubber shoe covers.
- 4.3.11. Place the self reading pocket dosimeter, if worn, on the coveralls in the upper body area on the breast tab or in the pocket **AND** place the primary dosimeter, if worn, on the inside in a comparable position, with the windows of the dosimeter facing out. When Tyvek® coveralls are worn that do not contain a breast tab or pocket, dosimetry should be attached per direction of Radiation Protection personnel.

- 1) The primary dosimeter is generally worn on the outside of the wearer's modesty clothing under their PPE. The dosimeter may be moved outside the PPE at the direction of the RPS.
- 2) The primary dosimeter may be placed in a thin plastic bag to protect it from contamination, but the beta window shall be kept facing away from the body at all times.
- 3) When bare unprotected skin is exposed to beta radiation, dosimeters selected and worn to measure beta radiation shall **not** be worn inside PPE or placed in pockets as it may not give an accurate representation of the dose to the exposed skin.

4.3.12. **IF** required, **THEN** don a surgeon's cap.

4.3.13. **IF** a respirator is specified on the RWP, **THEN**:

- 1) Ensure that the surgeons cap is situated such that it will not intrude into the respirator seal area.

**NOTE: Respirators should be donned at the entrance to the airborne radioactivity area rather than in the dress area if there is considerable distance between the two areas.**

- 2) Don the respirator.
- 3) Don the hood, allowing it to overlap the rubber around the lens of the face piece and fall over the shoulder.
  - a. If required, tape the hood to the respirator and to the coveralls.
  - b. Ensure that the hood is slack enough around shoulders to allow for full head movement.

4.3.14. **IF** a respirator **IS NOT** specified on the RWP, **BUT** a hood is, **THEN** don the hood, allowing it to fall over the shoulders and ensure that the hood is slack enough around shoulders to allow for full head movement. Tape the hood to the coveralls.

4.3.15. Don rubber gloves.

- 1) More than one pair of rubber gloves may be required for certain jobs.
- 2) Tape innermost rubber gloves to coverall sleeves.
- 3) Leather work gloves may be substituted for outer rubber gloves for some jobs as specified on the RWP.

4.3.16. **IF** specified on the RWP, **THEN** don plastic or paper suit or second set of coveralls.



#### **4.4 Removal of Protective Clothing**

**Note:** The sequence for protective clothing removal may vary at the discretion of the Radiation Protection Technician providing job coverage, as designated on the RWP, or as posted at control point egress locations, dependent upon radiological and hazardous material conditions encountered during the work evolution.

**CAUTION:** Pushing clothing or trash into the barrel to compress the contents may cause airborne radioactivity.

4.4.1. **WHEN** exiting an area with a double step-off-pad (SOP), **THEN** perform the following at the first pad:

- 1) Remove outer tape **AND** place in the trash receptacle.
- 2) Remove rubber shoe covers, then remove outer gloves and place in laundry receptacle.
- 3) Remove hood, then remove outer set of coveralls **AND** place them in laundry receptacle.
- 4) Remove outer booties **AND** step onto the SOP as each is removed.
- 5) Place booties in proper receptacle.
- 6) Continue with procedure for single SOP.

4.4.2. **WHEN** a single SOP is present or **WHEN** at the second SOP of a double SOP, **THEN:**

- 1) Remove all tape and place in the trash receptacle.
- 2) Remove outer gloves, if worn.
- 3) Remove the hood **AND** place it in the laundry receptacle.
- 4) **IF** worn, **THEN** remove respirator.
  - a. Bend forward and grasp the respirator by the snout.
  - b. Pull it straight down to clear the chin and out away from the face.
  - c. Remove any tape, which may still be on the respirator and discard in the trash container.
  - d. Separate the surgeons cap from the respirator and place it in the laundry receptacle.

**Note:** **DO NOT** place respirators in trash or laundry receptacles.

- 5) Remove rubber shoe covers, then remove rubber gloves and place in the laundry receptacle.
- 6) **IF** a respirator was **NOT** worn, **THEN** remove the surgeons cap **AND** place in the laundry receptacle.
- 7) Remove dosimetry if worn and place on the final SOP.
- 8) Remove coveralls by turning them inside out down over inner booties.

- 9) Carefully place coveralls in the laundry receptacle.
- 10) Remove booties **AND** step onto the SOP as each is removed.
- 11) Place the booties into the proper receptacle.
- 12) Remove glove liners and place them in the trash receptacle.

**Note: Take care to ensure that finger dosimetry, if worn, is not discarded with the glove liners**

4.4.3. Proceed to the nearest frisking station and:

- 1) Frisk dosimetry, if worn.
- 11) Frisk self in accordance with posted procedures.

## **5.0 ATTACHMENTS AND FORMS**

### **5.1 Guide for the Selection for Radiological Protective Clothing**

**Attachment 5.1 Guide for the Selection of Radiological Protective Clothing**

This chart is meant to provide guidance. The factors listed in this procedure, should be considered when determining area-specific clothing requirements. Respiratory protection requirements are provided in References 2.3 and 2.4.

Concentration Guide Limit in dpm/100 cm <sup>2</sup> removable	Recommended Minimum Protective Clothing
<b>BETA/GAMMA EMITTERS<sup>1</sup>,</b>	
a. 1,000-5,000 (inspection only)	Booties, rubber shoe covers, gloves
b. 5,000-100,000 (inspection only)	Coveralls, booties, rubber shoe covers, gloves, hood
c. 1,000-100,000 (hands on work)	Coveralls, booties, rubber shoe covers, gloves, hood
d. > 100,000 (all entries)	Two pairs of coveralls, cotton glove liners, two pairs of gloves, two pairs of booties, rubber shoe covers, hood
e. < 100,000 w/standing water	Same as (a-c) clothing with outer-most coveralls, gloves, and boots to be made of plastic or rubber
f. > 100,000 w/ spraying or standing water	Same as (d) above with outer most coveralls, gloves and boots made of plastic or rubber, face shields
<b>ALPHA EMITTERS</b>	
a. >20-500 (inspection only)	Booties, rubber shoe covers, gloves
b. 500-1,000 (inspection only)	Coveralls, booties, rubber shoe covers, gloves, hood
c. >20 (hands on work)	Coveralls, booties, rubber shoe covers, gloves, hood
d. > 1,000 (all entries)	Coveralls, cotton glove liners, two pairs of gloves, two pairs of booties, rubber shoe covers, hood
e. (a-c) levels with standing water	(a-c) clothing with outer-most coveralls, gloves, and boots to be made of plastic or rubber
f. > 1000, spraying, system breach	Same as (d) above with a second pair of outer coveralls and gloves and boots made of plastic or rubber

**NOTE:**

<sup>1</sup> Whenever personnel are working under conditions where beta radiation of >1.7 MeV maximum is expected to be a potential eye hazard, eye goggles or face shields should be worn. No credit is taken for eye glasses or contact lenses.