Non-Ionizing Radiation: Ultraviolet Light Sources

University of Tennessee Safety Program RAD-110

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Purpose

The University of Tennessee, Knoxville Non-Ionizing Radiation Safety Program exists to support the safe use of non-ionizing radiation sources on our campus and the University of Tennessee System-wide *Policy SA0100 – Safety and Health Program*.

Exposure to UV radiation should be controlled to prevent thermal injury to skin and eyes. Potential long-term damage that can cause skin cancer or cataracts can be controlled through engineering controls or personal protective equipment.

Scope and Applicability

The scope of this program is for faculty, staff, and students who use UV radiation sources other than laser generated UV sources on UT Knoxville campus. Laser generated hazards are covered under the Laser Safety Program RAD-120. Other forms of non-ionizing safety are described in RAD-100.

Abbreviations and Definitions

EHS: Environmental Health and Safety

NIR: Non-Ionizing Radiation

OSHA: Occupational Safety and Health Administration

PPE: Personal Protective Equipment

UTK: University of Tennessee, Knoxville

Non-Ionizing Radiation: is a form of electromagnetic radiation with varying effects on the body, depending largely on the particular wavelength of the radiation. The types of non-ionizing radiation are: radio frequencies (RF, including radar and microwave); infrared (IR), ultraviolet (UV) light, and visible light.

Roles and Responsibilities

Employees/Students shall

- Report all unintended or improper exposure incidents, near misses or unsafe equipment to your supervisor in the operation of NIR sources or related equipment.
- Follow all recommended work practices and specific operating procedures.
- Use PPE and equipment provided to decrease exposure to NIR hazards in the work area.

- Comply with all university policies, OSHA requirements and regulations to assure a safe and healthful working environment.
- Attend all required safety training and seek additional training or information if a NIR hazard is likely.
- Immediately terminate any work that is deemed unsafe or could lead to personal injury.

Supervisors/Principal Investigators shall

- Ensure that all individuals receive safety training before using NIR equipment.
- Provide individuals with appropriate PPE and other controls. Ensure that individuals properly use PPE and other control measures.
- Ensure that individuals are familiar with the hazards associated with NIR.
- Develop operating procedures specific to the NIR equipment (if needed).
- Ensure that proper warning signs are posted (if needed).

EHS shall

- Provide on-site hazard analysis upon request and assist in determining appropriate methods to minimize NIR exposure to within acceptable limits.
- Develop and implement UTK's NIR policy and update the policy as needed.
- Provide, or arrange for, exposure testing and monitoring, as appropriate.
- Investigate accidents or incidents involving NIR and initiate appropriate action.

Training and Information

EHS can provide guidance and general instruction on exposure prevention to various types of hazardous NIR upon request.

At a minimum, **supervisors** should provide individuals in the workplace with instruction of their specific NIR hazards.

Ultra-Violet Light Hazards

UV-A (Black Light)	315-400 nm	hazard rating - low	Risks or Injuries from Exposure: cataracts, retinal burns, skin cancer
UV-B (Erythemal)	280 – 315 nm	hazard rating – mid-high	Risks or Injuries from Exposure: corneal injuries, cataracts, photokeratitis, erythema, skin cancer
UV-C (Germicidal)	100-280 nm	hazard rating – highest	Risks or Injuries from Exposure: corneal injuries, photokeratitis, erythema, skin cancer

The biological effects of UV radiation depend on the wavelengths concerned. Since UV radiation has such low penetrating power, the effects are confined mainly to the eyes and the skin.

The effects on skin are two types, acute and chronic. Acute effects appear within a few hours of exposure while chronic effects are long lasting, cumulative and may not appear for years. Acute effects of ultraviolet radiation are like sunburn; the redness of the skin called erythema. Chronic effects include accelerated skin aging and skin cancer.

Protection of the skin from UV radiation hazards is best achieved by wearing clothing, gloves, and face shields. The use of UV skin blocks (creams or lotions) is considered inadequate for protection against the high irradiance of man-made UV radiation sources.

The eye is very sensitive to UV radiation where main effects are due to exposure to UV-B and UV-C, namely conjunctivitis and photokeratitis. In conjunctivitis the membranes lining the insides of the eyelids and covering the cornea become inflamed resulting in discomfort as if there was sand in the eyes. Photokeratitis manifests as an aversion to bright light. The severity of these conditions depends on the duration, intensity and wavelength of exposure. Symptoms may appear 6 to 12 hours after exposure and may subside after 24 to 36 hours with no permanent damage. Unlike the skin, the eyes do not develop a tolerance to repeated exposure to ultraviolet light.

Engineering Controls:

The use of light-tight cabinets or, enclosures is the preferred means of preventing exposure. Where it is not practicable to fully enclose the UV light, use screens, shields, and barriers to contain the UV radiation Some equipment come with interlock devices. Interlocks must not be tampered with or bypassed. They must be replaced or repaired if they are not functioning properly.

Administrative Controls:

Administrative controls for UV hazards consist of warning signs, limitation of access and exposure time and instructing individuals of the hazard and the precautions to be taken. The PI should decide what measures are necessary to limit access to the source and to make personnel aware of its presence.

Training

Personnel should review the manufacturer's manuals for the UV-generating equipment and be familiar with its use. The manufacturer's manuals provide specific safety-related information (type of eye/skin protection needed, ventilation requirements, etc.) that should be reviewed and implemented for safe operation. If any uncertainty or concern exists regarding the safe use of UV-generating equipment, contact the manufacturer for clarification.

Principal Investigators or supervisors should provide employees or lab personnel with the following when working with or around UV light sources:

- Proper use of the UV light–producing equipment
- Warning signs and labels
- Proper use and storage of personal protective equipment (PPE)
- Symptoms of UV exposure

Personal Protective Equipment (PPE)

Depending on the risk assessment, appropriate PPE may include eyewear, face shields, gloves, and lab coats.

Eyewear

Use eyewear that is appropriate for the work. Special safety glasses are available for the different UV ranges. For best UV protection, the eyewear should be compliant with ANSI Z87.1. ANSI Z87.1 requires markings on eye protection that relate directly to the device's ability to defend against specific hazards. Eye protection that is Z87.1-compliant is marked with "Z87."

Face shield

UV-absorbing full-face shields should be worn in addition to safety glasses or goggles (goggles may not provide sufficient face protection). Severe skin burns can happen in a very short time, especially under the chin (which is often left exposed). Full face shields are the only appropriate protection when working with UV light boxes for more than a few seconds.

Gloves

At a minimum, nitrile, latex, or tightly woven fabric gloves are recommended to protect against the significant amounts of UV-A and UV-B that may pass through to the skin; these types of gloves have a low transmission of UV compared to vinyl gloves. Gloves should protect personnel from UV light, as well as from the hazard of the activity being performed.

Lab coat

Personnel should wear lab coats that fasten securely at the wrists and up the neck so that no skin is exposed. Note that burns to wrists and the neck are not uncommon.

Specific Equipment Guidance

Biological Safety Cabinets are never to be occupied while the UV lamp is activated. Always lower sash and keep away from escaping rays. Mechanical safety devices should be standard on most new cabinets. Access to the interior of the biosafety cabinet while the lamp is operating is controlled by closing the sash. Some cabinets are equipped with an interlocking switch that deactivates the UV lamp when the fluorescent lamp is activated; however, personnel must ensure that the UV light is off prior to working at the cabinet. Placing labels that fluoresce when exposed to UV inside the biosafety cabinet should be considered if the UV lamp is not interlocked with the fluorescent lamp.

UV light boxes/ Transilluminators should be used with the protective UV shield in place. If the shield is removed, a UV filtering face shield, nitrile or latex gloves along with a lab coat should be worn to protect skin and eyes from UV radiation exposure.

Crosslinkers are not to be used if the door safety interlocking mechanism is not working properly.

Hand-held UV Lights or UV curing: Individuals should wear personal protective equipment while the hand-held UV unit is operating if the device is not enclosed. Follow manufacturer instruction for safe use of the device. Necessary PPE could include a UV resistant face shield, gloves and a lab coat with no gap between the cuff and the glove.

References

University of Tennessee System Policy SA0100–Safety and Health Program
https://policy.tennessee.edu/

OSHA Non-Ionizing Radiation
https://www.osha.gov/non-ionizing-radiation

OSHA: 29 CFR 1903.1 (General Duty Clause)

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