

UT Health Science Center: NRP01 Non-Ionizing Radiation Program	
Version 2	Publication Date: 10/30/2025

Objective

This procedure establishes the requirements and safe work practices for non-ionizing radiation sources, including Nuclear Magnetic Resonance (NMR), Ultraviolet (UV) radiation, microwave radiation, and visible light radiation.

Scope

This procedure has been developed and implemented by UTHSC Research Safety Affairs and approved by the UTHSC Radiation Safety Committee. This procedure applies to all affected activities on the campus.

Laser safety is not addressed in this procedure. Refer to [LS01 – Laser Safety Program](#) for campus safety requirements for lasers.

Roles

Radiation Safety Officer (RSO) – Provide assistance and guidance to UTHSC users and operators of equipment generating non-ionizing radiation.

Principal investigator/Authorized User – review this procedure and ensure that the equipment generating non-ionizing radiation is used safely and in accordance with the manufacturer's recommendations. Ensure all operators and bystanders are aware of the hazards posed and safe practices required to reduce or eliminate exposure hazards.

UTHSC staff, students, contractors, and visitors - comply with the requirements of this procedure when operating or in the vicinity of equipment on campus that generates non-ionizing radiation.

Definitions

Non-ionizing radiation – electromagnetic radiation that does not have sufficient energy to ionize atoms or molecules. Wavelengths classified as non-ionizing radiation are those greater than 100 nanometers (nm) and photon energies greater than 12.4 electron volt (eV).

Infrared light (IR) – light with a wavelength of 700 – 10^6 nm

Near-Infrared (NIR) - light with a wavelength of 700 - 1,400 nm

Mid-Infrared (MIR) - light with a wavelength of 1,400 - 3,000 nm

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Far-Infrared (FIR) - light with a wavelength of $3,000 - 10^6$ nm

Ultraviolet (UV) light – light with a wavelength of 100-400 nm.

Ultraviolet A (UVA) light – light with a wavelength of 320-400 nm

Ultraviolet B (UVB) light – light with a wavelength of 280-320 nm

Ultraviolet C (UVC) light – light with a wavelength of 100-280 nm

Visible light – light with a wavelength of 400-700 nm

Radiofrequency radiation – generally defined as the portion of the electromagnetic spectrum of frequencies between 3 kilohertz and 300 gigahertz. (US Federal Communications Commission)

Microwave radiation – generally defined as the portion of the electromagnetic spectrum of frequencies between 1 gigahertz and 30 gigahertz. (US Federal Communications Commission)

Procedure

I. Protocol and Registration Requirements

- A. Devices such as nuclear magnetic resonance (NMR) instruments and magnetic resonance imaging (MRI) devices generating an accessible magnetic field of more than 5 gauss must be registered by the device owner with the UTHSC Radiation Safety Office.
- B. Individuals using devices such as NMR and MRI devices generating an accessible magnetic field of more than 5 gauss used in research, development, teaching, or demonstration projects must complete a [radiation protocol](#) before work begins.

II. Ultraviolet (UV) Light Hazard

- A. Associated Hazards
 1. UV radiation is a known carcinogen. UV radiation has substantial energy that approaches the photon energy of ionizing radiation. UV radiation causes biological effects primarily through photochemical interactions. In addition to cancer, erythema (sunburn), and skin aging are also known consequences of UV skin exposure. The

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biological effects are dependent on the time of exposure, the specific UV wavelength, and the susceptibility of the individual exposed. Various components of the human eye are susceptible to damage from extended exposure to direct/reflected UV exposure from photochemical effects. The cornea, like the skin, can be “sunburned” by exposure to too much UV radiation. This is called keratoconjunctivitis (snow blindness or welders flash), a condition where the corneal (epithelial) cells are damaged or destroyed. This condition usually does not present symptoms until 6 to 12 hours following UV exposure. Although very painful (often described as having sand in the eyes), this condition is usually temporary (a few days) because the corneal cells will grow back. In very severe cases, the cornea may become clouded and corneal transplants may be needed to restore vision. Exposure to UV-C and UV-B presents the greatest risk to the cornea. The lens of the eye is unique in that it is formed early in human development and is not regenerated if it becomes damaged. For normal vision, it is essential that the lens remains clear and transparent. UV-A exposure is suspected as a cause of cataracts (clouding of the lens).

B. Safe Practices

1. When feasible, UV light systems should utilize a protective interlock system to shut off the UV light source when there is potential for human exposure.
2. Use of shielding to absorb UV light and reduce exposure to operators and bystanders.
3. Ensure locations where UV light sources are used are posted with warning signs and access is restricted.
4. Personnel must wear a face shield rated to provide protection from UV light and skin coverings whenever there is the potential for exposure.
5. Ensure operators and bystanders receive appropriate UV safety training before operating or assisting with UV-generating equipment.

C. Research Safety Affairs Responsibilities

1. UV sources and associated equipment are inspected.

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- D. UTHSC staff, students, contractors, and visitors operating UV-emitting equipment on campus
1. Ensure all operators and potential exposed persons are trained on the hazards and safe practices section of this procedure.
 2. Ensure all interlocks on UV-generating equipment are functional.
 - a. Biological Safety Cabinet sashes should be interlocked to prevent the use of the UV lamps unless the sash is closed.

III. Visible Light Hazard

- A. Associated hazards
1. All visible light (400 to 700 nm) entering the human eye is focused upon the sensitive cells of the retina, where human vision occurs. The retina is the part of the eye normally considered at risk from visible light hazards.

Any very bright visible light source will cause a human aversion response (we either blink or turn our head away). Although we may see a retinal afterimage (which can last for several minutes), the aversion response time (about 0.25 seconds) will normally protect our vision. This aversion response should be trusted and obeyed. NEVER STARE AT ANY BRIGHT LIGHT SOURCE FOR AN EXTENDED PERIOD. Overriding the aversion response by forcing yourself to look at a bright light source may result in permanent injury to the retina. This type of injury can occur during a single prolonged exposure. Welders and other persons working with plasma sources are especially at risk for this type of injury.

Visible light sources that are not bright enough to cause retinal burns are not necessarily safe to view for an extended period. Any sufficiently bright visible light source viewed for an extended period will eventually cause degradation of both night and color vision. Appropriate protective filters are needed for any light source that causes viewing discomfort when viewed for an extended period.

For these reasons, prolonged viewing of bright light sources (plasma

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arcs, flash lamps, etc.) should be limited using appropriate filters. Welding goggles or shields of the appropriate “shade number” will provide adequate protection for limited viewing of such sources. Reference the [UTHSC PPE Procedure](#) for additional information.

The blue light wavelengths (400 to 500 nm) pose an additional hazard to the retina by causing photochemical effects similar to those found in UV radiation exposure.

B. Safe Practices

1. Use barriers or appropriate shaded eyewear when appropriate.
2. Ensure operators and bystanders are aware of these sources of visible light and available PPE to mitigate the hazard.
3. For specific hazards from welding and cutting, reference the [UTHSC PPE Procedure](#) for additional information.

C. UTHSC staff, students, contractors, and visitors' responsibilities

1. Ensure operators and bystanders are aware of the hazards.
2. Use shading, light-blocking materials, or other engineering controls to reduce the hazard.
3. Provide appropriate PPE when engineering controls are not feasible.

IV. Infrared Radiation Hazard

A. Associated Hazards

1. Infrared radiation in the IR-A that enters the human eye will reach (and can be focused upon) the sensitive cells of the retina. For high irradiance sources in the IR-A, the retina is the part of the eye that is at risk. For sources in the IR-B and IR-C, both the skin and the cornea may be at risk from “flash burns.” In addition, the heat deposited in the cornea may be conducted to the lens of the eye. This heating of the lens is believed to be the cause of so called “glass blowers” cataracts because the heat transfer may cause clouding of the lens. Assessment of IR hazards present can be difficult, but mitigation of eye exposure is accomplished using appropriate eye protection.

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2. Some of the hazards associated with IR exposure are summarized below.
 - a. Retinal IR Hazards (780 to 1400 nm) - possible retinal lesions from acute high irradiance exposures to small dimension sources
 - b. Lens IR Hazards (1400 to 1900 nm) - possible cataract induction from chronic lower irradiance exposures. •
 - c. Corneal IR Hazards (1900 nm to 1 mm) - possible flash burns from acute high irradiance exposures.
 - d. Skin IR Hazards (1400 nm to 1 mm) - possible flash burns from acute high irradiance exposures
3. Other factors influencing the severity of the hazard include
 - a. The exposure time (chronic or acute)
 - b. The irradiance value (a function of both the image size and the source power)
 - c. The environment (conditions of exposure)

B. Safe Practices

1. Use barriers or appropriate shaded eyewear when appropriate.
2. Ensure operators and bystanders are aware of these sources of visible light and available PPE to mitigate the hazard.
3. For specific hazards such as welding and cutting, reference the UTHSC welding procedure for additional information.

V. Microwave and Radiofrequency Radiation Sources

A. RF/Microwave Hazard

1. RF and microwaves are generated in a variety of equipment. Some equipment, such as antennas, is designed to emit microwave and RF radiation. Other equipment, such as heaters, ovens, waveguides, etc., is designed to contain the energy during operation. Other devices, such as power supplies, may emit microwave/RF radiation when operating.
2. The hazards from exposure to microwave/RF radiation are a function of the following design and operating characteristics:

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- a. Frequency of the source
 - b. Power density at the point of exposure
 - c. Accessibility to the radiation field
 - d. Does the exposure occur in the near or far field
 - e. Orientation of the human body to the radiation field
3. Common biological effects of exposure to microwave/RF radiation are related to the direct heating of tissues (thermal effects) or the flow of current through tissue (induced current effects). Non-thermal effects, such as those resulting in carcinogenesis and teratogenesis, have been demonstrated in animals but have not been proven by epidemiological studies in humans.

The following biological effects have been demonstrated in humans:

- a. Cataract formation (from eye exposure).
 - b. RF (induction) burns.
 - c. Burns from contact with metal implants, spectacles, etc.
- B. Safety Practices
1. If the microwave/RF source is a primary antenna, determine if posting and a physical barrier are required by consulting the manufacturer or other sources such as the [US Federal Communication Commission Regulations](#).
 2. Review [the US Federal Communication Commission Regulations for permissible exposure limits](#) to RF radiation.
 3. Ensure all UTHSC staff, students, contractors, and visitors are aware of any RF/Microwave hazards in their work area.
 4. Ensure all interlocks, physical barriers, or other engineering controls are functional and used when operating RF/microwave generating equipment.

VI. Magnetic Field Hazards

A. Magnetic Field Hazards

1. Static magnetic fields can present health hazards. Large static magnetic fields may require appropriate controls to mitigate

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potential hazards. For sources that will subject human exposure to the magnetic field (such as MRI devices), it is critical that safety precautions cover not only the operator of the device, but also the research subject. There are no known adverse bioeffects for flux densities within the ACGIH (American Conference of Governmental Industrial Hygienists) exposure limits. Implanted medical devices pose a potential hazard to individuals exposed to fields exceeding the ACGIH limits (see the following section on kinetic energy hazards).

Due to the large fields associated with Nuclear Magnetic Resonance (NMR) magnets, ferrous objects can be accelerated toward the magnet with sufficient energy to seriously injure persons and/or damage the magnet.

Cryogenically cooled magnets can release enough inert gas to displace the oxygen in a room should a quench occur. The potential for frostbite of bystanders is another potential hazard.

B. Safety Practices

1. Notify the Radiation Safety Officer of NMR/MRI devices used on campus. These devices must be registered.
2. A field strength map of the area surrounding the magnet should be developed and posted in the vicinity of the system generating the magnetic field. The manufacturer should be requested for this survey at the time of installation or when the equipment is being serviced.
3. All access points to rooms containing magnetic fields more than 5 gauss shall be marked with magnetic field hazard signs on a barricade. The Radiation Safety Officer can provide the signage.
4. Persons with cardiac pacemakers or other implanted medical devices shall be restricted to areas outside the 5 gauss threshold line.
5. Security (locked doors) and proper door markings shall be maintained to prevent unauthorized access to the magnet area.

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6. All operators must be trained in safety hazards and safety work practices.
7. Other personnel must be escorted into the equipment room and advised of safety requirements. No metallic objects are permitted in the lab.

VII. Documentation

- A.
- B. Radiation Safety document associated with these activities will be saved in Environmental Safety and Health Assistant (EHSA) database or in designated folders on SharePoint.

Penalties/Disciplinary Action for Non-Compliance

License violations are subject to civil penalties up to \$5,000 per day per violation. In the event of a threat to public health and safety, the Division has the right to confiscate radiation sources.

References

- I. [Tennessee Administrative Code Title 0400 - Environment and Conservation Subtitle 0400-20 - Division of Radiological Health](#)
- II. [NUREG 1556 Volume 11 Revision 1](#)
- III. License R-79019-D30

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Responsible Official & Additional Contacts

This Responsible Official and Additional Contacts section contains those who are responsible or share certain policy responsibilities, organized by subject matter, such as monitoring compliance with the policy, providing additional guidance on policy clarifications, organizing policy training, updating the policy, etc.

Subject Matter	Office Name	Telephone Number	Email/Web Address
Policy Clarification and Interpretation	Research Safety Affairs	(901) 448-6114	radsafety@uthsc.edu
Policy Training	Research Safety Affairs	(901) 448-6114	radsafety@uthsc.edu

Related Policies/Guidance Documents

OSHA 1910.97 Nonionizing Radiation

[GS050 – Personal Protective Equipment](#)