CWA Occupational Safety and Health Fact Sheet #16

Radio Frequency (Microwave & Radio Wave) Radiation

Since World War II, many significant technological advancements have occurred within the telecommunications and other industries. One of these is the increased use of radio frequency, i.e., microwave and radio wave, radiation equipment. Such equipment is widely used in the broadcasting and communications fields in the form of cellular telephones and towers; in the health care industry for medical treatment; in the food industry for the processing and cooking of food; in the wood, textile, and glass fiber industries for drying materials; and in the automotive, electrical, rubber, and plastic products industries for fusing and sealing operations.

The National Institute for Occupational Safety and Health (NIOSH) estimates that millions of American workers work with and are exposed to radio frequency radiation equipment. CWA members who are exposed to radio frequency radiation include telecommunications microwave and radio wave service technicians and outside plant technicians, operators of (cathode ray tube) computers, employees who use microwave ovens at work, radio frequency radiation equipment operators, manufacturing workers, and health care workers who come in contact with or who operate medical diathermy equipment.

Radio frequency, i.e., microwave and radio wave radiation, is a specific component of the electromagnetic spectrum. Radio frequency radiation is in the non-ionizing portion of the spectrum. Non-ionizing radiation includes the lower frequencies in the electromagnetic spectrum such as ultraviolet and visible light, infrared, microwave and radio wave (See Table I).

Electromagnetic radiation consists of vibrating electric and magnetic energy or fields moving through space. For example, electric current in a transmitter circuit establishes electric and magnetic fields in the region around it. As the electric current moves back and forth, the fields continue to build up and collapse, forming electromagnetic radiation. This electromagnetic radiation is characterized in terms of the wavelength and the frequency of vibration.

Microwave and radio wave radiation may be categorized as continuous waves (e.g., communications equipment), intermittent (microwave ovens, medical diathermy equipment, and radio frequency equipment), or pulsed mode (radar systems). Microwave and radio frequency radiation may be transmitted, reflected, or absorbed upon striking an object.

When measuring radio frequency radiation emissions, the power of the source should be measured by the intensity of the field. Intensity should be measured in terms of power density. Power density is the amount of energy carried by radio frequency, i.e., microwave or radio wave, radiation as it proceeds each second through a square measure of space. The energy carried by microwave and radio wave radiation is expressed in terms of milliwatts per square centimeter (mW/cm (2) = 1/1,000 of a watt) or microwatts per square centimeter (uW/cm (2) = 1/1,000 of a milliwatt).

Health Effects

The various types of radiation affect the human body in different ways. For example, ionizing radiation, that contains a tremendous amount of energy and penetrating power, will cause changes in the body's molecular system. On the other hand, as noted, non-ionizing radiation operates at much lower frequencies and is not believed to be as harmful to the human body as ionizing radiation. The type of radiation to which affected CWA members are most often exposed is non-ionizing radiation, e.g., radio frequency, i.e., microwave and radio wave, radiation.

It is known, however, that exposure to non-ionizing radio frequency radiation may produce serious biological effects. As high frequency radio frequency radiation, i.e., microwave radiation, penetrates the body, the exposed molecules move about and collide with one another causing friction and, thus, heat. This is known as the thermal effect. If the radiation is powerful enough, the tissue or skin will be heated or burned. Such health effects may or may not be reversible, depending on the particular tissue or organ that is exposed, the intensity of the radiation, the frequency and duration of the exposure, the environmental temperature and humidity, and the body’s efficiency in dissipating the heat.

At the present time, there is substantial scientific data that establishes negative health effects associated with microwave radiation. For example, it has been demonstrated that microwave radiation may cause eye and testicular damage. These organs are highly vulnerable to radiation damage because they contain few blood vessels. Therefore, they are unable to circulate blood and dissipate the heat from radiation as effectively as other organs.

An additional health concern involves damage to the eyes. For example, several scientific investigations have shown that cataracts among humans and laboratory animals have occurred as a result of the intense heating of high frequency microwave radiation. Such data has revealed that a particularly important determinant in the causation of microwave radiation-induced cataracts is the time intervals between exposures, i.e., increased time intervals between exposures is thought to allow the body’s repair or defense mechanism more opportunity to limit ocular lens damage.

As noted, microwave radiation may also cause damage to the male testes/reproductive organs. Specifically, scientists have demonstrated that exposure to microwave radiation may result in partial or permanent sterility. In addition, some scientific evidence suggests similar effects associated with microwave exposure and female reproductive problems. Furthermore, the scientific literature indicates a relationship between exposure to microwave radiation and birth defects, such as mongolism (Down's Syndrome) and central nervous system damage.

Exposure to radio wave radiation may result in a non-thermal reaction that causes similar molecular interactions as in the thermal effect, but without the heating of the exposed tissue or organ. The site of energy absorption varies with the frequency, that is, exposure to low frequency non-ionizing radio frequency radiation will (theoretically) penetrate the skin and cause molecular interactions similar to those caused by high frequency radio frequency radiation. Complicating such non-thermal reaction, the body's heat and warning system may not provide protection

because the energy is absorbed at locations below the nerves.

Clearly, a review of the medical and scientific literature indicates a tremendous need for more scientific research. Such research should focus upon the effects of microwave and radio wave radiation upon humans. Particular emphasis needs to be directed at exposure to long-term, low-level biological effects of microwave and radio wave radiation. Such research is particularly important in order that the issue of exposure to potentially harmful microwave and radio wave radiation emissions from microwave and radio wave transmitters and human health effects might be more adequately determined.

An additional health concern regarding work with radio frequency equipment is potential electrical shock. This may occur when, under abnormal conditions, the operator is standing in water and comes into contact with a high-frequency generator circuit.

Controlling the Hazard

Employers must ensure that potentially exposed microwave and radio wave radiation workers have a safe and healthful workplace. This means that employers should implement engineering controls to minimize or eliminate potential exposure, conduct comprehensive training about the potentially hazardous working conditions, and institute medical surveillance programs.

The most effective way to eliminate and/or minimize occupational exposure to radio frequency microwave and radio wave radiation is through the use of engineering controls. For example, the source of the potential problem, i.e., the radiation-emitting equipment, should be enclosed or effectively shielded or the worker should be separated from the source. This requirement is equally important to all workers exposed to microwave and radio wave radiation. Where engineering controls cannot be implemented, personal protective equipment such as protective clothing and eyewear should be provided and utilized.

In addition, employers should provide comprehensive training regarding potentially hazardous working conditions. Such a program might consist of written and/or audio/visual materials that detail potential safety and health dangers, health effects of exposure, methods of control, first aid procedures, the use of hazard warning signs and labels, and the identification of restricted areas.

Employers should also institute medical surveillance programs that would provide workers with routine medical examinations specific to any biological effects resulting from occupational radio frequency radiation exposures. Potential benefits of medical surveillance would include: an assessment of employees' physical fitness to safely perform the work (consisting of a medical and occupational history as well as a physical examination), biological monitoring of exposure to a particular agent, and early detection of any biological damages or effects. In addition, documented health effects would allow the worker and her/his physician to make informed judgements about further exposures.

The OSHA Standard
The OSHA Standard for electromagnetic radiation (that does not cover low frequency radio frequency microwave or radio wave radiation) is 10mW/cm(2) (milliwatt per square centimeter) as averaged over any possible 0.1 hour period. This means the following:

Power Density: 10mW/cm(2) (milliwatt hour per square centimeter) for periods of 0.1 hour or more.

Energy Density: 1mW/cm(2) (milliwatt hour per square centimeter) during any 0.l hour period.

The Standard is based upon research conducted in 1953 examining the threshold for thermal (heat) damage to tissue. (Specifically, the amount of radiation that would cause cataract development). The power density necessary to produce cataracts was approximately 100 mW/cm(2) to which a safety factor of 10 was applied. Thus, a maximum permissible level of 10mW/cm(2) was established.

Unfortunately, as noted, the OSHA Standard does not provide coverage for low frequency radio frequency microwave and radio wave radiation. Therefore, given concerns among involved scientists and practitioners, three non-governmental organizations, e.g., the American National Standards Institute (ANSI) and the Institute of Electrical and Electronics Engineers (IEEE), as well as the National Council on Radiation Protection and Measurements (NCRP), developed and issued two different voluntary guidelines on radio frequency microwave and radio wave radiation. In turn, in 1996 the Federal Communications Commission has translated these voluntary guidelines into recommended exposure criteria (See Table II).

What Can You Do?
All CWA members should make sure that their employer is maintaining a safe and healthful workplace. The key to making the workplace safe for all CWA members is strong, active local safety and health committees. The committee can identify dangerous conditions at the workplace and discuss them with management. If the employer refuses to cooperate, the committee can request an OSHA inspection. The committee should always coordinate its activities through the local officers, the CWA Representatives, and negotiated safety and health committees. In addition, CWA members may obtain information and assistance by contacting the:

CWA Occupational Safety and Health Department
501 Third Street, N.W.
Washington, D.C. 20001-2797
Webpage: www.cwasafetyandhealth.org
Phone: (202) 434-1160.

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