

Issues Regarding Refuge Chamber Training

NIOSH's research experience related to the present application

The operation of a refuge chamber is a motor task. In other words, there are discrete steps at which the miner will be required to physically perform an action. For example, one chamber requires a series of 18 sequential steps to activate and maintain. Some of these steps involve turning handles, opening valves, depressing buttons and pulling latch handles out, setting oxygen flow meters guided by a chart for the number of people in the chamber, placing soda lime cartridges on top of scrubber tray slots, and monitoring the atmosphere by taking readings. As with all motor tasks, there is a two-fold issue to be considered: How does the individual learn the task in the first place, and once having learned it, how does he or she retain what has been learned?

A series of NIOSH investigations involving coal miners' ability to don their emergency breathing apparatus, called "self-contained self-rescuers (SCSRs)", have addressed these questions. In contrast to the 18 sequential steps to operate the refuge chamber, there are only six steps to donning an SCSR. Yet, NIOSH testing has shown that without repeated hands-on practice, miners quickly forget how to physically perform these steps. In one NIOSH experiment, a group of miners received hands-on training until they demonstrated proficiency. They were not given any additional training and were tested throughout the year. Proficiency declined at every test point. At the end of one year only ten percent of the individuals sampled were proficient. Also as part of the experiment, other miners completed hands-on training quarterly. At the end of a year, 70% were still proficient. In sum, the NIOSH research confirmed what is known empirically about all motor tasks: initial instruction should involve hands-on practice, which must be repeated in order to maintain proficiency¹.

Type and frequency of training

Motor task training: Generally, there is little or no reason to believe the operation of a refuge chamber is in any way exempt from the principles that have held true for literally hundreds of motor tasks that have been studied since the turn of the 20th century: people learn by doing, and tend to forget over time unless they practice. There are, therefore, implications for how miners should be trained to operate a refuge chamber:

- Hands-on training – Trainers ought not to rely solely on verbal or printed instructions, videos, etc. At a minimum, miners should be given a chance to visit a chamber, be talked through the steps involved in its operation, and simulate activating the various controls while demonstrating that they have heard and understood key components of the process. Ideally, of course, instructors would have access to a chamber or mock-up dedicated to training so that workers could physically practice the steps.

¹ Schmidt, R. [1988]. Motor control and learning: A behavioral emphasis. Champaign, IL: Human Kinetics Publishers.

- Frequency of training – The optimum intervals for retraining on a refuge chamber are not known. A reasonable approach, however, would be to integrate instruction on the refuge chamber into the emergency mine evacuation training and drills that are mandated to be held quarterly. It is a logical fit, and would provide repetition throughout the year.

Decision making training: Once miners have learned *how* to use a refuge chamber, they need to be taught *when* to use it. Research has shown that the simple admonishment to “escape if at all possible” has little impact on the trainee because it is not placed in any kind of context². NIOSH researchers are constructing a simulation problem that provides context. It has one principle aim: to help miners understand when, under what conditions, they might choose to enter a refuge chamber rather than attempt self-rescue. There are many instances, especially in the first moments of an incident, when miners could be called upon to make these critical decisions. The simulation problem will engage miners in a scenario that develops over time and requires them to make choices at key decision points. As they work through the scenario the miners will receive feedback regarding the alternatives they have chosen. The exercise will teach by reinforcing the strengths and correcting the weaknesses in miners’ logical decisions when they are faced with the predicaments and difficult alternatives involved in choosing whether or not to use a refuge chamber.

Expectations training:

NIOSH will develop training materials to help coal miners attain realistic expectations about what it would be like to spend four days inside a refuge chamber. It is common to observe panic and elevated levels of anxiety during mine emergencies. Those levels may be amplified when miners experience the feeling of entrapment or lack of information. Educating miners on probable events that can occur while using a refuge chamber may decrease their level of panic and anxiety about unanticipated outcomes. It is crucial to teach miners that these responses are normal under emergency situations, and to teach them the appropriate coping skills. Past research has found that developing expectations training can increase success and decrease negative responses during emergencies^{3 4}. The training will consist of two parts: 1) training regarding the potential physiological responses, and 2) the potential psychological or emotional responses--including stress factors for being confined in a refuge chamber.

² Cole, H. [1997]. “Stories to live by: A narrative approach to health behavior research and injury prevention”. In D. Gochman (Ed.), *Handbook of Health Behavior Research IV: Relevance for professionals and Issues for the Future* (pp. 325-349). New York: Plenum.

³ Kowalski KM, Vaught C, Mallett L & Brnich MJ [1997]. “*Worker Response to Realistic Evacuation Training*” In: Proceedings of the International Emergency Management and Engineering Society Conference (TIEMES '97), June 10-13, 1997, pp. 52-56.

⁴ Vaught, C, Mallett LG, Brnich MJ & Peters RH [2004]. “*Expectations vs. Experience: Training Lessons Based Upon Miners’ Difficulties When Using Emergency Breathing Apparatus.*” *J of the International Society for Respiratory Protection*, v. 21, Spring/Summer, pp. 49-59.

Type of training materials

Training manuals in which the manufacturers explain how to operate and maintain their refuge chambers have been collected by NIOSH. Only one is complete at present. All of the training manuals contain operational instructions. One of the manuals also includes expectations training. Most of the manufacturers have DVDs in progress.

All training materials developed by the manufacturers will be collected and assessed. A matrix will be developed to summarize the various components of each refuge chamber's instructional materials. Training guidelines and templates will be created to demonstrate what a manufacturer's training module should include, and how the material could be presented. Some key components to the training module are trainers' guides, maintenance check lists, competency assessments, operating manuals and a set of instructions for posting within the refuge chamber. An Information Circular report will be written to provide guidance on how to effectively train miners to operate refuge chambers. This report will include information that should be useful for training miners to survive in refuge chambers.