Bioenvironmental Engineering Site Assessment I

Unit 12: Non-ionizing Radiation, UV / IR

Unit Description: In this unit, you will be stationed at RAF Yorkton in Mindenhall, United Kingdom. While you're stationed there you will conduct a routine HRA at a shop performing welding work on base where you will need to consider UV/IR health threats. When you're done, you will be able to identify and analyze UV/IR health threats and recommend appropriate controls.

Table of Contents

Lesson 1: Ultraviolet and Infrared Hazards

Lesson Description

In this lesson, you will conduct a routine HRA at a shop that is performing welding work. Upon completion of this lesson, you will be able to explain how UV/IR hazards are identified, analyzed, and managed.

Lesson Overview (Page 1 of 11)

UV/IR are non-ionizing forms of radiation that are used throughout the Air Force for a variety of purposes. It's important to be able to identify and analyze UV/IR health threats in order to recommend appropriate controls to adequately protect workers.

While conducting the HRA at the metal shop, you will:

- Recall UV/IR sources and concerns.
- Determine UV/IR exposures for a given scenario.
- Determine appropriate controls for UV/IR radiation.
- Select appropriate UV/IR PPE, given hazards and equipment limitations.
- Determine if PPE for UV/IR is used and maintained in accordance with established guidelines.

Audio Script

Narrator: During the morning meeting with the rest of the BE Techs in your shop, you volunteer to perform a routine HRA at a metal shop on base to ensure that newly issued hearing protection is working properly. While you're there, you will also investigate any issues the shop supervisor may bring to your attention

RAF Yorkton Scenario (Page 2 of 11)

When you arrive at the shop, you head to the supervisor's office to inform him of your arrival.

Audio Script

Shop Supervisor: Good morning. Is there something I can help you with today?

BE Tech: I wanted to make sure the hearing protection issued last week is working well for your personnel.

Shop Supervisor: Everything seems to be working great. I've checked with the personnel, and they agree the new HPD has corrected the hearing fatigue they had.

BE Tech: That's great.

Shop Supervisor: There's actually something else I'd like to ask you about. Two workers met with me this morning complaining of discomfort they've been having with their eyes. And, someone mentioned at lunch yesterday that her face, arms, and neck turned red and became irritated for no reason. Any idea what could be causing that?

BE Tech: Not off-hand. I'll look around the shop and let you know if I find anything we should look at more closely.

Shop Supervisor: Thank you.

RAF Yorkton Scenario (Page 3 of 11)

Audio Script

Narrator: As you look around, you notice something you haven't seen in the shop before. There are 3 individuals in a previously unoccupied area of the shop performing welding work on what looks like livestock fences.

RAF Yorkton Scenario (Page 4 of 11)

When you are walking across the shop, you notice that a worker who is facing the direction of the welding is rubbing his eyes, which seem red and irritated.

Audio Script

BE Tech: Good morning, I'm investigating some health concerns that may be occurring in this shop. I noticed you were rubbing your eyes and they seem a bit irritated. Can you tell me anything about that?

Shop Worker: Yeah, they've been really burning and watering a lot for about a week now. I can barely sleep at night.

BE Tech: Do you think something in particular is causing the irritation?

Shop Worker: They put in an air purifier near my workstation last week. I wonder if that has anything to do with it because my eyes started watering the same day it was installed.

By the way, a co-worker told me a couple days ago that she has been experiencing irritation to her skin. She said that it started happening about the same time my eyes began irritating me.

BE Tech: Have there been any other changes in the shop, such as new processes or anything out of the ordinary?

Shop Worker: Now that you mention it, the air cooling system stopped working last week and it got pretty hot in here. It was just fixed this morning.

BE Tech: Have any new projects started that include work not normally performed here?

Shop Worker: Those guys over there started a special project last week. I think they're welding horse stables, but they're working on those in the corner area away from the other workers.

BE Tech: I appreciate the information. I'll see what I can do to find out what may be causing the problem with your eyes.

Scenario Challenge Point (Page 5 of 11)

Based on the information you learned from your conversation with the worker, which one of the following situations is most likely causing the symptoms?

A The air cooling system in the metal shop was not operational.

B An air purifier was installed next to the worker's station.

C Workers are welding and assembling new horse stables.

D None of the situations described would cause the symptoms.

Sources and Concerns (Page 5a of 11)

Ultraviolet (UV) radiation and infrared (IR) radiation are common types of non-ionizing radiation that occur from natural or man-made sources. Knowing the sources that can produce UV/IR radiation and the various health concerns associated with a UV/IR exposure is critical to protect personnel from overexposures which could potentially impact the mission. More information about the sources of and concerns associated with UV and IR radiation is provided below.

Tab: UV Radiation

UV radiation is primarily generated by the **sun**; however, there are also many artificial sources of UV radiation you may encounter across the Air Force. Some sources produce UV radiation directly, while other sources create it as a byproduct. Artificial sources of UV radiation include:

- Welding.
- Photoelectric scanning.
- Tanning booths.
- Germicidal disinfection.
- Black lights.
- Medical diagnostics.

Depending on the length and amount of exposure, **photochemical reactions** can cause different biological effects to occur from exposure to each type of UV radiation.

Ultraviolet Radiation from the Sun

The amount of UV radiation from the sun varies through the year and throughout the day. The amount of UV radiation is greatest when the sun is directly overhead. At this time, the UV radiation travels through less atmosphere and is therefore stronger, potentially causing more damage.

When the sun is lower in the sky, more UV radiation is absorbed and scattered in the atmosphere, making the amount of UV exposure less detrimental.

BE plays an important role when protecting personnel who work outside from a UV overexposure due to excessive time spent in the sun.

Photochemical Reactions

A photochemical reaction is a chemical reaction which is induced by the absorption of energy in the form of visible, infrared, or ultraviolet radiation.

UVA

UVA is the long wave type of UV radiation which includes the area on the electromagnetic spectrum between 315 nm and 400 nm. This type of radiation comes mainly from black lights.

The primary health concerns from this type of UV radiation exposure are skin damage from flash burns, inflammation of the cornea or eyelid, and skin aging. The symptoms of an overexposure can occur within 30 minutes to 24 hours after exposure.

UVB

UVB is the middle wave type of UV radiation and is the most dangerous form of UV radiation. This type of Ultraviolet Radiation (UVR) occurs between 280 nm and 315 nm on the electromagnetic spectrum.

The major source of UVB is the sun; however, other sources include phototherapy and welding. The primary health concerns from UVB are sunburn, skin aging, skin cancer, and eye damage.

UVC

UVC is the short wave type of UVR. It occurs between 100 nm and 280 nm on the electromagnetic spectrum and is commonly used for germicidal purposes in operations such as food storage and meat processing facilities or in air purifiers. There are no direct health threats associated with a UVC exposure.

Tab: IR Radiation

IR radiation is primarily generated from artificial sources and can be classified in the 700 nm – 1 mm range on the electromagnetic spectrum. Common generators of IR include:

- Welding.
- Molten metal processes.
- IR heaters.
- IR lamps.
- Medical thermotherapy.
- Plasma torches and cutters.

IR radiation is detectable as heat and can cause **heat loading** in the human body. Skin is normally able to **dissipate a heat load** imposed by IR radiation, thereby minimizing health effects. However, IR radiation can also cause acute thermal injury to the eyes which can lead to cataract formation.

Heat Loading

Health effects caused by heat loading include:

- Heat exhaustion.
- Heat stress.
- Heat stroke.

Dissipating a Heat Load

Skin is normally able to dissipate a heat load from IR radiation through:

- Capillary bed dilation.
- Increased blood circulation.
- The production of sweat.
- Ambient air movement.

Appraisal (Page 6 of 11)

Which three of the following are potential sources of IR radiation?

A Germicidal Disinfection

B Molten Metal Processes

C Phototherapy.

D Plasma Torches.

E Plasma Cutters

Scenario Challenge Point (Page 7 of 11)

Which two of the following are the primary factors you should consider when recommending controls for the metal shop?

A The control's impact on the mission's effectiveness.

B The cost of removing existing controls from the area.

C The ability of the control to address the health threat.

D The workers' requests pertaining to control placement.

Scenario Challenge Point (Page 8 of 11)

Since you've determined that the workers' symptoms are most likely related to welding of the horse stables, you begin to consider how this health threat should be controlled.

Build a list of potential actions that could be taken to control the non-welding workers' exposure to UV radiation.

Word Bank	List
Issue face shields to all workers	_____
Install increased ventilation in the area	_____
Issue sunscreen and lotions	_____
Restrict access to the area	_____
Increase distance from welding	
Discontinue all welding operations	
Decrease numbers of workers in the shop	
Install welding curtains	

UV/IR Radiation Controls (Page 8a of 11)

As with other types of radiation, the primary methods for controlling UV/IR exposures include time, distance, and shielding.

The less time someone is exposed to the source of the UV/IR radiation, the less dose of radiation he or she will receive, decreasing the possibility of effects. The more distance that can be placed between personnel and the source of the UV/IR radiation, the smaller the dose of radiation received. Shielding for UV/IR radiation incorporates a variety of controls and techniques, including:

- Welding curtains.
- Concrete walls.
- Restricting access to the area.
- Sunglasses, goggles, and plastic face shields.
- Protective clothing.
- Sunscreen creams and lotions.
- Welding helmets and goggles.

Scenario Challenge Point (Page 9 of 11)

As you observe the workers performing welding on the horse stables, you notice some are not wearing all of the required PPE.

Build a list of appropriate PPE for the worker to wear while performing the welding operations.

Word Bank	List
Sunscreen	_____
Welding Helmet	_____
Light Colored Clothing	_____
Welding Vest and Gloves	_____
Respirator	
Dark Colored Clothing	
Sunglasses	

PPE Selection, Use, and Maintenance (Page 9a of 11)

When selecting PPE for UV/IR exposures, it is important to make sure not only that the appropriate PPE is selected, but also that it is used and maintained in accordance with established guidelines. Exposures to UV/IR often vary in duration and the type of work being performed; therefore, it's important to always follow the most stringent **UV standards and guidance** and **IR standards and guidance** available.

As a general rule, heavy clothing almost always shields UV radiation adequately. In addition, dark clothing should be worn to avoid reflecting UV radiation. Eye protection must be selected based on the wavelength of UVR being produced. A final shielding in the form of sunscreen should be used on any exposed skin to protect the skin from being burned.

Since the skin can normally dissipate heat load from IR radiation, primarily administrative controls are used. These may include monitoring work/rest cycles to ensure personnel do not experience heat load while performing the mission.

Once the appropriate PPE has been selected, it is important to conduct training on its **proper use and maintenance** because even the best PPE cannot protect personnel if it is used or maintained incorrectly.

UV Standards and Guidance

For welding, cutting, and brazing, Table 2.1 in AFOSH Std 91-5 provides guidance on the selection of PPE.

IR Standards and Guidance

Standards used for controlling IR radiation can be found in the near-IR tables in the ACGIH TLV Booklet.

Correct Use and Maintenance of PPE

Once appropriate UV/IR PPE has been selected, it must be used and maintained correctly to protect personnel. Examples of appropriate use and maintenance of PPE include:

- Keeping outer clothing free from oils and grease.
- Ensuring sleeves and collars are kept buttoned to prevent hot metal and sparks from contacting the skin when welding.
- Wearing caps made from flame-resistant material under welding helmets to prevent head burns.
- Inspecting eye and face protection equipment prior to each use.
- Following all manufacturer's specifications and established guidelines for the PPE.

Appraisal (Page 10 of 11)

Which two of the following are factors which should be considered when determining the correct use and maintenance of PPE for UV/IR health threats?

A Ensuring caps are not worn under welding helmets to prevent burns.

B Ensuring eye and face protection equipment are inspected prior to each use.

C Ensuring all PPE manufacturer's specifications and established guidelines are followed.

D Ensuring sleeves and collars are kept unbuttoned to allow the body to regulate its temperature.

Lesson Summary

In order to explain how UV/IR hazards are identified, analyzed, and managed, you should be able to identify the sources and concerns associated with each type of UV/IR radiation. For example, UV radiation sources can include the sun, black lights, or germicidal units. Infrared radiation can include sources such as welding, IR heaters and lamps, and thermotherapy.

The selection of controls for UV/IR not only includes engineering controls, such as shielding, and administrative controls, but also the use of PPE.

It's important to make sure PPE is used and maintained in accordance with established guidelines to provide adequate protection.

In this lesson you:

- Recalled UV/IR sources and concerns.
- Determined UV/IR exposure for a given scenario.
- Determined appropriate controls for UV/IR radiation.

- Selected appropriate UV/IR PPE, given hazards and equipment limitations.
- Determined if PPE for UV/IR is used and maintained in accordance with established guidelines.

Audio Script

Narrator: When you examined the situation at the metal shop further, you determined the proper controls were not in place to protect the shop workers from health effects associated with the welding. After you made recommendations to the shop supervisor for additional controls, he implemented the controls, and workers have not experienced any further symptoms relating to the welding operations.

Resources

- AFOSH Std 91-5, Welding, Cutting, and Brazing
- ACGIH *Threshold Limit Values and Biological Exposure Indices* book or CD

Answer Key: Appraisals / Scenario Challenge Points

Lesson 1: Ultraviolet and Infrared Hazards

Page 5 of 11

Based on the information you learned from your conversation with the worker, which one of the following situations is most likely causing the symptoms?

C Workers are welding and assembling new horse stables.

Rationale: The welding and assembling of new horse stables is the most likely cause of the worker's symptoms because he is facing the welding and is experiencing the common effects of a UV radiation exposure which include irritation to the eyes and skin. The installation of the air purifier or the air cooling system being out of operation would not cause the symptoms experienced by the worker.

Page 6 of 11

Which three of the following are potential sources of IR radiation?

B Molten Metal Processes

D Plasma Torches

E Plasma Cutters

Rationale: Molten metal processes, plasma torches, and plasma cutters are examples of IR radiation found in the Air Force. Germicidal disinfection and phototherapy are potential sources of UV radiation.

Page 7 of 11

Which two of the following are the primary factors you should consider when recommending controls for the metal shop?

A The control’s impact on the mission’s effectiveness.

C The ability of the control to address the health threat.

Rationale: When recommending controls for the metal shop, you should consider the control's impact on the mission's effectiveness and the ability of the control to address the health threat. The workers' requests pertaining to control placement and the cost of removing existing controls from the area are not the primary considerations when recommending controls at the metal shop.

Page 8 of 11

Build a list of potential actions that could be taken to control the non-welding workers' exposure to UV radiation.

Issue sunscreen and lotions

Install welding curtains

Restrict access to the area

Increase distance from welding

Rationale: Appropriate PPE for the worker includes sunscreen, a welding helmet, a welding vest and gloves, and dark colored clothing. Light colored clothing reflects UV radiation causing potential health effects, a respirator is not needed for welding operations, and sunglasses would not provide the level of protection needed for welding

Page 9 of 11

Build a list of appropriate PPE for the worker to wear while performing the welding operations.

Sunscreen

Welding Helmet

Welding Vest and Gloves

Dark Colored Clothing

Rationale: Appropriate PPE for the worker includes sunscreen, a welding helmet, a welding vest and gloves, and dark colored clothing. Light colored clothing reflects UV radiation causing potential health effects, a respirator is not needed for welding operations, and sunglasses would not provide the level of protection needed for welding.

Page 10 of 11

Which two of the following are factors which should be considered when determining the correct use and maintenance of PPE for UV/IR health threats?

B **Ensuring eye and face protection equipment are inspected prior to each use.**

C **The ability of the control to address the health threat.**

Rationale: When determining the correct use and maintenance of UV/IR PPE, you should ensure eye and face protection equipment is inspected prior to each use, manufacturer's specifications and established guidelines are followed, sleeves and collars are buttoned to prevent hot metal and sparks from contacting the skin when welding, caps are worn that are made from flame-resistant material under welding helmets to prevent head burns, and outer clothing should be free form oils and grease.

Course Glossary

Acronyms

AAR
After Action Report

ACADA
Automatic Chemical Agent Detection Alarm

AFI
Air Force Instruction

AFMIC
Armed Forces Medical Intelligence Center

AFMS
Air Force Medical Service

AFMSA
Air Force Medical Support Agency

AFOSH
Air Force Occupational and Environmental Safety, Fire Prevention and Health

AFRRAD
Air Force Radiation and Radioactive Recycling and Disposal

ALARA
As Low As Reasonably Achievable

AMC
Aerospace Medicine Council

amu
Atomic Mass Unit

AO
Area of Operations

AOC
Area of Concern

AOR
Area of Responsibility

BE
Bioenvironmental Engineering Flight

CBRN
Chemical, Biological, Radiological, Nuclear

CE
Civil Engineering

COA
Course of Action

COC
Contaminant of Concern or Constituent of Concern

CONUS
Continental United States

CSM
Conceptual Site Model

CV
Coefficient of Variability

DIA
Defense Intelligence Agency

DF
Duty Factor

DOD
Department of Defense

DOE
Department of Energy

DOS
Department of State

DOT
Department of Transportation

D_{pel}
Estimated Hazard Distance

DRI
Direct Reading Instruments

EHF
Extremely High Frequency (Occurs between 30 and 300 GHz)

EMR
Electromagnetic Radiation

EPA
Environmental Protection Agency

EPD
Electronic Personal Dosimeters

FPWG
Force Protection Working Group

G_{abs}
Absolute Gain

HF
High Frequency (Occurs between 3 and 30 MHz)

HRA
Health Risk Assessment

HRE
Health Risk Estimate

HRM
Health Risk Management

IATA
International Air Transport Association

IPE
Individual Protection Equipment

LCL
Lower Confidence Limits

LET
Linear Energy Transfer

LF
Low Frequency (Occurs between 30 and 300 kHz)

MAJCOM
Major Command

MEDIC CD
Medical Environmental Disease Intelligence and Countermeasure CD

MIO
Medical Intelligence Officer

MF
Medium Frequency (Occurs between 300 and 3,000 kHz (3MHz))

MOPP
Mission Oriented Protection Posture

MPE
Maximum Permissible Exposure

MSP
Mission Support Plan

NFB
Near-Field Boundary

NGIC
National Ground Intelligence Center

NHZ
Nominal Hazard Zone

NIOSH
National Institute for Occupational Safety and Health

NOHD
Nominal Ocular Hazard Distance

NRC
Nuclear Regulatory Commission

OCONUS
Outside the Continental United States

OEH
Occupational and Environmental Health

OEHSA
Occupational and Environmental Health Site Assessment

OEL
Occupational Exposure Limits

OEL-C
Occupational Exposure Limits-Ceiling

OEL-STEL
Occupational Exposure Limits-Short Term Exposure Limit

OEL-TWA
Occupational Exposure Limits-Time Weighted Average

OH
Occupational Health

ORM
Operational Risk Management

OSHA
Occupational Safety and Health Administration

OSI
Office of Special Investigation

P_{avg}
Average Power

PEL
Permissible Exposure Limit

PH
Public Health

P_p
Peak Power

PPBS
Planning, Programming and Budgeting System

PPE
Personal Protective Equipment

PPM
Parts per million

PRF
Pulse Repetition Frequency

PW
Pulse Width

RFR
Radio Frequency Radiation

RSO
Radiation Safety Officer

S
Main-Beam Power Density

SAR
Specific Absorption Rate

S_{avg}
Power Density Average

SEG
Similar Exposure Group

SHF
Super High Frequency (Occurs between 3 and 30 GHz)

SLM
Sound Level Meter

S_{max}
Maximum Power Density

SPL
Sound Pressure Level

TLD
Thermoluminescent Dosimeters

TWG
Threat Working Group

UHF
Ultra High Frequency (Occurs between 300 and 3,000 MHz)

USACHPPM
United States Army Center for Health Promotion and Preventive Medicine

UTC
Unit Type Code

VA
Vulnerability Assessments

VHF
Very High Frequency (Occurs between 30 and 300 MHz)

VLF
Very Low Frequency (Occurs between 3 and 30 kHz)

Definitions

Absolute Gain (G_{abs})
The ratio of the power that would be required at the input of an ideal isotropic radiator to the power actually supplied to the given antenna, to produce the same radiant intensity in the far-field region.

Action Level
An airborne exposure level that dictates active air monitoring, medical monitoring, and employee training. The Action Level is one-half the Occupational Exposure Limit for time-weighted average (OEL-TWA) exposures, except where 29 CFR 1910 Subpart Z designates a different concentration or where the statistical variability of sample results indicates that a lower fraction of the OEL should be used as the Action Level.

Activity
The number of disintegrations or transformations of radioactive material per unit of time (usually expressed in seconds).

Antenna
The point on an RFR emitter where RFR energy radiates into free space.

Asbestos
A natural material that is made of tiny threads or fibers. The fibers can enter the lungs as a person breathes. Asbestos can cause many diseases, including cancer. Asbestos was used to insulate houses from heat and cold. It has also been used in car brakes and for other purposes. Some old houses still have asbestos in their walls or ceilings.

Asbestosis
A lung disease caused by breathing asbestos fibers over a period of time. The fibers eventually scar the lungs and make breathing difficult. Symptoms are similar to asthma.

Atomic Mass Unit (amu)
Approximately equal to the mass of a proton or a neutron and is used to describe the mass of an atom.

Becquerel (Bq)
The international standard for the unit of measurement for activity.

Breathing Zone
The location where exposure is measured in air sampling. The breathing zone is located forward of the shoulders within 9 inches of the nose and mouth. Breathing zone measurements are taken beneath a welder's helmet or face piece but outside of any respiratory protective devices.

Bremsstrahlung
An interaction that causes a form of x-ray production in which high-speed beta particles penetrate the electron cloud and interact with the nucleus.

Carcinogens
Hazardous materials that stimulate the formation of cancer.

Ceiling Limit (OEL-C)
The limit for an employee's exposure which shall not be exceeded during any part of the work day. If instantaneous monitoring is not feasible, the OEL-C will be evaluated during the worst-case 15-minute exposure period.

Chrysotile
The most common asbestos type. Chrysotile asbestos fibrils may appear crinkled, like permed or damaged hair, under plane-polarized light.

Coefficient of Variation (CV)
For an air sampling method, the CV is the standard deviation of the sampling and analytical error divided by the mean of the sample results. The CV is used to calculate the confidence limits for sampling. OSHA uses the term sampling and analytical error (SAE) to account for the total variation or error in the method.

Compton Scatter
A gamma/x-ray interaction which takes place between a photon and an outer electron where the photon has more energy than the electron can accept, so it imparts only a portion of its energy to the electron.

Conceptual Site Model (CSM)
Articulates the health threats and exposure pathways and begins when data or information is gathered during Predeployment and Baseline Activities.

Confidence Limits
The upper confidence limit (UCL) and lower confidence limit (LCL) are the boundaries for a single sample or a series of samples that have a specified probability (usually 95 percent) of including the true value of the level of exposure.

Controlled Environments
An area where personnel are aware of the potential for RFR exposures associated with their employment or duties.

Counts per minute (cpm)
The amount of radiation detected by an instrument each minute.

Diffuse Reflection
Situations where a laser beam is bounced off a dull or uneven surface that breaks the beam apart.

Disintegration per minute (dpm)
The number of atoms that decay or transform in a given amount of material per minute.

Disintegration per second (dps)
The number of atoms that decay or transform in a given amount of material per second.

Dose
The quantity of radiation absorbed.

Dose Rate
The quantity of radiation absorbed per unit of time.

Duty Factor (DF)
A unit-less number which only applies to pulsed wave systems that describes the ratio of time an RFR emitter is on to the total operating time.

Electromagnetic Radiation (EMR)
Waves of energy that can travel through space and matter.

Electromagnetic Spectrum
The entire frequency range of electromagnetic waves, or wave radiation.

Energy
The ability to do work.

Estimated Hazard Distance (D_{pel})
The distance from the antenna to the point where the power density equals the permissible exposure limit (PEL).

Excitation
Occurs when there is an addition of energy to an atomic system, changing the atom from a "ground" state to an excited state.

Exposure
Exposure occurs when an employee is subjected to a hazardous material through any of these routes: inhalation, ingestion, skin contact, or skin absorption. Airborne exposures are specified as the duration and concentration of hazardous materials measured in the breathing zone of an individual worker without regard for personal protective equipment used by the worker.

Exposure Assessment
An exposure assessment is a process of estimating or calculating potential exposure of a health threat for an individual or population at risk. The assessment includes professional judgment, calculations based on estimates or models, actual measurements, collection and analysis of samples, and statistical evaluation.

Exposure Pathway
Includes a threat and the opportunity for the population to come into contact with the threat.

f
Algebraic express that means, "a function of."

Fission
The splitting of the nucleus of an atom into nuclei of lighter atoms, accompanied by the release of energy.

Frequency
A value of how often a wavelength cycle occurs in a second.

Gain
The antenna's ability to concentrate its energy in a certain direction.

Hazardous materials
Materials that pose a hazard and require a Material Safety Data Sheet as defined in FED-STD 313, Federal Standard, Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Governmental Activities.

Health Risk
The health risk equals threat "combined with" vulnerability (health risk = (threat) + (vulnerability)). A health risk is an identified health threat and the vulnerability of the population at risk of coming into contact (i.e., completion of an exposure pathway) with the health threat.

Health Risk Assessment (HRA)
Health risk assessment is the process of identifying and analyzing or evaluating (exposure and toxicity assessments) OEH threats in populations or at locations over time (HRA = f [(health risk) "+" (HRE) "+" (COA)]). The HRA "product" is the validated health threat, qualified by the HRE, and the COA which includes overall mission impact, recommended control options, associated uncertainties, risk mitigation estimate(s), and a cost-benefit analysis if applicable.

Health Risk Communication
Health risk communication is the process of effectively communicating potential health effects, outcomes, and control measures to all stakeholders (i.e., commanders, supervisors, AF personnel, military, families, and the public). It provides detailed information about the HRA and should occur throughout the HRA process.

Health Risk Estimate (HRE)
Health Risk Estimate is the probability and severity of loss from exposure to the health threat. The HRE is a function of probability and severity when either or both increase the Health Risk Estimate increases. The HRE is also referred to as a health risk level.

Health Risk Management (HRM)
Health risk management is a decision-making process to evaluate and select COAs, minimize OEH risks, and maximize benefits for operations and missions. HRM is the health component of the ORM process and health risk management recommendations and decisions are integrated into the commander's ORM decision-making.

Health Threat
A health threat is a potential or actual condition that can cause short or long-term injury, illness, or death to personnel. A health threat can be occupational or environmental in origin; internal or external to the installation; or continuous, intermittent, or transient; and includes enemy capability and intent.

Ionization
Occurs when beta particles interact with nearby atoms causing an electron to be removed, creating an ion pair.

Ionizing Radiation
Radiation which has enough energy to change the atomic structure of matter.

Isotope
Elements with the same number of protons, but a different number of neutrons.

Kinetic Energy
Energy of motion.

Laser
Light amplification by stimulated emission of radiation.

Linear Energy Transfer (LET)
Energy lost by particles along the path through which they are traveling.

Mass
Description of how much matter there is present in an object.

Maximum Permissible Exposure (MPE)
The level of laser radiation to which a person may be exposed without hazardous effects or adverse biological changes in the eyes or skin.

Mesothelioma
Cancer that generally occurs in the chest, abdominal region, and areas surrounding the heart. It is typically associated with exposure to asbestos.

n
Algebraic express that means, "Number of samples."

Nominal Hazard Zone (NHZ)
The area within a laser workplace in which the exposure from direct beam, specular reflection, and diffuse reflection could exceed the Maximum Permissible Exposure (MPE).

Nominal Ocular Hazard Distance (NOHD)
The distance along the laser beam beyond which the exposure is not expected to exceed the appropriate Maximum Permissible Exposure (MPE).

Non-aqueous Phase Liquids (NAPLs)
Non-aqueous phase liquids are liquids that are sparingly soluble in water. Because they do not mix with water, they form a separate phase. For example, oil is an NAPL because it does not mix with water, and oil and water in a glass will separate into two separate phases. NAPLs can be lighter than water (LNAPL) or denser than water (DNAPL). Hydrocarbons, such as oil and gasoline, and chlorinated solvents, such as trichloroethylene, are examples of NAPLs.

Non-ionizing Radiation
Radiation which does not have enough energy to change the atomic structure of matter.

Nuclear Stability
Describes the certain combinations of neutrons and protons within a nucleus of an atom which are required for that atom to be considered stable.

Occupational and Environmental Health Site Assessment (OEHSA)
The key operational health tool for producing data or information used for health risk assessments (HRA) and to satisfy Occupational and Environmental Health (OEH) surveillance requirements.

Occupational Exposure Limit (OEL)
The limit for the airborne concentrations of a specified substance for a specified time. Employees will not be exposed to concentrations greater than the OEL. The term OEL includes all OEL-TWAs, OEL-STELs, OEL-Cs, and acceptable ceiling concentrations, that apply to a specific substance. For each hazardous material, the OELs are the most stringent limits found in the latest edition of the TLV Booklet published annually by the American Conference of Government Industrial Hygienists, in 29 CFR 1910 Subpart Z, and in AFOSH Standards for specific substances. OELs apply to occupational exposures for each individual worker for a single 8-hour work shift except where 29 CFR 1910 Subpart Z allows 40-hour averages. Exposure during work shifts that exceed 8 hours must be adjusted before applying an OEL.

Operational Risk Management (ORM)
A systematic process of identifying hazards, assessing risk, analyzing risk control options and measures, making control decisions, implementing control decisions, accepting residual risks, and supervising/reviewing the activity for effectiveness.

Optical Cavity
The component that houses the laser.

Pair Production
Occurs when a photon disappears in the vicinity of a nucleus, and an electron and positron appear in its place.

Particulate Radiation
Fast-moving atomic or subatomic particles that may be charged positively or negatively or not at all.

Peak Power (P_p)
The maximum power density during the on time for a pulsed wave system.

Permissible Environment
Operational environment in which host country military and law enforcement agencies have control as well as the intent and capability to assist operations that a unit intends to conduct.

Permissible Exposure Limit (PEL)
The value to which an individual may be exposed without exhibiting damaging biological effects and is based on the emitter's frequency.

Photochemical Reaction
A chemical reaction which is induced by the absorption of energy in the form of visible, infrared, or ultraviolet radiation.

Photoelectric Effect
An "all or none" energy loss where gamma rays impart all of their energy into an electron.

Pleural Effusion:
When too much fluid collects between the lining of the lung and the lining of the inside wall of the chest.

Positron
Created when a proton changes into a neutron and a positron because there are too many protons in the n:p ratio.

Potential Energy
Energy of position.

Pulse Repetition Frequency (PRF)
The number of times the signal is on per unit of time.

Pulse Width (PW)
The length of time the signal is on for a pulsed wave system.

Quality Factor (Q)
A dimensionless quantity assigned to each type of radiation that allows doses to be normalized in relation to each other.

Radiation
Energy in the form of waves or moving subatomic particles emitted by an atom or other body as it changes from a higher energy state to a lower energy state.

Radiation Absorbed Dose (RAD)
The amount of radiation absorbed by the tissue.

Radioactive Decay
The spontaneous disintegration or transformation of an atom in an attempt by that atom to reach a stable state.

Radioactive Material (RAM)
Material which contains unstable (radioactive) atoms that give off radiation as they decay or transform.

Radioactivity
The spontaneous emission of matter or energy from the nucleus of an unstable atom.

Radioisotopes
Unstable isotopes that, in an attempt to become a stable atom, emit energy in the form of radiation.

Regulated Area
An area under the supervisor's control where entry and exit are restricted and controlled to prevent exposure to hazards. An area shall be established when a requirement in 29 CFR 1910 or 29 CFR 1926 exists, or when BE determines that employees entering the area might be exposed to a hazard unless access is controlled.

Short Term Exposure Limit (OEL- STEL)
A time-weighted exposure for a 15 minute (or shorter) period which shall not be exceeded during the work day. The definition of STEL is different in 29 CFR 1910.1000 (a) (5) (ii) and in the TLV Booklet. The definition must correspond to the reference being cited. As with other OELs, OEL-STELs are the most stringent limits found in the latest TLV Booklet, in 29 CFR 1910 Subpart Z, and in AFOSH Standards for specific substances.

Short-Term Public Emergency Exposure Guideline (SPEGL)
An acceptable peak concentration for unpredicted, single, short-term emergency exposures of the general public. These limits do not apply to occupational exposures.

Specific Absorption Rate (SAR)
An expression of how much RFR energy is imparted to each kilogram of biological body mass per second. SAR is expressed in units of watts per kilogram (W/kg).

Specular Reflection
Situations where a laser beam is reflected from shiny, mirror-like surfaces.

Spontaneous Fission
Spontaneous fission is a natural mode of decay in which nuclei disintegrate.

Stakeholders
Any individual who is affected by the content of the communication and/or will be making decisions based on the information provided.

Stratigraphy
The layering of rock or ice strata, from which information on succession, age relations, and origin can be deduced.

Threshold Limit Values—(TLVRs)
Exposure guidelines published annually by the American Conference of Governmental Industrial Hygienists (ACGIH) in Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. TLVRs are employed as OELs when they are more stringent than the OSHA PELs.

Time-Weighted Average (OEL-TWA)
Eight-hour average concentration for which the average is mathematically adjusted for the duration of exposure. The method for calculating OEL-TWAs is shown in 29 CFR 1910.1000 (d) and in the TLV Booklet.

Toxicology Assessment
Process of estimating the human toxicological impact of a specific material based on published and unpublished literature sources and taking into consideration: uptake, metabolism/biotransformation, transport and storage, and excretion including acute (short-term) and chronic (long-term) human health endpoints.

Transmission Line
Carries the RFR signal from the transmitter to the antenna.

Transmitter
The part of an RFR emitter that generates the RFR signal.

Uncontrolled Environments
An area where exposures may be incurred by people who have no knowledge or control of the hazard.

Wavelength
The distance from one peak of a wave to the next peak of a wave.