

<b>JSC Safety and Health Handbook</b>	JPR No.	<b>1700.1K</b>
	Effective Date:	<b>11/25/2013</b>
	Expiration Date:	<b>11/25/2018</b>
	Page Number	Page 7.3-1 of 5

## Chapter 7.3 Radiation Protection

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### ***This could be you . . .***

***A researcher ingested radioactive dust. He made notes on his work and then held his pencil, which had dust on it from his hands, in his mouth.***

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#### **7.3.1 Applicability of this chapter**

You are required to follow this chapter if you handle radioactive materials or radiation-producing equipment.

#### **7.3.2 What this chapter covers**

This chapter covers the minimum requirements for handling and using radioactive materials, ionizing radiation-producing equipment, and non-ionizing radiation-producing equipment. See Chapter 6.2 of this Handbook for lasers.

#### **7.3.3 Ionizing radiation and why it is harmful**

Ionizing radiation is any of the following: alpha particles, beta particles, gamma rays, X rays, neutrons, high-speed electrons, protons, and other atomic particles. Ionizing radiation doesn't include sound waves, microwaves, radio waves, or visible, infrared, or ultraviolet light. These are covered in the next subchapter. Ionizing radiation is harmful because it alters the cells of the human body and could produce cancer and other chromosome damage.

#### **7.3.4 Precautions to take when working with ionizing radiation**

7.3.4.1 Before bringing on site, purchasing, using, or modifying any radioactive material or ionizing radiation-producing devices, you shall contact the Occupational Health Branch at x36726 for a radiation hazard evaluation. The JSC Radiation Safety Officer (RSO) or their designee will determine any documentation, approvals, additional safety requirements and training necessary for purchase, use, or modification of ionizing radiation sources. The JSC Radiation Safety Committee (RSC) will authorize the use and users of radioactive materials and radiation-producing equipment as follows:

- a. Use approval forms listed below from the JSC Forms Website:
  - (1) JF1942 Radioactive Material Use Authorization
  - (2) JF1943 Radioactive Machine Use Authorization
  - (3) JF1944 Radiation User Approval
- b. Ask the RSO to measure and evaluate the x-ray hazard posed by all equipment with voltages over 15,000 V.

<b>JSC Safety and Health Handbook</b>	JPR No.	<b>1700.1K</b>
	Effective Date:	<b>11/25/2013</b>
	Expiration Date:	<b>11/25/2018</b>
	Page Number	Page 7.3-2 of 5

### **7.3.5 Controlling radioactive materials and radiation-producing equipment**

7.3.5.1 You control radioactive materials and radiation-producing equipment by tracking when and where it comes on site, where it is stored and used, how it is transferred, and how it is disposed of. Follow these precautions:

- a. The JSC RSO or designee shall:
  - (1) Approve all purchase requests for or any evaluations of radioactive material or radiation-producing equipment.
  - (2) Survey new packages containing radioactive material promptly (usually at logistics receiving) for contamination and radiation levels.
  - (3) Approve all storage and use areas for radioactive material.
  - (4) Document all transfers of licensed material, making sure that the material is properly identified and the radiation levels are controlled.
  - (5) Approve and keep a record of all radioactive material shipments.
  - (6) Certify that materials are properly classified, described, packaged, marked, and labeled under applicable regulations (both NRC and DOT).
  - (7) Arrange for radioactive waste disposal.
- b. You shall:
  - (1) Mark each room or area in which radioactive material is used or stored as containing radioactive material, as recommended by the JSC RSO.
  - (2) Label each container of radioactive material as recommended by the JSC RSO.
  - (3) Request disposal of radioactive material through the JSC RSO.
  - (4) Never release radioactive gases or particulate radioactive material into the air. Control the release of these materials through the use of a RSO-approved procedure.

### **7.3.6 Special requirements for off-site contractors doing radiographic work on site**

7.3.6.1 Seventy-two (72) hours before performing any type of radiographic work with radioactive material or radiation-producing devices, you shall contact the Occupational Health Branch at x36726 for a radiation hazard evaluation. The JSC RSO or their designee will determine any documentation, approvals, additional safety requirements and training necessary for approval. Use the approval forms listed below from the JSC Forms website:

- a. JF1013 Temporary Radiological Work Permit – JSC, EF, SCTF
- b. JF1014 Temporary Radiological Work Permit - WSTF

### **7.3.7 Non-ionizing radiation and why IT IS harmful**

Non-ionizing radiation includes any of the following from the electromagnetic radiation spectrum: ultraviolet rays, visible light, lasers (for laser controls, see Chapter 6.2 of this Handbook), infrared radiation, radar, radio waves, microwaves, and Hertzian waves. Equipment that produces non-

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	Effective Date:	<b>11/25/2013</b>
	Expiration Date:	<b>11/25/2018</b>
	Page Number	Page 7.3-3 of 5

ionizing radiation includes radio frequency (RF) and microwave devices such as radar, telemetry, communications systems, and test equipment; laser systems and optical devices; and microwave ovens. Non-ionizing radiation is classified as a physical agent and can be harmful because it produces thermal and other effects that damage cells in the body. RF and microwave devices may cause these effects through electric and magnetic fields and induced currents. For more information on hazards from non-ionizing radiation at JSC, contact the JSC Radiation Safety Office.

**7.3.8 Requirements for working with non-ionizing radiation producing devices**

7.3.8.1 Before bringing on site, purchasing, using or modifying any non-ionizing radiation-producing devices, you shall contact the Occupational Health Branch at x36726 for a radiation hazard evaluation (for laser controls, see Chapter 6.2 of this Handbook). The JSC RSO or their designee will determine any documentation, approvals, additional safety requirements and training necessary for purchase, use or modification of non-ionizing radiation sources. Follow these requirements:

- a. Use approval forms listed below from the JSC Forms Website:
  - (1) JF44A Radio Frequency / Microwave Hazard Evaluation Data
  - (2) JF1023 Non-ionizing Radiation Training & Experience Summary
- b. Follow paragraphs 4.13 – 4.17 of NPR 1800.1.

**NOTE:** UL-listed COTS equipment that isn't modified is exempt from this requirement.

**7.3.9 Exposure limits for non-ionizing radiation**

JSC uses limits found in the ACGIH publication, "Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices" (latest version). You can find additional information on exposure limits for RF radiation in the IEEE C95.1 Standard, "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz." Remember, as with all hazardous physical agents, keep the exposure as low as reasonably achievable. Contact the JSC Radiation Safety Office for assistance in determining the specific exposure limit for the non-ionizing radiation from your equipment, process, procedure, or application.

**7.3.10 Precautions when working with non-ionizing radiation**

- 7.3.10.1 You shall follow these precautions when working with non-ionizing radiation:
- a. Follow 29 CFR 1910.97 and paragraphs 4.13 – 4.17 of NPR 1800.1.
  - b. Don't look into waveguide horns, antennas, or open waveguides when any microwave equipment is on.
  - c. Don't wear metal jewelry or eyeglasses near electronic equipment radiating RF energy, even if the level is below the established safe value. Jewelry or eyeglasses may act as a conductor and cause a shock or burn.

<b>JSC Safety and Health Handbook</b>	JPR No.	<b>1700.1K</b>
	Effective Date:	<b>11/25/2013</b>
	Expiration Date:	<b>11/25/2018</b>
	Page Number	Page 7.3-4 of 5

d. Follow Chapter 6.2 of this Handbook, “Laser safety and health,” for using and controlling lasers.

### 7.3.11 Requirements for RF interference

7.3.11.1 For RF interference, you shall:

- a. Make sure that the operation of industrial, scientific, medical, and other equipment generating RF energy doesn’t interfere with authorized radio, radio-navigation, and telecommunication systems.
- b. Treat equipment generating RF energy between 30 Hz and 30,000 MHz as a cause of interference unless you provide the equipment with power line filters, shielding, bonding, and grounding.
- c. Keep RF energy within the limits specified in Chapter 7 of the *Manual of Regulations and Procedures for Federal Radio Frequency Management*.

### 7.3.12 For more information on radiation protection

- a. 10 CFR, “U.S. Nuclear Regulatory Commission Rules and Regulations”
- b. 21 CFR 1000 – 21 CFR 1040, “Food and Drug Administration Rules and Regulations”
- c. 29 CFR 1910.1096, “Ionizing Radiation”
- d. 29 CFR 1910.97, “Non-ionizing Radiation”
- e. 49 CFR 177, “Carriage by Public Highway”
- f. IEEE C95.1 Standard, “IEEE Standard for Safety Levels With Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz
- g. NPR 1800.1, NASA Occupational Health Program Procedures, paragraphs 4.13 – 4.17
- h. JPR 1860.2, “Radiological Health Manual”
- i. *Manual of Regulations and Procedures for Federal Radio Frequency Management*, U.S. Department of Commerce,” National Telecommunications and Information Administration, Washington, D. C., January 2008 Edition/September 2009 Revision
- j. *Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices (TLVs<sup>®</sup> and BEIs<sup>®</sup>)*, American Conference of Governmental Industrial Hygienists, latest edition
- k. Presidential Guidelines for Diagnostic X-Rays at Federal Installations, approved January 16, 1978

### 7.3.13 Responsibilities for radiation safety

- a. As a **supervisor**, you are responsible for:
  - (1) Making sure that your employees participate in the JSC RPP
  - (2) Providing training to your employees in their radiation tasks and procedures

<b>JSC Safety and Health Handbook</b>	JPR No.	<b>1700.1K</b>
	Effective Date:	<b>11/25/2013</b>
	Expiration Date:	<b>11/25/2018</b>
	Page Number	Page 7.3-5 of 5

- (3) Assuring that all JSC-issued personal radiation dosimetry devices are returned to the Radiation Safety Office in conjunction with all employment termination
- b. As the **JSC RSO**, you are responsible for:
  - (1) Implementing JSC’s radiation protection program
  - (2) Supervising the Radiation Safety Office
  - (3) Answering to the JSC Radiation Safety Committee
  - (4) Being appointed by the Director, Space and Life Sciences
  - (5) Following your specific JSC RSO responsibilities, as described in Part 2.4 of JPR 1860.2
- c. The **Director of Human Health and Performance** is responsible for:
  - (1) Making sure that the radiation protection program is developed and carried out
  - (2) Securing licenses or permits where required
  - (3) Establishing an RSC
- d. The **Radiation Safety Committee** is responsible for:
  - (1) Coordinating the requirements for controlling radiation among the various agencies that regulate radiation
  - (2) Approving all uses of radiation on site
- e. The **Radiation Safety Office** is responsible for:
  - (1) Reviewing procedures
  - (2) Monitoring operations
  - (3) Educating personnel in radiation protection and in the safe handling of radioactive materials and radiation-producing equipment
  - (4) Providing radiation dosimetry equipment, such as thermo-luminescent dosimeters, pocket dosimeters, warning signs, and labels for radiation or radioactive materials
  - (5) Making sure that all operations meet NRC requirements

**7.3.14 Safety and health records for radiation protection**

Center-level – The Occupational Health Branch shall keep records on NRC licenses and radiation exposure.

NOTE: See Appendix F, Attachment 1.1A for details on records required by this Chapter.