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From: **Lenny Siegel <lsiegel@cpeo.org>**
Date: **19 May 2004 18:45:45 -0000**
Reply: **cpeo-military**
Subject: **RAND Review of UXO Risk Assessment**

The RAND Corporation has recently published an independent, thoughtful, and robust analysis of approaches to risk evaluation at sites known or suspected to contain unexploded ordnance. UNEXPLODED ORDNANCE: A CRITICAL REVIEW OF RISK ASSESSMENT METHODS, by Jacqueline MacDonald et al, 2004, is a must read for anyone interested in setting priorities or selecting remedies in the area of munitions response.

For ordering information or an on-line version, see http://www.rand.org/publications/MR/MR1674/.

The RAND team believes that existing methods provide a solid basis for priority setting and assessing toxic risks, but they are more critical of risk assessment methods used for explosive risk management. They suggest that the Army develop a probabilistic risk assessment methodology, based upon the work of other agencies that evaluate the likelihood of catastrophic failure.

After the following key passages from the concluding chapter, I offer a few thoughts of my own.

Lenny Siegel

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Chapter Five
CONCLUSIONS AND RECOMMENDATIONS

None of the UXO risk assessment methods that we evaluated fully meets the Army?s need for sound technical analysis to inform decision-making, either for the purpose of setting priorities among UXO sites or for detailed analysis of explosion and munitions constituents risks at individual sites. Table 5.1 summarizes the methods? strengths and limitations. As shown, each method falls short in one or more of the key criteria necessary for an effective method: technical soundness of risk

calculations, effectiveness of implementation, or ease of communication. Furthermore, stakeholders and regulators involved at the various sites have not uniformly accepted these methods as credible elements of the decision-making process, and continued reliance on them is likely to delay the UXO response process further.

A fundamental reason why none of the modeling methods evaluated meets the Army?s needs is that the UXO problem is not reducible to a single, objective measure of risk. Risk methods must address the risk of explosion of the munitions but also consider the risk of chemicals from exploded munitions and UXO that leach into the soil and groundwater. Further, the methods used for analyzing these two broad categories of risk (explosion and munitions constituents), while different in substance, both depend on subjective judgments about modeling assumptions and data. For example, assessing the explosion risk requires, among other types of information, estimates of the probability that humans will come in contact with UXO. These estimates require assumptions about human behavior and predictions of future population and land use; the density and distribution of UXO items that cannot be seen because they are buried; and the probability that the fuze of a UXO item that may have been buried for decades is intact.

Despite these difficulties, credible UXO risk assessment methods are needed to allow progress toward defining acceptable UXO cleanup standards. Most would agree that zero risk at UXO sites would be the ideal standard, but in reality that standard cannot be achieved with the resources and technical capabilities available now or in the foreseeable future. As explained in Chapter One, the only process that currently can guarantee that all UXO has been removed involves

* burning or cutting all vegetation,

* excavating the entire site one foot at a time down to the maximum possible penetration depth of the UXO (as much as 10 feet or more), and

* sifting all the excavated soil.

This process is too costly to be feasible for the DoD to implement as the standard process for UXO response. Furthermore, it causes irreparable damage to what are often uniquely preserved ecosystems and in many cases will be unacceptable to regulators from natural resource management agencies.

Because sifting is neither possible nor desirable in most cases, UXO clearance relies on metal detectors to locate buried UXO items. Metal detection technologies are imperfect: they do not find all buried UXO. The Army and regulators alike need to publicly acknowledge this reality and design risk-informed decision-making processes that can lead to acceptable compromises.

This chapter suggests steps for the Army and DoD to take toward developing risk assessment methods for prioritizing UXO sites and for evaluating individual sites in detail. The goal is to develop methods that are technically credible, acceptable to stakeholders, and practical to implement. While challenging, evidence from the successful use of risk assessment in other agencies (described in Chapter Four) demonstrates that the task is not impossible.

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SUMMARY OF RECOMMENDATIONS

In summary, UXO risk assessment requires two processes. The first process would prioritize UXO sites for remediation (as Congress now requires). The second process would provide for detailed evaluations of appropriate responses to UXO at specific sites. The Army would benefit from new technical methods for both applications because the existing options are unsatisfactory for the Army?s current and future needs.

We recommend that a new UXO prioritization process (1) sort sites into bins by explosion risk and (2) within these bins, sort sites by munitions constituents risks.

The suggested prioritization process would preserve the information about the two separate risk types: although sites would be grouped first according to explosion risk, within these groups the sites would be ordered by munitions constituents risk. Policy-makers then could decide how much to allocate to sites with varying levels of explosion versus munitions constituents risks.

We recommend developing a new process for sorting sites by explosion risk (stage one of the prioritization process).

RAC could provide elements and a starting point for the new process, but stakeholder concerns would need to be addressed.

We recommend using HRS or RRSE for sorting sites by munitions constituents risks (stage two of the prioritization process). These methods are well established and well accepted. There is no need for a new approach for munitions constituents, since the behavior of these contaminants and the risks they pose are similar to those of chemical contaminants found at non-UXO hazardous waste sites.

We recommend producing two separate UXO site priority lists: one for sites with known and documented future land use and another for sites with uncertain future land use.

Having two lists would prevent manipulation of the process by choosing the least restrictive land uses. Also, it would allow policy-makers to

decide how to trade off current and future risks when allocating funds. The lists could be updated annually or as often as new information became available.

We recommend using RAGS for site-specific assessment of munitions constituents risks.

RAGS is well established for assessing risks of chemicals in water and soil, and there is no need for the Army to develop a new method. We recommend that the Army develop a new, probabilistic approach using the PRA techniques developed by the NRC, NASA, and others for site-specific assessment of explosion risks.

None of the available UXO explosion risk assessment methods by itself satisfies our technical criteria for an effective risk assessment method, and therefore a new approach is needed. Many other agencies use PRA to assess risks of acute events analogous to UXO explosion.

Finally, we recommend that an independent technical review board and an advisory committee of stakeholders oversee development of both the prioritization system and scenario-based site-specific risk assessment processes.

The technical board would consist of independent experts in risk assessment and explosive ordnance disposal. The advisory committee would include representatives of the different groups of stakeholders (state regulators, Native Americans, federal regulators, members of the public, military personnel) involved at UXO sites.

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(commentary by Lenny Siegel)

By clarifying the two major purposes of risk assessment, RAND has made a valuable contribution to the science of munitions response. In particular, I find novel and creative the suggestion that probabilistic risk assessment (PRA) methods, such as event or fault trees, be used to quantify explosive risk, but I'm not convinced. Though the primary goal of munitions response is to prevent casualties, there is a secondary goal: to prevent encounters. That is, I don't believe that people raking leaves in their backyards, or even walking trails in a regional park, should ever come into contact with unexploded ordnance.

Perhaps the PRA approach could be modified to consider this problem, but for now I think the solution lies in the establishment of clear risk management principles. Not only should ordnance be removed from the surface of land where there is public access, but further removal or other responses should be taken to ensure that migration, erosion, or excavation do not lead to contact.

The authors recognize the difficulty of incorporating potential land use

changes into risk-based prioritization process, but they say little about anticipated land use in risk management (remedy selection). This is emerging as one of the key issues in munitions response. For example, if a developer want to build housing on privately owned property containing unexploded ordnance deposited by the military, how much remediation should be done to ensure that the future residents are safe? And if the developer or regulators err on the side of safety, is the Defense Department obligated to pay for additional cleanup?

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