Bioenvironmental Engineering Site Assessment I

Unit 2: HRA (Health Risk Assessments)

Unit Description: For this unit, you will be stationed at Justford AFB in Logan, Utah. During your assignment, you'll be participating in a Health Risk Assessment (HRA). When you're finished, you will be able to explain the process for executing HRAs and how the HRA process relates to overall mission objectives.

Table of Contents

Lesson 1: Health Risk Assessments

Lesson Description

During this lesson you'll learn about the process for executing Health Risk Assessments (HRAs). In addition, you'll learn about the roles that BE plays when conducting an HRA.

Lesson Overview (Page 1 of 19)

Conducting HRAs helps prevent injury or illness to personnel while performing mission-critical duties. The HRA process is important because it focuses on correlating health threats with other types of operational risks. This correlation provides a framework for commanders and decision-makers to balance operational risks with health risks so they can weigh mission requirements against short and long-term risks present.

After conducting a routine assessment of a base maintenance shop, you'll be able to describe the process for executing Health Risk Assessments (HRAs).

Audio Script

Narrator: You will be conducting a routine Health Risk Assessment for personnel on base performing maintenance work on aircraft landing gear. You need to apply Health Risk Assessment principles to identify and analyze any health risks involved with the work being done at that shop.

Goals of HRA (Page 2 of 19)

The Air Force Medical Service (AFMS) uses **HRAs** to support mission and operational requirements while addressing potential **health threats** and **health risks** as early in the decision-making process as possible.

Health threats and health risks must be identified and analyzed within an **operational context** such as specific missions or operations, geographical location, populations at risk, and time periods.

The goals of the HRA process are to:

- Provide the commander a concise course of action (COA) that clearly articulates potential impacts and provides recommendations to maximize operations.
- Minimize health threats and negative health outcomes.

Health Risk Assessments (HRAs)

Health Risk Assessment is the identification and analysis of Occupational and Environmental Health (OEH) threats in populations or at locations over time.

The process of HRA can be thought of in terms of the following equation, which illustrates that a final Health Risk Assessment is a function of balancing the health risk, the Health Risk Estimate (HRE), and the course of action (COA).

HRA= f [(health risk) + (HRE) + (COA)].

Health Threats

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.
- Continuous, intermittent, or transient.
- Enemy capability and intent.

Health Risks

A health risk is an identified health threat combined with the vulnerability of the population at risk of coming into contact with the health threat. A health risk can be thought of as: Health Risk = Threat + Vulnerability.

Operational Context

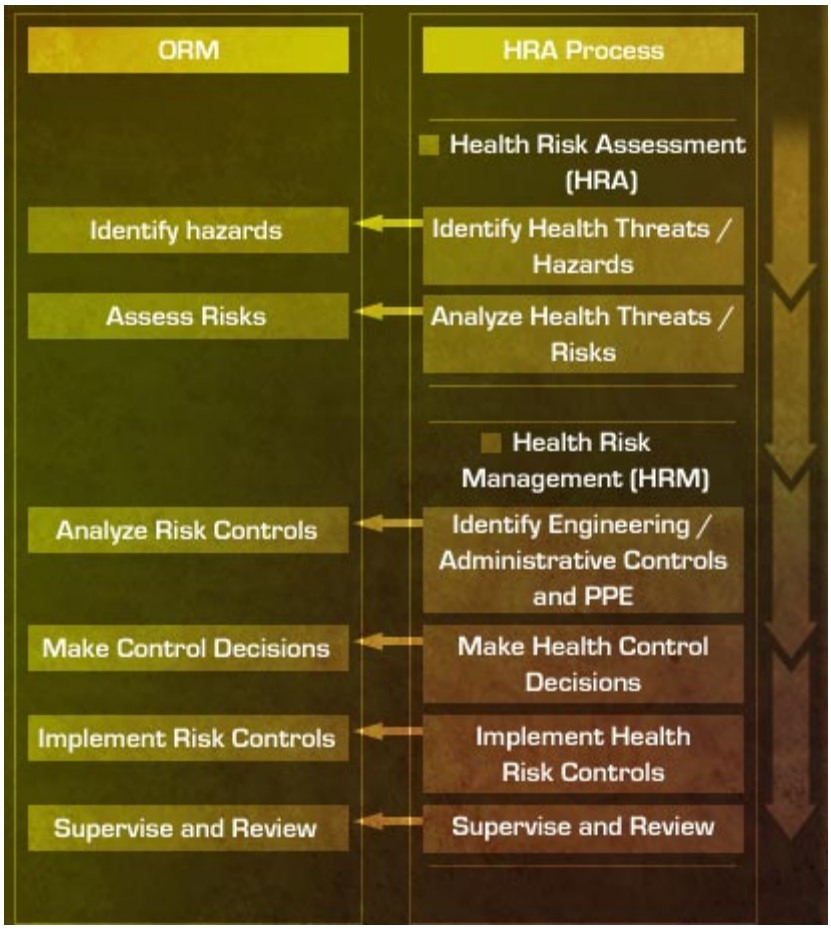
Key points regarding operational context include:

- Type of mission.
- Living conditions (e.g., field, hardened facilities, hotel).
- Geographical location and conditions (e.g., temperature, humidity, altitude).
- Threat characteristics (e.g., toxicity, volatility, transmissibility, communicability).
- Exposure parameters (e.g., pathway, frequency, duration, concentration, exposures from unrelated activities).
- Personal protective equipment (PPE) or individual protective equipment (IPE) (e.g., MOPP).
- Length of deployment and employment (CONUS or OCONUS).
- Medical treatment sources (e.g., US forces, coalition, local, non-governmental organizations).
- Response capabilities.

The HRA Process (Page 3 of 19)

HRA and **Health Risk Management (HRM)**, known as the HRA process, mirror **Operational Risk Management (ORM) principles** which makes the HRA process useful for balancing health and operational risks against mission requirements and objectives.

The HRA process is systematic and applies to all BE functions, making the process relevant in both deployed and garrison situations. The following graphic outlines the steps of the HRA process. It also illustrates the relationship between the HRA process and ORM.



Health Risk Management (HRM)

HRM is a decision-making process, within the HRA process, used to evaluate and select COAs, minimize OEH risks, and maximize benefits for operations and missions.

Operational Risk Management (ORM) Principles

ORM is 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. The ORM guiding principles that you should be aware of include:

- Accept no unnecessary risk.
- Make risk decisions at the appropriate level.
- Accept risk when the benefits outweigh the costs.
- Make recommendations to the commander.

Justford AFB Scenario (Page 4 of 19)

Before you depart for the maintenance shop, you meet with the BEE, Capt Wright, to discuss the tasks for the day.

Audio Script

OIC: What do you have on your agenda today?

BE Tech: I'm headed over to one of the maintenance shops for a routine assessment. They usually work on aircraft landing gear, but about six months ago they started doing some smaller types of aircraft maintenance work.

OIC: Sounds like you need to make sure they're using the proper controls for the new processes.

BE Tech: Yes, Ma'am. I'll let you know what I find.

OIC: Okay, sounds good. Thanks.

Scenario Challenge Point (Page 5 of 19)

Before you get to the maintenance shop you should consider what you'll be doing as part of an HRA. Build a list of the roles that BE plays when conducting HRAs.

Word Bank	List
Lead the execution of Health Risk Assessments	_____
Ensure involvement in each HRM activity	_____
Facilitate development of policy	_____
Set MAJCOM priorities for occupational health	_____
Communicate HRA information to commanders	
Provide data management support	

BE Roles in the HRA Process (Page 5a of 19)

When conducting an HRA, your role as a BE is to:

- Lead HRA execution.
- Incorporate CBRN and physical threat analysis from intelligence and line functions into HRAs.
- Communicate health risk information and recommend COAs to commanders.

- Ensure involvement in each HRM activity.
- Maintain clear lines of communication with commanders to cross talk emerging and identified health threats, risk controls, and the impact of threats and controls to the mission.

Other HRA Process Roles (Page 5b of 19)

It's also important to understand the roles that other personnel play in the HRA process. There are several additional groups that assume key roles in the HRA process.

- **Air Force Medical Support Agency (AFMSA)**
- **MAJCOM**
- **Public Health**

Air Force Medical Support Agency (AFMSA)

AFMSA's role in the HRA process is to:

- Provide strategic direction and advocacy for OEH program development and execution.
- Facilitate development of policy to support and enhance the OEH program.
- Use the Mission Support Plan (MSP) to provide strategic direction and advocacy for development and execution of the OEH program.
- Provide data management support through the OEH corporate information management (CIM) systems and develop methods and programs to provide information on compensation costs.

MAJCOM

The role of MAJCOM related to the Health Risk Assessment process is to:

- Support OEH initiatives by validating requirements and technical needs.
- Set MAJCOM priorities for OEH.
- Use the operational task 4 (OT4) Investment Strategy, Mission Support Plan (MSP), and Planning, Programming, Budgeting, and Execution System (PPBES) to acquire resources and execute OEH programs.

Public Health

Public Health (PH) provides HRA expertise regarding intervention strategies to prevent or mitigate health risks and assist in identifying emerging health threats through vector and disease surveillance programs, food/public facility sanitation programs, force health protection data, and collaboration with civilian public health agencies.

Scenario Challenge Point (Page 6 of 19)

One of the first tasks you observe being performed in the maintenance shop is a group of workers de-painting aircraft wheel wells. Should this be included in your HRA?

A Yes

B No

When HRA is Conducted (Page 6a of 19)

The HRA process is conducted under a variety of occupational and environmental circumstances as part of your routine duties. The HRA process should be used:

- **Any time you want to assess a health threat / health risk.**
- **When known health threats exist in a certain area.**
- **On an on-going basis as a cyclical process.**

Any Time You Want to Assess a Health Threat / Health Risk

An assessment of health threats and risks would be required for environmental situations such as the selection of a beddown area. You also need to conduct assessments when monitoring occupational locations such as aircraft maintenance facilities or metal shops where personnel may be exposed to a variety of health threats.

When Known Health Threats Exist in a Certain Area

An example for this situation may include personnel using x-ray equipment to survey an aircraft fuselage. The equipment used emits radiation that may be harmful to personnel if certain precautions are not followed.

On an On-going Basis as a Cyclical Process

An example of this situation may include the routine monitoring of a water system to ensure the water is safe for personnel to use.

Health Risk Communication (Page 7 of 19)

Identifying and analyzing health threats and risks are important to ensure the safety of personnel who may be working in hazardous conditions. HRA provides a standard method for BE to address health risks and communicate the significance of those health risks to **stakeholders**. The concept through which these risks are communicated is known as **Health Risk Communication.**

Stakeholders

Stakeholder is a term referring to any individual who is affected by the content of the communication and/or will be making decisions based on the information provided.

Examples of stakeholders include:

- Commanders.
- Exposed personnel.

- Family members.
- Special interest groups.
- General populace.

Health Risk Communication

Health Risk Communication is the process of effectively communicating potential health threats, effects, outcomes, and control measures to all stakeholders. It provides detailed information about the HRA and should occur throughout the HRA process.

Risk communication is discussed in more detail later in this course.

Justford AFB Scenario (Page 8 of 19)

After observing the workers de-painting the wheel wells, you realize there could be several issues to consider during your HRA. You begin by interviewing a worker about the tasks performed in the shop.

Audio Script

BE Tech: Good morning. I'm from the Bioenvironmental Engineering office. If you don't mind, I'd like to ask you a few questions.

Shop Worker: Sure, I'll be glad to help.

BE Tech: What type of work do you and the other people in this shop do every day?

Shop Worker: Well . . . a lot of what we do is related to fixing aircraft landing gear. We also do de-painting on the wheel wells after we're finished with the landing gear.

BE Tech: What type of chemicals do you use for the de-painting work?

Shop Worker: We use benzyl alcohol, alodining fluid, and soap as the solvents to de-paint the aircraft.

BE Tech: When you're working with those chemicals, what kind of PPE do you wear?

Shop Worker: We don't usually wear PPE when we're de-painting.

BE Tech: What kind of schedule do you keep on a typical workday?

Shop Worker: We hold pretty close to an 8-hour day most of the time, and we normally take a 15 minute break every 2 hours.

BE Tech: Okay, thanks. I'm going to look around a bit more.

Shop Worker: No problem.

Justford AFB Scenario (Page 9 of 19)

Audio Script

Narrator: As you work your way closer to the aircraft, you notice some of the workers performing the de-painting tasks are in tight quarters, and no one is wearing PPE. You have identified at least one potential health threat requiring further analysis.

When conducting a full HRA, you will assess every health threat present but in this instance you will continue by focusing only on the health threat associated with benzyl alcohol.

Justford AFB Scenario (Page 10 of 19)

Audio Script

OIC: How's the assessment at the aircraft maintenance shop going?

BE Tech: Well, one of the things I'm including in the HRA is that the workers over there are using benzyl alcohol every day with no PPE. They could be at risk for health effects when the benzyl alcohol is absorbed through the skin or inhaled. It's an irritant to the eyes, skin, and respiratory system. It's also harmful if they ingest it – say, if they don't wash their hands before they eat.

I took a second trip to the shop to check the ventilation, and I used DRIs to measure airborne exposure concentrations. I haven't found any published standards to compare the results against, so what should I do from here?

OIC: Keep in mind that, since you're not finding standards for the benzyl alcohol, it could mean the inhalation hazard may not be as much of an issue for this chemical. You'll have to use professional judgment to determine what controls should be put in place, if any.

BE Tech: Yes, Ma'am. I'll get started on my recommended course of action for this health threat.

Scenario Challenge Point (Page 11 of 19)

Based on your actions to this point, which two steps of the HRA process have you accomplished?

A Making Health Control Decisions

B Identifying Health Risk Controls

C Identifying Health Threats

D Supervising and Reviewing

E Analyzing Health Threats and Risks

Identifying and Analyzing Health Threats (Page 11a of 19)

HRAs can be performed in both large and small-scale situations. Regardless of the size of the HRA, the assessment is comprised of two primary steps.

Tab: Identifying Health Threats

Identifying health threats is vital to focus resources on credible health threats instead of tracking or assessing threats with minimal or no impact to the mission, operations, or personnel.

You will identify health threats to determine whether a potential or existing exposure poses a health risk to a specific population during a specific period at a specified location. In addition, in this step you should assess the vulnerability for each potential health threat identified.

The identification of health threats is determined without consideration of countermeasures or controls necessary to reduce the health threat.

Tab: Analyzing Health Threats and Risks

It is critical to analyze a health threat within the context of the mission and operational requirements. Remember, professional judgment must be exercised to analyze the situation and determine a recommended COA. It's the commander's decision to accept, reject, or attempt to control a health risk based on information provided.

When analyzing health threats you should consider several factors that can affect both large and small-scale HRAs:

- **Why is the health threat a potential or actual problem?**
- **Are there other potential threats surrounding the problem?**
- **Does the threat impact operations, or is it a nuisance?**
- **Is there the potential for exposure variability?**

Why is the health threat a potential or actual problem?

Health threat determinations should consider immediate and long-term health effects. You can accomplish this by addressing the possible outcomes associated with identified exposure levels.

Determine whether the health threat is an actual health risk by comparing exposure levels to established guidelines, or using professional judgment when guidelines are not available.

Are there other potential threats surrounding the problem?

To determine if there are additional threats surrounding the problem, involve other functional areas such as intelligence for CBRN threat analysis, PH for infectious disease threats, or pest management for vector threats. Some sources for intelligence information include the Threat Working Group (TWG), Force Protection Working Group (FPWG), and the Medical Intelligence Officer (MIO).

Does the threat impact operations, or is it a nuisance?

When determining how much a threat impacts operations, consider how the health threat affects personnel, mission, and operational requirements. To identify the impact, you must first determine the adverse health effects and whether the effect is imminent, delayed, or reversible.

Once the immediate and long-term health effects are identified, determine appropriate controls, given operational requirements.

Is there the potential for exposure variability?

You should determine if the exposure has the potential to vary based on factors such as changing environmental conditions, movement of personnel into other locations, or working between several shops while performing similar functions. These situations may require additional analysis to ensure the changes do not affect the potential risk to personnel. Exposure changes may also impact the choice of controls used to manage the health risk.

Scenario Challenge Point (Page 12 of 19)

As the final step in your analysis process, before you determine control recommendations, use the Health Risk Estimate (HRE) Matrix to determine the health risk level for shop personnel exposed to the **benzyl alcohol health threat**.

Benzyl Alcohol Health Threat

Remember the following information about the benzyl alcohol health threat:

- No PPE is worn when working with benzyl alcohol.
- Workers are exposed to benzyl alcohol daily.
- Benzyl alcohol poses a health threat through absorption, inhalation, ingestion, and is an irritant to the eyes, skin, and respiratory system.

Choose the most appropriate health risk level using the following HRE Matrix.

AFMAN 48-153, Table 3.1 Health Risk Estimate Matrix

Severity			Probability				
			Frequently	Likely	Occasional	Seldom	Unlikely
	Catastrophic	I	Extremely High	Extremely High	High	High	Moderate
	Critical	II	Extremely High	High	High	Moderate	Low
	Moderate	III	High	Moderate	Moderate	Low	Low
	Negligible	IV	Moderate	Low	Low	Low	Low

Health Risk Level: _____

Determining the Health Risk Estimate (Page 12a of 19)

When faced with situations where there is a potential risk to personnel, you will be required to provide recommendations to commanders regardless of whether a standard exists. Decision-makers require recommendations to minimize the health threat(s) that have been identified.

One way that recommendations can be communicated is by determining a **Health Risk Estimate (HRE)** for each health threat identified in an HRA. The HRE provides a common format for determining which health risks may have the greatest impact to the individual and mission and provides a consistent way for communicating the risk. The HRE is determined by estimating each health threat's **probability** and **severity**, using the HRE Matrix (shown above).

Health Risk Estimate (HRE)

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

Probability

The probability of the health threat should be estimated in terms of how often the event is expected to occur, as defined in AFPAM 90-902.

The options for probability are:

- Frequently – Occurs often in a career.
- Likely – Occurs several times in a career.
- Occasional – Will occur in a career.
- Seldom – May occur in a career.
- Unlikely – So unlikely you can assume it will not occur in a career.

Severity

The severity of the potential health threat should be estimated in terms of its potential impact on personnel and the mission, as defined in AFPAM 90-902.

This is classified as:

- Catastrophic – Complete mission failure, death, or loss of system.
- Critical – Major mission degradation, severe injury, occupational illness, or major system damage.
- Moderate – Minor mission degradation, injury, micro occupational illness, or minor system damage.
- Negligible – Less than minor mission degradation, injury, occupational illness, or minor system damage.

Communicating Health Risk Assessment Results (Page 13 of 19)

One of the most critical responsibilities associated with the HRA process is the effective communication of health risks. The primary goal of effective HRA communication is to integrate your findings with other operational risks that may be present.

You should always make sure qualitative and quantitative data are translated into understandable information for commanders or other decision-makers. In addition, your communication should consider the estimated health risk in relation to the mission.

Justford AFB Scenario (Page 14 of 19)

After completing your identification and analysis, you decide how best to communicate your HRA findings to the shop supervisor. You make sure all of your qualitative and quantitative notes are written in a way that will be useful for the supervisor to make a decision on managing the risk.

Audio Script

BE Tech: Good afternoon. I've been performing an assessment of your shop to ensure that the de-painting work being done is safe for personnel.

Shop Supervisor: What have you found out?

BE Tech: Well, the health effects caused by benzyl alcohol are moderate, and there's a frequent probability of workers being exposed to it. Those two factors combined make the health risk high.

Shop Supervisor: What does that mean for us?

BE Tech: I understand that the de-painting is a mission-critical function, so we need to implement controls to mitigate the health risk.

Shop Supervisor: We have a ventilation system in that area. Isn't that sufficient?

BE Tech: I did check the ventilation system, and there isn't any issue with your system right now. If any of your processes change, the ventilation system may need to be reevaluated. The highest risk for this chemical comes from contact exposure, so the workers need to wear safety glasses and protective clothing.

Shop Supervisor: Okay, thank you. I'll see to it that they start wearing PPE.

Scenario Challenge Point (Page 15 of 19)

Match each possible control with the category to which it belongs.

Audio Script

Narrator: There are several types of controls that you may need to consider in a situation like this. Match each possible control with the category to which it belongs.

Recommended Controls
Neoprene Gloves
Ventilation
Adjusted Work / Rest Cycle

	Control Category
_____	Engineering Controls
_____	Administrative Controls
_____	Protective Equipment (PPE)

Controls and Health Risk Management (Page 15a of 19)

Remember, HRM is a decision-making process, within the HRA process, used to evaluate and select COAs, minimize OEH risks, and maximize benefits for operations and missions. HRM can be described as the health component integrated into the commander's ORM decision-making process.

One of the most important components of HRM is the use of controls to address specified risks. When you are **recommending control options**, you should keep in mind they will be implemented based on mission requirements and resources. There are three primary types of controls that are commonly recommended during the HRM process.

- **Engineering Controls.**
- **Administrative Controls.**
- **Personal Protective Equipment (PPE).**

Recommending Control Options

It's important to remember that even though there are often several types of control options available for a given risk, providing recommendations for control options that are not feasible for the situation does not support the objective of completing the mission.

Engineering Controls

Engineering controls are the most desirable type of control because they do not rely on personnel to follow administrative guidelines or to use PPE correctly. Examples of engineering controls include:

- Shielding
- Barriers
- Enclosures
- Design changes
- Ventilation

Administrative Controls

After engineering controls, administrative controls are the next most desirable type of control because they can reduce the risk of exposure without requiring personnel to correctly use PPE. Examples of administrative controls include:

- Reduced work hours
- Personal hygiene
- Housekeeping
- Maintenance
- Training

Personal Protective Equipment

Personal Protective Equipment (PPE) is selected last in the hierarchy of controls because there is a probability of the PPE being used incorrectly or not in accordance with the manufacturer's specifications. Examples of PPE include:

- Protective masks or eye wear
- Welding helmets
- Gloves
- Protective suits
- Respirators

Health Risk Control Decisions (Page 16 of 19)

The responsibility of making health risk control decisions to manage the identified risk falls on the commander. When making control decisions and implementing controls, commanders may accept ancillary risks that have the potential to impact the mission.

BE's responsibility in this decision-making process is to complete the HRA without bias and clearly communicate the health risks and recommendations for controlling those risks. You should continue to evaluate the current situation, update the HRA as new information becomes available, and communicate increases or decreases in risk to the appropriate level within the chain of command.

Communicating with Commanders

Make sure your analysis is clearly understood by the commander and can be defended at a later date, especially if a long-term health risk was accepted to accomplish the mission at that time. Noncompliance with various requirements, when a health risk is minimal, is an option depending on the operational context; however, commanders must understand the implications and select COAs accordingly.

Justford AFB Scenario (Page 17 of 19)

The shop supervisor implemented your recommended controls of safety glasses and protective clothing.

Audio Script

OIC: The shop supervisor told me he appreciated your recommendations. He talked to the shop workers about the health risk you identified, and he's making sure they all wear the appropriate PPE while they're de-painting.

Scenario Challenge Point (Page 18 of 19)

Which two actions should be taken if the recommended controls are found to be inadequate?

A Removing existing controls

B Redefine the mission

C Consider redirection of resources

D Reevaluate the risk

Implementation of Health Risk Controls (Page 18a of 19)

Once the health risk control decisions have been made, they must now be implemented.

Stakeholders will perceive risks and control of those risks differently; therefore, when implementing controls, it's important to anticipate any negative outcomes due to perceptions of the health risk within the population at risk, surrounding populations, or other individuals.

In the event that controls are found to be inadequate, reevaluation of the risk must be completed and redirection of resources may be appropriate.

Supervise and Review (Page 18b of 19)

The culminating phase of HRM addresses supervision and review of the health risk controls that are in place.

Those responsible for the review process need to determine whether the risks and mission are balanced and should continually evaluate the effectiveness of controls. Your responsibility is to remain available to assist with adjusting the balances if required.

Lesson Summary (Page 19 of 19)

You have learned that an HRA is the identification and analysis of OEH threats. HRAs are used to support mission and operational requirements while addressing potential health threats and health risks as early in the decision-making process as possible.

The HRA process is important because it focuses on correlating health threats with other types of operational risks. This correlation provides a framework for commanders and decision-makers so they can weigh risks against mission requirements.

In this lesson, you described the process for executing Health Risk Assessments.

Audio Script

Narrator: Understanding the HRA process is an essential part of your responsibilities. You will continue to apply what you have learned in this lesson in the rest of the BESA course and throughout your career in bioenvironmental engineering.

Resources

- AFMAN 48-153, Health Risk Assessment
- AFPAM 90-902, Operational Risk Management (ORM) Guidelines and Tools

Answer Key: Appraisals / Scenario Challenge Points

Lesson 1: HRA

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Before you get to the maintenance shop you should consider what you'll be doing as part of an HRA. Build a list of the roles that BE plays when conducting HRAs.

Lead the execution of Health Risk Assessments

Ensure involvement in each HRM activity

Communicate HRA information to commanders

Rationale: The BE role in the HRA process is to lead HRA execution, communicate health risk information and recommend COAs to commanders, ensure involvement in each HRM activity, and maintain clear lines of communication with commanders to cross talk emerging and identified health threats, risk controls, and the impact of both threats and controls to the mission.

Page 6 of 19

One of the first tasks you observe being performed in the maintenance shop is a group of workers de-painting aircraft wheel wells. Should this be included in your HRA?

A Yes

Rationale: Since there are tasks being performed that could pose a health risk to workers, you should include the de-painting work as a part of the HRA.

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Based on your actions to this point, which two steps of the HRA process have you accomplished?

C Indentifying Health Threats

E Analyzing Health Threats and Risks

Rationale: You have identified a potential health threat and analyzed the health risks, which represent the initial two steps of the HRA process. Making Health Control Decisions, Identifying Health Risk Controls, Implementing Health Risk Controls, and Supervising and Reviewing are subsequent steps in the HRA process, traditionally referred to as HRM.

Page 12 of 19

As the final step in your analysis process, before you determine control recommendations, use the Health Risk Estimate (HRE) Matrix to determine the health risk level for shop personnel exposed to the benzyl alcohol health threat.

Health Risk Level: High

Rationale: In this scenario, the best answer is that the health risk level is high because the benzyl alcohol is used frequently by the workers and the health effects would most likely be considered moderate, especially without PPE. Health effects of an exposure might be considered negligible, in which case an assessment of the health risk level as moderate would also be acceptable.

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Match each possible control with the category to which it belongs.

Recommended Controls	Control Category
Ventilation	Engineering Controls
Adjusted Work/Rest Cycle	Administrative Controls
Neoprene Gloves	Protective Equipment (PPE)

Rationale: Engineering Controls, Administrative Controls, and Personal Protective Equipment all serve important purposes when managing health risks because the types of controls selected will be determined based on consideration of health risks and mission requirements. Ventilation is an engineering control, adjustment of work/rest cycles is an administrative control, and neoprene gloves are an example of PPE.

Page 11 of 19

Which two actions should be taken if the recommended controls are found to be inadequate?

C Consider redirection of resources

D Reevaluate the risk

Rationale: If the initial controls are found to be inadequate, the risk must be reevaluated and redirection of resources may be appropriate. The controls are then adjusted based on the reevaluated risk. If you remove existing controls before the risk is reevaluated, you may be increasing exposure of personnel to a health risk. The mission is not redefined if the controls are initially found to be inadequate.

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.