CHAPTER 12
RISK CHARACTERIZATION

12-1. Introduction.

a. This chapter describes risk characterization for MMRP and is limited to risk from MEC. A risk assessment is used to describe and estimate the likelihood of adverse outcomes from an encounter with MEC. Several methods exist for performing a MEC risk assessment for MRSs; however, there is no single MEC risk assessment methodology that is applicable to a variety of MRSs that has been widely accepted, tested, and fully implemented.

b. An explosives safety hazard is the probability that MEC might detonate and potentially cause harm as a result of human activities. An explosives safety hazard exists if a person can come near to or into contact with MEC and then energy of some sort is applied to it to cause it to detonate. The energy could be applied by the person, by external forces not associated with the person's contact, or an internal mechanism within the MEC item itself.

c. Most MEC risk assessments will concentrate on the explosive hazards associated with MEC. However, there may also be a risk associated with the presence of MCs. This risk would be characterized IAW with the procedures used to assess HTRW risk; which may include an assessment of both human and ecoreceptors. See EM 200-1-4 for additional guidance on HTRW risk process.

12-2. CSM. The CSM is used to communicate and describe the current state of knowledge and assumptions about the MEC risk at a project property. The CSM presents the exposure pathway analysis by integrating information on the MEC source, receptors, and receptor/MEC interaction. See EM 1110-1-1200 for additional guidance.

12-3. MEC Risk Pathway.

a. The potential for an explosives safety hazard depends upon the presence of three critical elements to complete the risk pathway. If any one of these three elements is missing, there is no completed pathway and, therefore, no resulting MEC risk. Each of the three elements also provides a basis for implementing effective risk management response actions. The three critical elements include:

(1) A source of MEC (or the presence of MEC).

(2) A receptor or person.

(3) The potential for interaction between the source and the receptor (such as picking up the item or disturbing the item by plowing).

b. Source of MEC.

(1) The factors affecting risk associated with the MEC source are the quantity or density of the MEC. The more MEC present at a project property, the greater the likelihood for an interaction between a receptor and MEC. If there is no MEC present, there is no completed pathway and, consequently, no explosives safety hazard.

(2) At military training facilities, it was customary to conduct training exercises using practice munitions, including those ranges designated for use of High Explosive- (HE-) filled munitions. Only after troops demonstrated proficiency in firing tactics were troops allowed to use HE-filled munitions. As a result, training ranges contain a preponderance of practice munitions.

(3) The primary release mechanisms resulting in the occurrence of MEC are related to the type of military munition activity, or result from the improper functioning of the military munition. For example when a military munition (HE artillery shell) is fired it will do one of three things:

(a) It will detonate completely. This is called a high order detonation.

(b) It will undergo incomplete detonation. This is called a low order detonation.

(c) It will fail to function. This results in UXO.

(4) Military munitions may be lost, abandoned, or buried, resulting in unfired munitions that could be fuzed or unfuzed.

(5) In addition there are military munitions that will have a delayed function and may be hidden by design resulting in a deployed, armed, and fuzed muntion.

(6) Military munitions demilitarization through OB/OD is used to destroy excess, obsolete, or unserviceable munitions by combustion (OB) or by detonation (OD). An OD operation can result in a high order detonation or a low order detonation. In addition, the munitions may possibly be spread beyond the immediate vicinity by the detonation ("kick-outs"). Incomplete combustion or low/high order detonation failure can leave uncombusted explosives.

c. Receptor. Receptors are people that have the potential to contact MEC. The factors affecting risk associated with the receptor include the number of people that access the area containing MEC and the accessibility of the property containing MEC. The more receptors that use the location and the easier it is to access the property, the greater the potential for MEC contact. The converse is also true: the fewer the people that are present and the harder it is to access the property due to man-made or natural barriers, the lower the potential for MEC contact.

d. Interaction. The factors affecting risk that are associated with the interaction with the MEC include: MEC contact potential; energy application; and MEC sensitivity and potential severity.

(1) The MEC contact potential is affected by: the depth of the MEC; site stability (erosion); and the depth and type of receptor activity. For instance if the project property is unstable there is a greater likelihood the MEC will be brought closer to the surface and increase the potential for interaction. Also the greater the depth of intrusion by the receptor the greater likelihood there will be receptor and MEC interaction.

(2) The energy application factor affects the likelihood that a receptor will apply enough energy to a MEC item causing it to function. The risk to the receptor increases greatly the more energy is applied to a MEC. Examples include an item is picked up, hit with a hammer, thrown in a fire, etc. However, there may also be the case where the type of MEC requires no force be applied to it by the receptor in order to function.

(3) Sensitivity and Severity.

(a) The greater the sensitivity, the greater the likelihood for a MEC item to function. The type of MEC affects the likelihood and severity of injury if a MEC functions. The hazard from MEC typically results from a single interaction between a receptor and a MEC source and may have one of three outcomes: no effect, injury, or death. The consequence of a military munitions detonation is associated with physical forces resulting from blast pressure, fragmentation hazards, thermal hazards and shock hazards. The type of hazard threat and the severity of the hazard depend on the type of MEC.

(b) Different types of military munitions vary in their likelihood of detonation and their potential for harm. The classification of energetic materials used in military munitions can be divided by their primary uses: explosives, propellants, and pyrotechnics. Explosives and propellants, if properly initiated, will evolve into large volumes of gas over a short period of time. The key difference between explosives and propellants is the reaction rate. Explosives react rapidly, creating a high-pressure shock wave and are designed to break apart a munitions casing and cause injury. Propellants react at a slower rate, creating a sustained lower pressure. Propellants are designed to provide energy to deliver a munition to its target. Pyrotechnics produce heat, but less gas than explosives or propellants. Pyrotechnics are used to send signals, to illuminate areas, simulate other weapons during training, and are used as ignition elements for certain weapons. When initiated, pyrotechnics produce heat, noise, smoke, light or infrared radiation. Incendiaries are a class of pyrotechnics that are highly flammable and are used to destroy a target by fire.

(c) Explosives can be further subdivided into low explosive and high explosive based on the velocity of the explosion. When a HE munition is initiated, it decomposes almost instantaneously and the detonation can be lethal. Low explosives undergo decomposition or combustion at rates from a few centimeters per minute to approximately 400 meters per second (EPA, 2002). Black powder is a common low explosive and when used as a spotting charge it can cause injury or burns. In a 37mm projectile, the black powder is fully encased and can be lethal if initiated.

(d) Some practice munitions contain an energetic, (low explosive or pyrotechnic charge) and include a fully functional fuzing system, while other practice munitions are wholly inert. A practice munition poses less of a hazard than an HE-filled UXO item. The hazard from a practice munition may result from a fuze or spotting charge contained in the munition in order to produce a flash or smoke upon impact. Unexpended spotting charges may cause a flesh burn. The wholly inert practice items have no explosive parts, including fuze components, and do not pose an explosive safety hazard.

12-4. Risk Management Principles.

a. Risk management consists of a two-part response, those munitions response actions that remove the hazard such as physical removals and those munitions response actions that manage the residual hazards such as land use controls (LUCs). Physical removal involves reducing the quantity of MEC at the property, which directly lowers the risk. However, there frequently is residual risk at MRAs since it is technically and financially impracticable to provide 100 percent removal of all items. However, LUCs can be used to effectively manage the residual risk.

b. LUCs are an important component of the overall risk management strategy. LUCs may consist of educational awareness programs, legal restrictions on land use, and physical access controls. See EP 1110-1-24 for procedural information on establishing and maintaining land use controls. The educational awareness program should be the cornerstone of the LUC program because of the paramount importance of effective risk communication. Controlling or altering the behavior of receptors can reduce the potential for interaction with MEC and reduce the risk. Defense Environmental Network & Information Exchange provides an Internet web-based Educational Program, available at https://www.denix.osd.mil/denix/Public/Library/Explosives/UXOSafety/uxosafety.html. LUCs such as access and activity restrictions can also be used to decrease the number of receptors and the potential for interaction with MEC. If you reduce the number of receptors on-site and the activities that cause interaction the risk is reduced.

c. In summary, if there is potential for a completed MEC pathway the following risk management principles can be applied to mitigate the risk:

(1) Reducing the quantity of MEC on-site lowers the risk.

(2) Reducing the number of potential receptors on-site lowers the risk.

(3) Reducing the potential for interaction between receptors and MEC lowers the risk.

(4) Modifying or controlling the behavior of the receptors lowers the risk.

12-5. Risk Characterization Methods.

a. Risk characterizations are site-specific evaluations and may vary in both detail and extent to which qualitative and quantitative inputs are used. The risk characterizations depend on the complexity and particular circumstances of the project property, as well as the availability of Applicable or Relevant and Appropriate Requirements and other guidance. The risk characterization should consider the potential risks associated with current land use and activities, as well as reasonably anticipated future land use. Existing site conditions should be evaluated to provide a baseline risk in the absence of any actions to control or mitigate that risk.

b. EPA has developed general risk assessment methods for evaluating human health and environmental risks at HTRW-contaminated locations. These general risk assessment methods are conducted using four basic steps: (1) hazard identification, (2) dose response modeling, (3) exposure assessment, and (4) risk characterization. These methods are typically used to quantify risk from long-term, chronic exposure to low levels of contamination. EPA has no provisions for evaluating explosives safety risk.

c. The risk assessment processes that have been developed for chemical contaminants do not lend themselves to a MEC risk characterization because of the unique properties of the MEC pathway. The MEC pathway, including the potential for human interaction with military munitions, needs to be evaluated differently than processes developed for chemical contaminants.

d. Both quantitative and qualitative methods have been used to evaluate MEC risk. Information on available risk tools can be found on the OE Directorate website. Additional guidance on recommended models can be obtained by contacting the MM CX.

e. The results of the risk characterization should be used to evaluate potential munitions response alternatives. Specifically, risk characterization results can be an input to the evaluation of the Protectiveness of Human Health and the Environment criterion in an EE/CA or RI/FS. The risk characterization is used to communicate the magnitude of the risk at the location and the primary causes of that risk, and to aid in the development, evaluation, and selection of appropriate response alternatives.

12-6. Risk Communication.

a. Risk communication is an integral part of risk management. Early, effective communication of risk will allow the public to have a stake in the decisions made and increase the likelihood that the decisions made will be supported by the community. When the public perceives the government as being unresponsive and community relationships are poor, the public will tend to judge the risk as being more serious. Without effective risk communication, the level of risk will have little effect on the public's perception of risk and increasing the amount of technical detail will have no effect on the perceived risk.

b. Critical to effective risk communication is early stakeholder involvement. Restoration Advisory Boards (RABs) are the cornerstone of public involvement for implementing effective communication. RABs are advisory groups for the environmental restoration process and may involve representatives from the DOD, EPA, state and local governments, tribal governments and the affected local community. Although RABs are not decision-making bodies, the RAB members share community views and enable the continuous flow of information. The PDT should plan to have a risk assessment presentation to the RAB provided by an expert from the MM CX. Additional information on developing a public participation plan can be found in EP 1110-3-8.

c. There are many ways to effect risk communication and because of the differences in the education, interest level, and knowledge of the audience, more than one communication venue may be appropriate. The PDT should consider designating one person as a communications coordinator. This person could be from the public affairs office or a RAB member and does not necessarily have to be a technical expert. The communications coordinator should become knowledgeable about MEC risk assessment issues and know when and where to go for additional expertise. The PDT and communications coordinator should develop at the beginning of a project a site-specific risk communications plan. Components of the plan may utilize different methods of risk communication including presentations, videos, partnering meetings, public information forums, and printed media.