

***Better Understanding Public
Perceptions of Risk: Possible
Implications for Long-Term
Environmental Stewardship
and Hazardous Waste
Management***

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**Better Understanding Public Perceptions of Risk:
Possible Implications for Long-Term Environmental
Stewardship and Hazardous Waste Management**

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ABSTRACT

In the treatment, disposition, and long-term stewardship (e.g., storage) of hazardous waste forms, questions that are of particular concern are:

- What is technically feasible and safe,
- What is economically affordable,
- What is legally mandated and allowable, and
- What is publicly acceptable?

Although DOE is exerting considerable effort in making *sound science-based decisions that are economical and meet legal requirements*, it may be lapse in not gaining a better understanding of how public perceptions are formed. This observation appears especially true in regards to the perceived long-term integrity and safety of various proposed hazardous waste storage options. The purpose of this research was to investigate how differences in how hazardous materials are configured and how those configurations are presented affect peoples' perceptions of how safe they are. Specifically, we designed a preliminary experiment that assessed the public's perception of risk for various storage configurations of hazardous materials. We included into the design factors to measure participants' deliberative and spontaneous response to the perceived safety (or danger) posed by different hazardous materials storage configurations. The critical objectives of the proposed effort were to identify *specific* characteristics of hazardous materials storage configuration and to identify possible differences in deliberative and spontaneous processing of those specific characteristics. Identification of these objectives is critical in understanding what does and does not constitute an acceptable approach to hazardous waste treatment, disposition, and long-term storage.

FY01 TECHNICAL OBJECTIVES

- Develop an experimental process for collecting perceptions regarding the perceived safety and long-term integrity of hazardous waste storage systems.
- Develop a computer-based, reusable collection instrument "system" with associated graphical images.
- Validate the applicability and value of the developed methodology by conducting an on-site experiment.
- Submit results for publication in an applicable, peer-reviewed scientific journal.
- Propose follow-on work and funding requests and submit to DOE-EM for complex-wide use and applicability.

TECHNICAL NARRATIVE

Although numerous articles have argued both the pros and cons of the utility of studying public perceptions of risk (see Pidgeon, 1998 and McDaniels, 1998 for reviews), one inescapable fact remains – *public perceptions have consequences*. At best, adverse public perceptions of a proposed action can lead to work stoppage and schedule slippage. At worse, such negative perceptions can result in costly litigation, extended delay, public embarrassment, and even decision reversal, thereby significantly increasing all decision-related transactional costs, both real and political alike.

The public relations disaster associated with Shell Oil Company's attempt to decommission a no longer needed offshore oil platform by sinking it in the North Atlantic Ocean clearly demonstrates the consequences of failing to understand public perceptions and their associated environmental risk concerns (Elkington and Trisoglio, 1996). Closer to home, INEEL's recent incinerator "experience" points out the same fact. In both instances, decision actions were stopped, litigation was threatened or enacted, and the initial decision was reversed at great expense.

DOE-EM, as well as other governmental organizations (e.g., EPA), have identified a critical need to enhance the environmental decision process, particularly in regards to the challenges posed by long-term waste storage/management (i.e., stewardship) and future site remediation efforts. To achieve a marked improvement in the environmental decision process, it is imperative that both the physical and social sciences make significant and more integrated contributions. This LDRD focused on enhancing the contribution of the social sciences to solving DOE-EM and INEEL-specific environmental problems, particularly in regards to enabling environmental decisions to be made in a more cost-effective and timely manner.

The first task was to develop a number of hazardous materials configurations that varied in their actual safety. The developed configurations were high-resolution three-dimensional computer graphics drawn from a number of real-world scenarios. The storage configuration could be located on the surface, in a shallow pit, or buried in a deep cavern. Half of the storage configurations also had a secondary containment feature, while the other half did not. The combination of location (surface, shallow, deep) and secondary containment (present, absent) yielded six different storage configurations. Short text descriptions that described the features of the six different storage configurations were also developed.

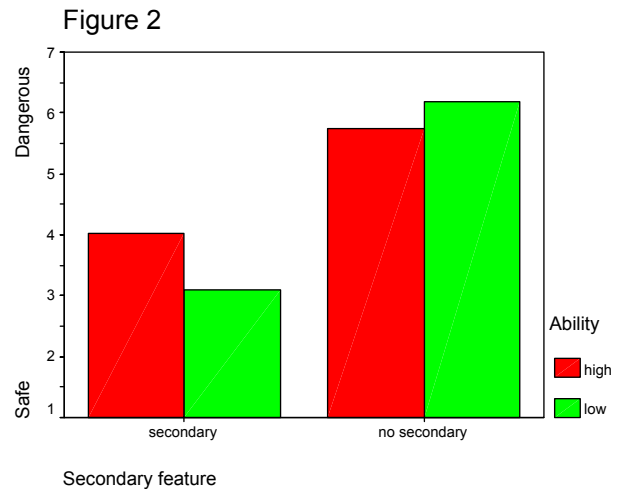
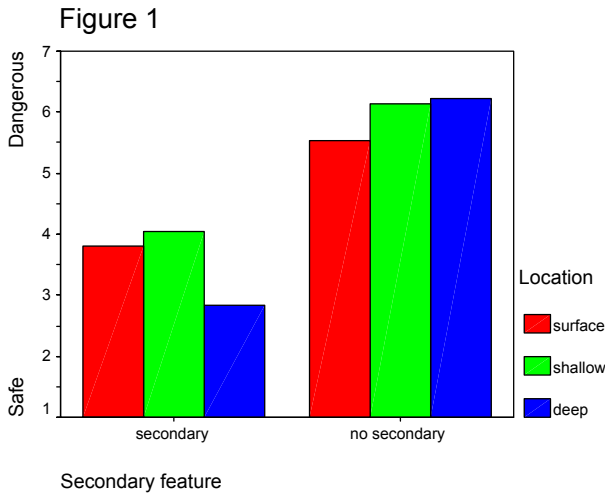
In addition, the experiment was designed to test both deliberately and spontaneously based perceptions of these six configurations. We believed that the task of assessing participant's perceptions of how safe different hazardous materials storage configurations are was similar to social psychological research measuring spontaneously and deliberately formed attitudes (e.g., Petty and Cacioppo, 1986; Fazio, 1999). Based on dual pathway model research, we designed an experiment to test for people's spontaneously and deliberately formed perceptions of hazardous materials storage configurations. Testing for these perceptions can be done by systematically varying the

participants' motivation and ability to process information presented to them and then by measuring their response. According to these dual pathway models, if the person is not motivated and doesn't have the ability to process information in a logical manner, then they can only rely on attitudes that are formed spontaneously.

To manipulate motivation and ability, we used similar techniques used by Sanbonmatsu and Fazio (1990) by manipulating processing time and participants' innate concern of invalidity (Kruglanski & Freund, 1983). Specifically, two factors were orthogonally varied in the experiment. Participants were either told they had only 15 seconds to give us their perception of how safe the configuration was, or they were given an unlimited amount of time. In addition, half of the participants were told that their perceptions would be compared to the responses gathered from a panel of experts and the other half received no such instruction. The combination of these two factors yielded four distinct conditions (e.g., high motivation & high ability, high motivation & low ability, low motivation & high ability, low motivation & low ability). To accentuate the possibility of obtaining a difference between spontaneously and deliberately based perceptions, we included an additional factor. Half of the participants were shown both the graphic and the accompanying text description of the particular configuration, while the other half were only show the text description of the particular configuration.

Volunteer participants were recruited from within the INEEL. We requested that only those employees who would be more representative of the non-technical public in the region participate. After being given the appropriate motivation and ability variations in the instructions, participants were shown all six hazardous materials storage configurations on a computer program we developed. The presentation of the configurations was ordered such that each configuration appeared at each ordinal position in the sequence and each configuration preceded and followed another configuration only one time (i.e., Latin Square design). After the presentation of a single hazardous materials configuration, participants were asked to answer a question on how safe they perceived that configuration to be and another question on how confident they were in their perception. The participants who were only give 15 seconds to view each configuration were given a total of 30 seconds to answer these two questions.

Data were analyzed in a mixed 3 (Surface vs. Shallow vs. Deep) X 2 (Secondary containment vs. No secondary containment) X 2 (High vs. Low motivation) X 2 (High vs. Low ability) X 2 (Picture & text vs. Text only) factorial MANOVA. The first two factors in the model were within participant and the last 3 factors were between participant. Results show that participants perceived configurations with a secondary containment feature overall as more safe then configurations without secondary containment. Participants also perceived that shallow burial was overall significantly more dangerous than either surface or deep burial. Surface containment and deep burial were perceived as being equally safe. In addition, an interaction of these two within participant factors was obtained. The deep burial configuration that had a secondary containment feature was viewed as the safest configuration, but the deep burial configuration that did not have secondary containment was viewed as one of the most dangerous. Although the mean differences in perceived safety for the other two locations



(i.e., surface, shallow) were also in the same direction, they were not as influenced by the presence or absence of secondary containment (see Figure 1). Finally, an interaction between the presence or absence of secondary containment and the participants' ability was also obtained. When participants only had 15 seconds to view the information, they indicated that configurations with secondary containment were significantly safer than configurations without secondary containment. Participants who had an unlimited amount of time to process the information did not (see Figure 2).

Based on these results, there are a number of interesting inferences that we believe are valid. First, we believe these results clearly show that some features of storage configurations are perceived as safer than other features (e.g., the presence of secondary containment) and that there are interactions between various containment features that augment the perceived safety or danger of a configuration (e.g., deep burial with vs. without secondary containment). Furthermore, we infer from these findings that how this information on hazardous materials storage is presented and processed by the recipient matters. People appear to give markedly different kinds of responses when given a limited amount of time to process the information and to provide their perception versus when they have an unlimited amount of time to process the information and provide their perception. We believe these results are informative and should be helpful in making better, more effective environmental decisions.

BUSINESS DEVELOPMENT OPPORTUNITIES

The primary objective of this LDRD is to help the INEEL and DOE-EM assess public perceptions more accurately and as a result make better, more effective environmental decisions. We believe these preliminary results are informative about the perception of the safety of storage options, and that more research is needed to understand additional factors that can affect how a storage facility is perceived. The products will include published papers, people with expertise to assist in assessing public perceptions, and a computer based measurement tool.