

When Do You Take **Refuge**?

Decisionmaking During Mine Emergency Escape
Instructor's Guide and Lesson Plans



Report of Investigations 9682

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Overview

This booklet contains the instructor's guide and lesson plans that can be used by instructors for the "When Do You Take Refuge? Decisionmaking during Mine Emergency Escape" training program. This training program was created by a multidisciplinary team at the National Institute for Occupational Safety and Health (NIOSH) to help trainees practice correct decisionmaking skills during an underground mine emergency. The training program consists of three parts. The first part is the computer-based training (CBT) program which can be used by groups or individual trainees. The CBT program is run on a computer (refer to the Computer System Requirements section) and uses a multimedia software application called ToolBook®. The training program contains pictures and audio files that simulate the decisions involved in mine emergencies. The second part is the instructor's guide and lesson plans. The third part is an optional evaluation form that the instructor can deliver to trainees to obtain feedback about the training program and discussion sessions.

Purpose

The purpose of the CBT program is to simulate an underground mine emergency and require trainees to make choices similar to those that they would have to make in a real emergency. This training incorporates recent safety developments in underground coal mining technology by including emergency escape options such as refuge alternatives located near the working face, outby refuge alternatives, and caches of extra self-contained self-rescuers (SCSRs). Refuge alternatives are a new technology that is unfamiliar to many miners. Some miners may not know when to use a refuge alternative, or they may be reluctant to enter a refuge alternative at all. Discussion questions are also included in the lesson plan to reinforce the lessons and stimulate thought and discussion about emergency escape. In the event of an actual mine emergency, miners may not have the option to communicate verbally if they are wearing their SCSRs. Therefore, this training will expose trainees to the types of decisions that they may need to make during a mine emergency escape and stimulate group discussion about when and why to use a

refuge alternative. Having these discussions now will prepare miners for emergency situations that may occur later.

Target Audience

This material has been designed for underground coal miners at all skill levels. Although it was designed for coal miners, it may be used for training miners at all types of underground operations that have added refuge alternatives.

Requirements for Teaching This Module

- If this training is part of a Mine Safety and Health Administration (MSHA) required course as per 30 CFR, an approved instructor and/or content expert must deliver the training.
- Basic computer skills are required (for example, knowledge of how to utilize a keyboard, mouse, and speakers, and how to connect a computer to LCD projector).
- If downloading this program from the Internet, the ability to access Internet browsers is required.

Intended Use

The instructor's guide and lesson plans provided in this booklet are intended as guides for the instructor to use during the training session. The training program and lesson plans are flexible and can be utilized by individuals or groups. It is recommended that discussion of the topics be included upon completion of the training program. Questions are provided in this guide to promote discussion. These discussion questions and teaching points are intended for use after the training program. Overall, completing the CBT program, discussion section, and evaluation can take 30–90 minutes, depending on the time spent on the discussion section.

In the case of group training, the trainer should permit discussion while trainees take the CBT training to allow decisions to be made by group consensus. For individual training, the trainer should lead discussion after all individuals have completed the CBT training.

The instructor of this training program must have knowledge of refuge alternatives including information about the specific type of refuge alternative at the individual mine for which the training is taking place. This will enable the instructor to answer questions about the refuge alternative locations, type, size, contents, and interior.

Installation

The training program must be completed on a PC. The training program can be installed using the CD-ROM (included) or it can be accessed and downloaded from the NIOSH Mining webpage (<http://www.cdc.gov/niosh/mining/products/>) and then installed. The computer system requirements for installing and running the program are listed below. If the program will be downloaded from the NIOSH Mining web page, the computer must also have a modern Internet browser such as:

- Microsoft Internet Explorer
- Google Chrome
- Mozilla Firefox

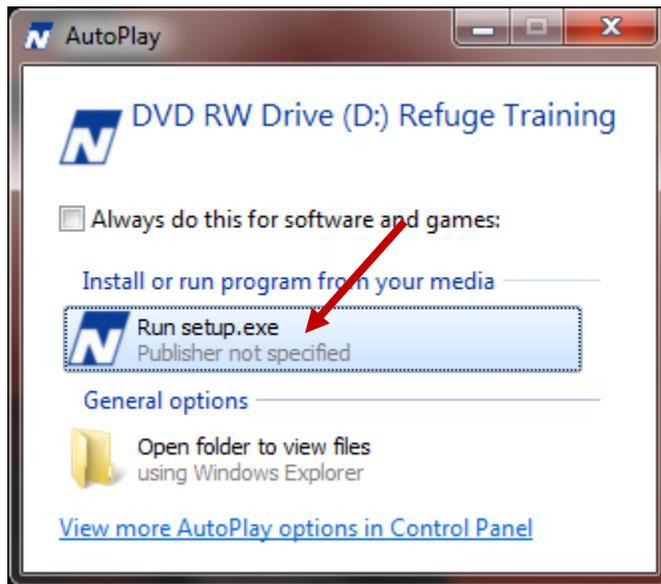
Computer System Requirements

To install and run the training program, you will need the following:

- Administrative rights to install software on your PC
- CD-ROM or DVD drive
- A sound card to play the audio files
- Speakers or headphones to hear the audio
- 500 MHz processor or greater
- A supported operating system:
 - Windows 7
 - Windows Vista
 - Windows XP
- RAM: Minimum of 512 MB
- Graphics card that is capable of displaying 800 x 600 pixels resolution with 16-bit color or greater (1,024 x 768 recommended).

Installing the Application

- Depending on the PC, the program may automatically initiate installation (via the *Autorun.inf* file) when the program CD-ROM is inserted in the CD-ROM drive. If this occurs, skip to Step 4 below.
- Other computers may display a dialog box (pictured below) when the CD-ROM is inserted in the CD-ROM drive. If this occurs, double click on the **Run setup.exe** option and skip to Step 4 below.

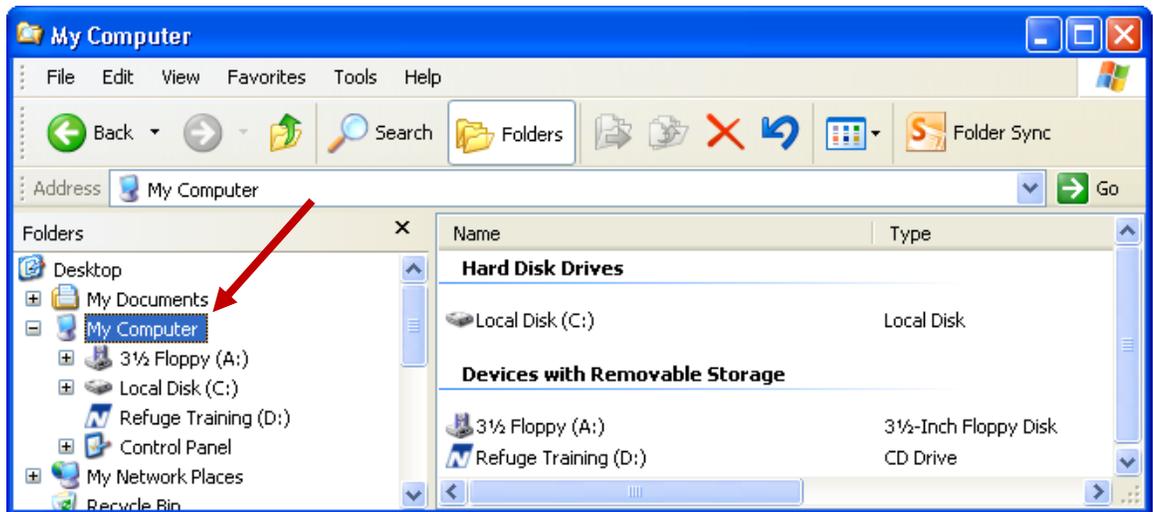


- If neither of the above actions occur, follow the steps listed below to manually install the application.

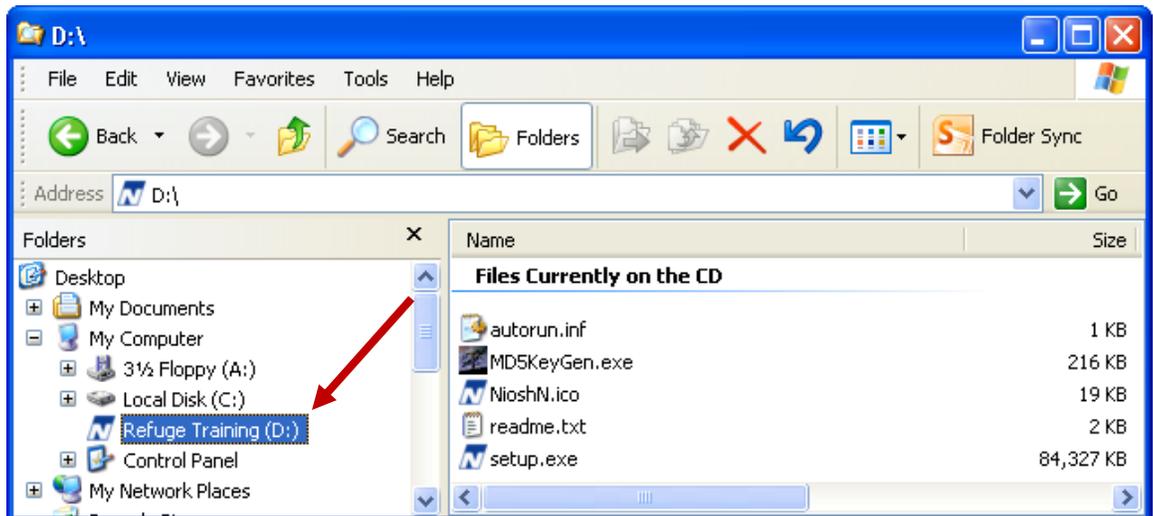
Manually Installing the Application

- If the program does not automatically install after you have inserted the CD-ROM, use the following instructions to manually start the program:

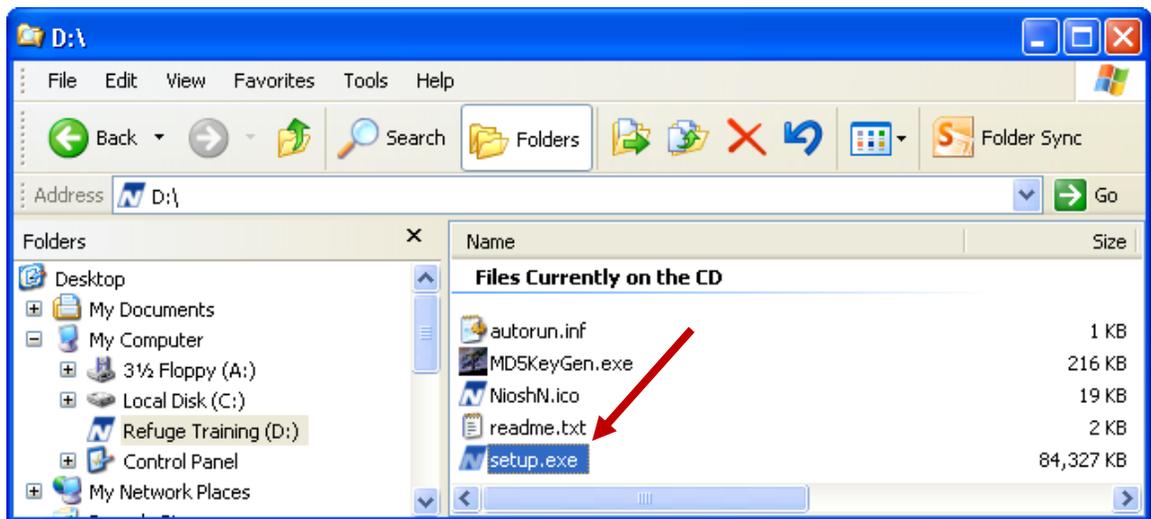
1. Open **My Computer**.



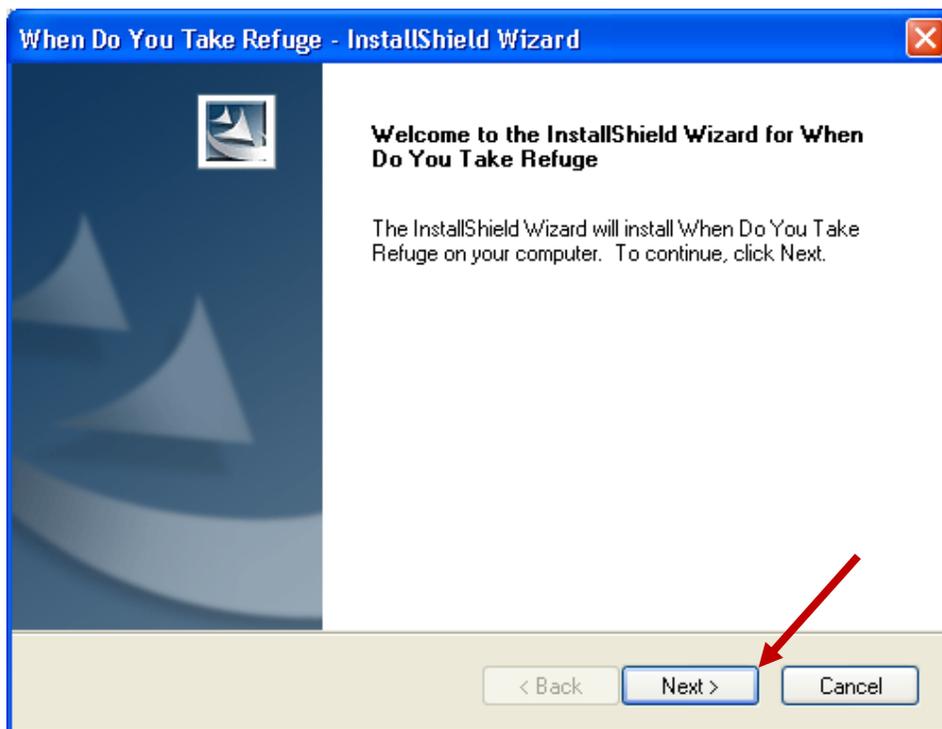
2. Click on the CD-ROM drive as shown below.



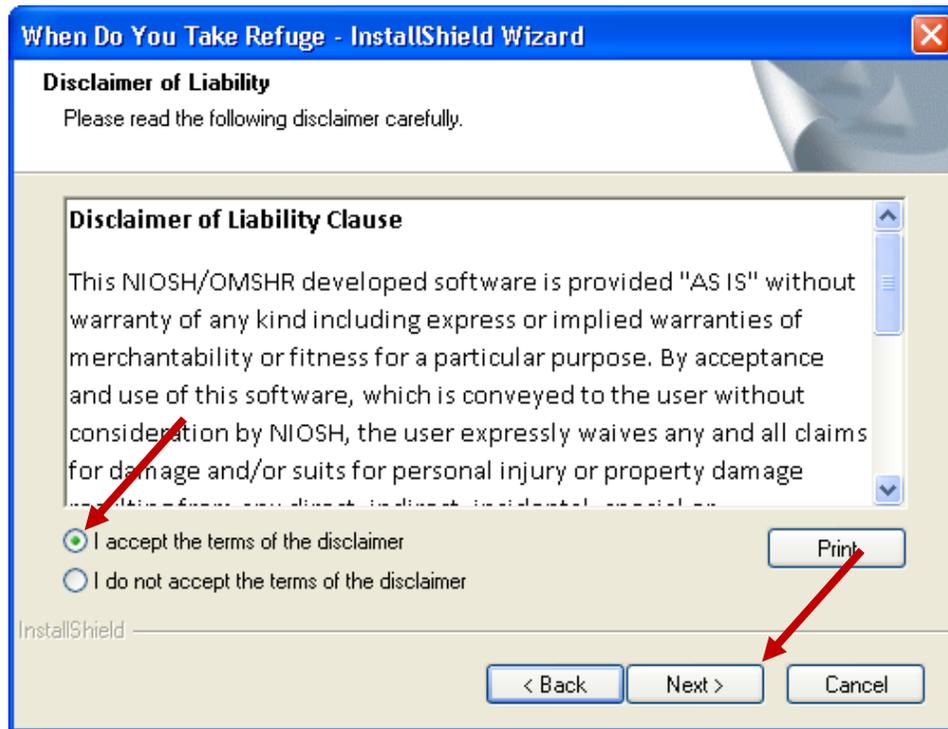
3. Double click the *setup.exe* executable file.



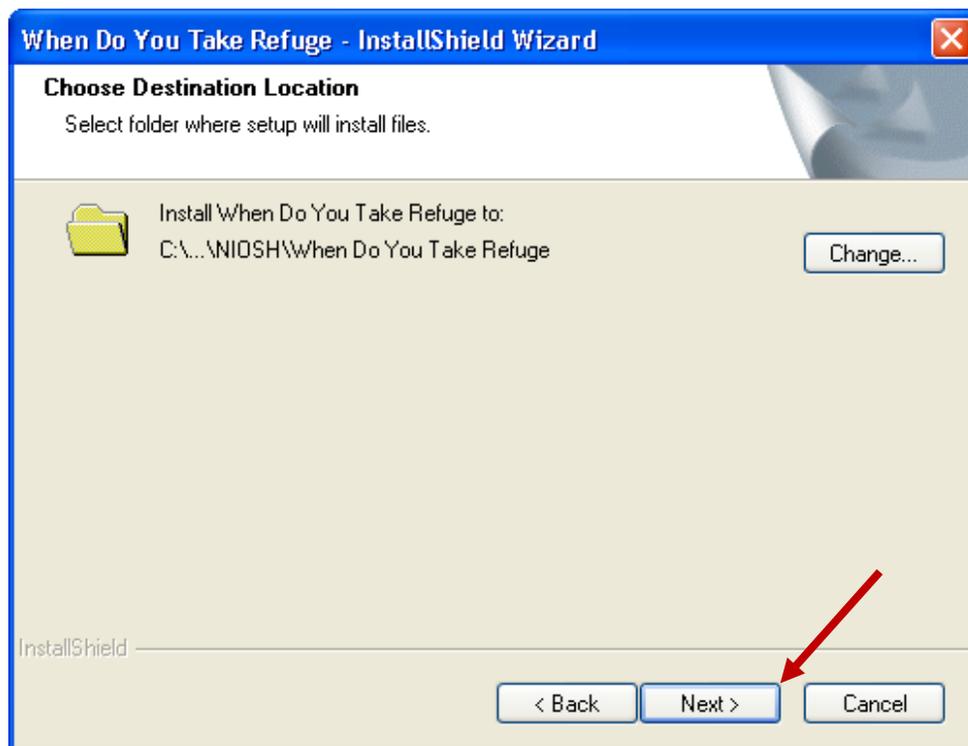
4. An InstallShield Wizard dialog box will appear. Click **Next >** to continue.



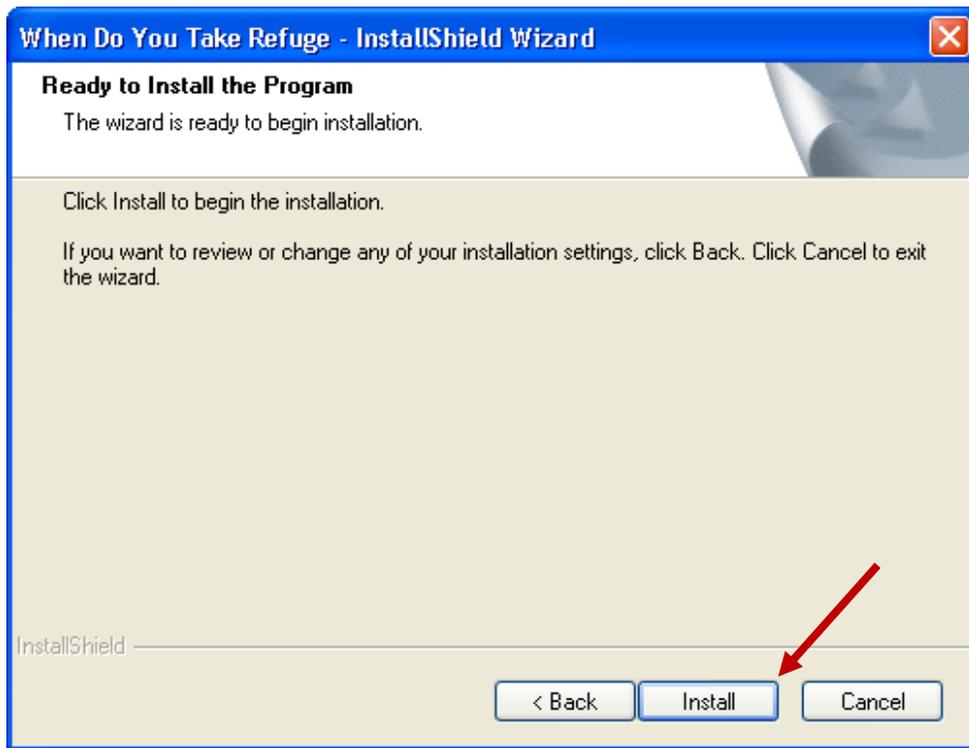
5. Read the Disclaimer of Liability. Click on the radial button for “**I accept the terms of the disclaimer**” then click **Next >** to continue.



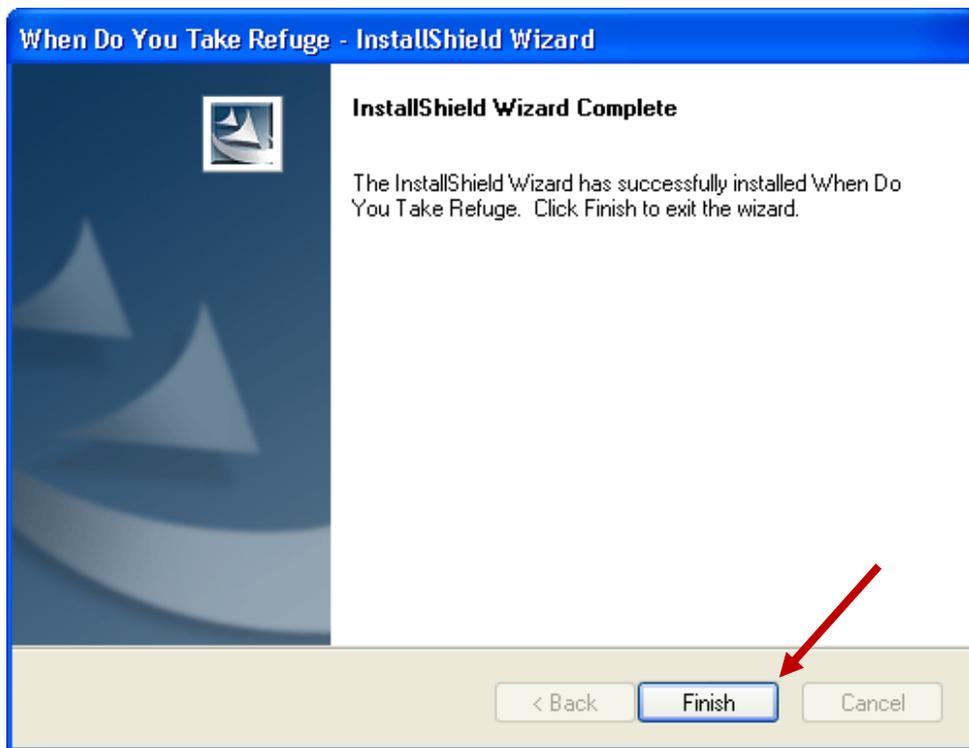
6. Click **Next >** to continue.



7. Click **Install** to continue.



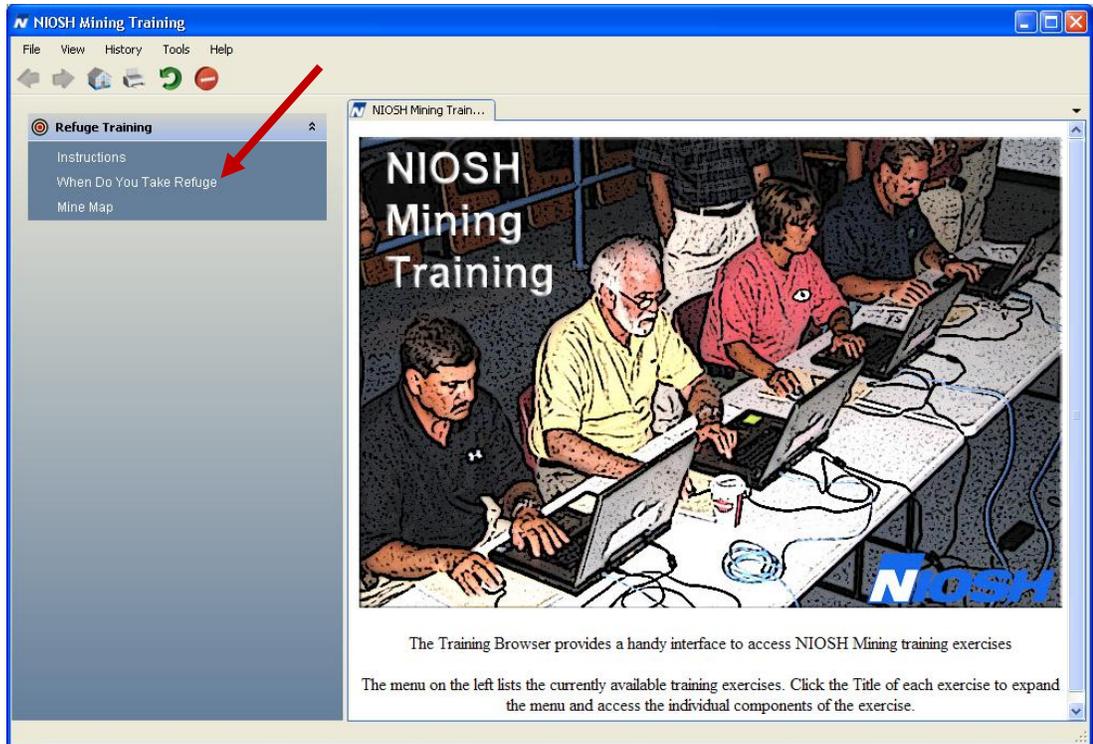
8. Click **Finish**.



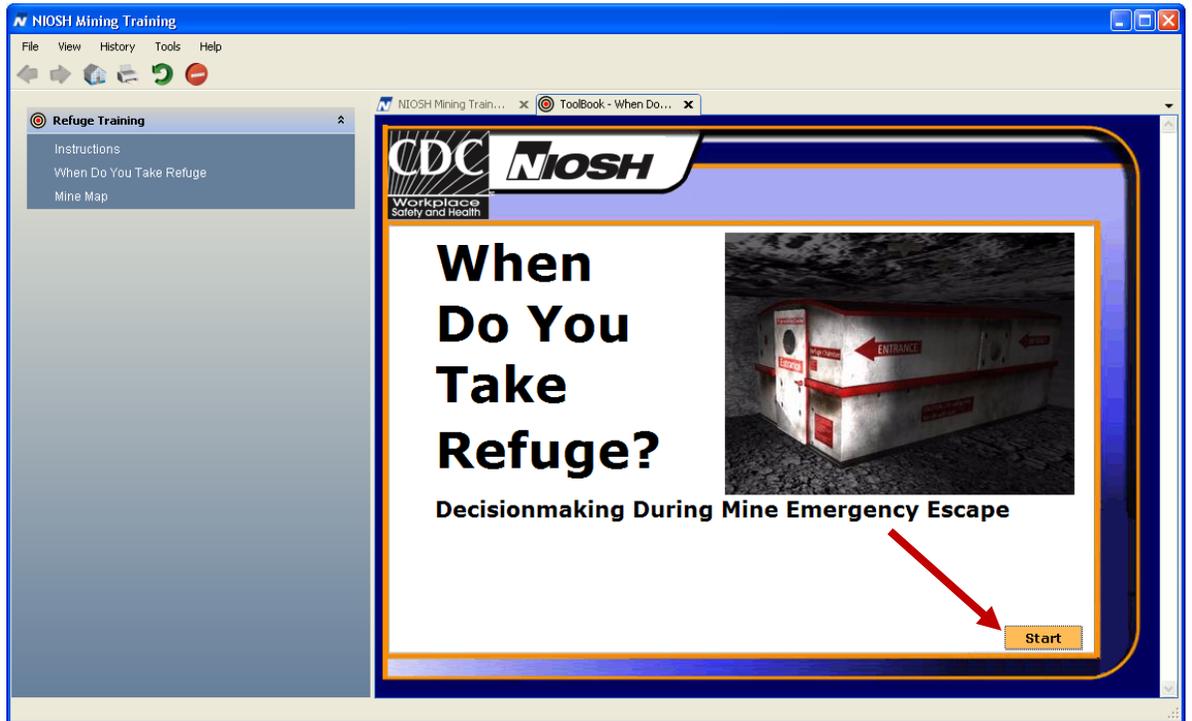
9. Double click the program icon that is now on your computer desktop.



10. Click on **When Do You Take Refuge** to launch the training program.



11. Use the navigation buttons within the training program to progress through the training scenario.



12. Make sure the speakers are turned on because this program has sound.

If a problem occurs while attempting to run the training program, please review the instructions above before reporting the problem.

Instructor's Guide

For the Refuge Alternative Computer-Based Training Program

Background Information

Refuge alternatives may be portable units that are either made of steel or inflate from a steel skid, or they may be hardened rooms that are built into a crosscut. They provide breathable air, water, food, a toilet, and a seal from the outside environment for 96 hours. Refuge alternatives are intended to be used as a last resort when all escape options have been exhausted.

This training program includes refuge alternatives that are near the face and also outby the face.

Training Room Setup and Equipment

- Trainees should be seated so they have a clear view of a computer screen.
- For training one *large* group (5 or more people) at a time, the following equipment must be present:
 - one computer
 - LCD projector with audio capabilities
 - large projection screen
- For training multiple *small* groups (2-4 people per group), the following equipment must be present:
 - one computer for each small group of trainees
 - computer speakers for each group or headphones for each trainee
- For *individual* training, the following equipment must be present:
 - one computer per trainee
 - headphones for each trainee (if more than one computer is in the room)
- A supply of Training Evaluation forms (enough for all trainees) must be present in the training room (this form is available in the back of this booklet).

Advance Preparation

- Review the “When Do You Take Refuge?” computer-based training program prior to the training class. When you take the training program yourself, it will be easier for you to lead a group discussion with the trainees after they have completed the training program. This will help you understand the decisionmaking challenges the trainees will experience. You will be able to emphasize that there are many paths that a miner can take, but only three main outcomes. These include: (1) escaping the mine, (2) entering a refuge alternative, and (3) leaving an injured miner in a refuge alternative while others escape the mine.
- Review information about the specific refuge alternative(s) that are in the mine where the trainees work. Know the location, size, and type of refuge alternative that will be used in the mine for which training is taking place. Find out if the refuge alternative can be used as a way station.
- Double check all equipment before the training session. Have the program(s) open and ready to start.
- Make sure that the sound is working properly and that the computer and/or speakers are not muted.
- Review the Discussion Questions section of the lesson plan in this booklet to determine the most appropriate discussion questions for the specific mine and group of trainees.
- Make copies of the Refuge Alternative Computer-Based Training Evaluation form (see pages 33–35). Make enough copies so that every miner who takes part in the training session will be able to fill one out.
- Make copies of the Mine Map and Lifeline Tactile Signals handouts (see pages 39–40). Make one copy per trainee if conducting individual training and one copy per group if conducting group training.

Refuge Alternative Decisionmaking

Because every mine emergency is unique, there is not one set of prescriptive guidelines about when to use a refuge alternative. Trainees should be reminded that it is always best to try to escape. However, if miners cannot escape, a refuge alternative will provide breathable air, water, food, and toilet facilities for up to 96 hours. When discussing refuge alternative decisionmaking, it is important to discuss both the benefits and drawbacks of using a refuge alternative. Trainees will see the following list at the end of the training program. You may wish to discuss this information with the trainees.

Information about Refuge Alternatives

- Rescuers know where the refuge alternatives are located.
- Breathable air will be available for at least 96 hours.
- Supplies will be available - food, water, first aid.
- Potential for communication with the surface is available in the refuge alternative.
- Refuge alternative could be designated as a meeting location during escape.
- Conditions may be uncomfortable—hot, cramped, and stressful.
- Rescuers need acceptable conditions to reach the refuge alternative.
- Refuge alternatives could be damaged by roof falls, fires, or explosions.
- Miners cannot leave or reenter the refuge alternative without expending oxygen and shortening the time the refuge alternative can sustain life.

Outline of the Training Program

1. Introduce the “When Do You Take Refuge? Decisionmaking during Mine Emergency Escape” computer-based training (CBT) program.
2. Distribute copies of the mine map.
3. Run the CBT program.
 - The time needed to complete the CBT will vary by person. In general, it should take about 10–20 minutes to complete.
4. Conduct either an in-depth or abbreviated group discussion session.
 - The in-depth discussion session provides a detailed follow-up after the trainees have completed the CBT. This discussion will take about 30–60 minutes. See page 16.
 - The abbreviated discussion will take about 15 minutes. See page 30.
 - Distribute the Lifeline Tactile Signals handout during the discussion. See page 40.
5. Evaluation of Training
 - The Refuge Alternative Computer-Based Training Evaluation form is provided to trainees to help evaluate the utility of this training; it takes about 5 minutes to complete this form. See pages 33–35. Note: The instructor’s answer key for questions 14–18 is shown on the back of the second page of the evaluation form (page 36).

Lesson Plan for Training with In-Depth Discussion

- This lesson plan can be used when presenting the training to one large group or several smaller groups. Parts of the lesson plan can be used when the training is given to several individuals at one time.
- Ask the trainees the questions in *italics*. Then, use the Summary Teaching Points included after each set of discussion questions to help you sum up the discussion and provide the trainees with advice relating to a particular aspect of mine emergency escape. You can decide if you want to discuss *all* of the teaching points, *some* of the teaching points, or only *one* of them. You can decide which teaching points are most important to cover. You may decide to save some of the teaching points for use during a later training session. Included in this discussion guide are real-life examples that relate to the teaching points. These can be shared with the trainees to enhance the credibility and realistic nature of the teaching points because they relate to actual mine emergency situations that have occurred in recent years.

Introduce the Training

- *“We are going to use a computer program to practice making decisions during a mine emergency. Select the option that you would choose if this situation occurred in real life. If you want to return to the previous slide to make a different decision, you can select the Go Back button at any time.”*
- *“If you are working in a group, you will need to work together to decide what to do at each step. Because you would probably be wearing your SCSR during a real emergency—and would not be able to communicate verbally—today’s training is a chance for you to have a discussion with your crew and practice making decisions as a group. If you are working alone, make the decisions that you think are best.”*
- *“Remember, escape should always be your first priority. However, the decision about whether to continue to escape or seek refuge is not always an easy one. There may be a time when all escape options have been exhausted and taking refuge is your last resort.”*

Computer-Based Training Program

- When the trainees begin the CBT program, remind them that they must select a choice by clicking a decision box in the lower right of each page to advance to the next page. If trainees are completing the training individually or in small groups, they will progress through the CBT at their own rate. If you are conducting the training for one large group, make sure to allow enough time for all trainees in the room to read each slide and make a decision before going to the next one. This training program should take about 10–20 minutes to complete.

Group Discussion Session

- The following sections include discussion questions and teaching points for important topics relating to emergency escape and the decision of when or when not to use a refuge alternative. These topics include: group dynamics, refuge alternative use, communicating important information, SCSR use, and alternate escapeways. Each topic includes multiple discussion questions in *italics*. These questions can be asked verbatim to elicit discussion among the trainees. Summary teaching points follow each set of related discussion questions. These summary teaching points should be conveyed to the trainees to sum up the discussion that has just taken place before moving on to the next set of discussion questions. Each discussion guide (i.e., in-depth or abbreviated) concludes with a set of summary statements that can be read to conclude the training and highlight the important lessons trainees learn from the training.

Discussion 1 Questions: Group Dynamics. Use the following questions and teaching points to address trainees' abilities and concerns regarding decisionmaking and escaping as a group.

Part A: Agreement as a group:

1. *“Did everyone in your group agree on the same decisions?”*
2. *“Did different people have different opinions about when it is best to use a refuge alternative?”*
 - Prompt: *“If so, what were the opinions and what did you do when there was a difference of opinion?”*
3. *“Do you think people have different opinions when planning their escape during true mine emergencies?”*
 - Prompt: *“If so, how can they be resolved?”*

Summary Teaching Point: In past mine emergencies, miners often escaped in groups. Escaping in a group can be helpful if you are with other miners who are more familiar than you with navigating through the mine. However, attempting a group escape can be dangerous if miners go along with decisions that are made by other miners when they believe there may be better options. Remember, your first priority in a mine emergency should be getting out of the mine.

Part B: Group versus individual escape

1. *“What are some pros and cons of group escape?”*

- Pros:
 - If the emergency does not require wearing SCSRs, escaping miners can discuss options for escape (routes to take, mode of egress, etc.).
 - Escapees can draw on the knowledge of others to decide on the best course of action.
 - Escapees can help each other with the donning and use of SCSRs, navigating escapeways, etc.
 - A decisive leader may emerge if the traditional leader cannot take charge.
- Cons:
 - The group can only travel as fast as the slowest person
 - Groups can spend excessive time deciding on a course of action
 - Groups may want to split up and allow the faster escapees to continue ahead of the slower ones.

2. *“What are some pros and cons of individual escape?”*

- Pros:
 - Individual escape permits those who can travel faster to move out and reach safety sooner.
 - Those who reach safety sooner can report the locations, if known, of other escaping miners.
- Cons:
 - A lone miner may not have anyone close by who can help if he/she has difficulty escaping.
 - A lone miner may not have a multigas meter to assess the mine atmosphere.
 - A lone miner may lack sufficient experience to have good judgment, decisionmaking, and/or navigational skills leading to poor choices when escaping.

3. *“What are some situations when escaping alone might be necessary?”*

- Possible Answers:
 - A miner is working separately from a crew and a mine emergency occurs between a miner and others underground, and they are unable to reach each other.
 - A miner is separated from the group and cannot find anyone else.
 - A miner is the only person to survive the emergency or the only person physically capable of attempting escape.
 - All of the other miners refuse to try to escape and want to enter the refuge alternative.

Summary Teaching Point: In an emergency, you will have to decide if self-escape or staying with the group will give you the best chance of escaping the mine. Keep in mind, though, that it is always best to try to escape before using a refuge alternative.

Part C: Escape while tethered

1. “What are some advantages and disadvantages of escaping while tethered?”

- Advantages:
 - Allows escaping miners to stay close together, even in dense smoke
 - Reduces likelihood miners will become separated
- Disadvantages:
 - If a miner in the group trips and falls, other miners could be pulled down.
 - Being tethered can cause difficulty when miners have to pass through mandoors, cross overcasts, or maneuver through tight clearances.

2. “What are some techniques that make escaping while tethered easier?”

- Possible Answers:
 - Adequate distances between miners can be maintained.
 - The tether can be secured to enable miners to easily detach themselves should there be a need.



Real Life Example: There have been past disasters where miners have become separated because they did not use a tether or a tether was not yet available. During a mine fire in 2006 at the Aracoma Coal Company, Alma No. 1 Mine, a group of 12 miners attempted to escape from their working section by mantrip. Before leaving, the foreman told the crew that if they could not travel all the way on the mantrip they should move into the Northwest Mains belt entry, which served as the section’s alternate escapeway. After travelling about 2,220 feet, the crew abandoned the mantrip because of heavy, dense smoke. The miners exited the mantrip, donned their SCSRs in heavy smoke, and began their egress on foot, heading toward a crosscut with a mandoor which led to the Northwest Mains belt entry. The crew crossed into the belt entry, where the air was clear of smoke. When doing a head count, the foreman noticed that two miners were missing. For some unknown reason, the two miners became separated from the rest of the crew. The foreman and two other miners went back into the smoke to look for the missing workers but could not locate them. The crew continued to travel on foot about 1,900 ft in the belt entry until they were outby the fire location and moved back into the primary escapeway. The bodies of the two missing miners were found on January 21, 2006 [MSHA 2007].

Summary Teaching Point: When escaping through dense smoke, groups of miners should tether together to avoid losing individuals.

Part D: Leaving a miner behind

1. *“What kinds of situations could occur at your mine where you might need to leave a miner behind?”*
 - Possible Answers:
 - A miner is physically unable to escape.
 - A miner has separated from the group and cannot be found.
 - A miner refuses to attempt to escape and wants to deploy the refuge alternative.

2. *“What can you do to help the miner escape before making the decision to leave the miner behind?”*
 - Possible Answers:
 - Try to physically assist the miner by supporting the miner as he/she walks.
 - Attempt to convince the miner that escape may be possible, and entering the refuge alternative is not the right thing to do at the time.

3. *“What do you need to do if you leave a miner behind?”*
 - Possible Answers:
 - Note the time and location you last saw the miner.
 - Leave any available food and water with the miner.
 - Try to get the miner to a refuge alternative.
 - Assist rescue efforts by communicating as soon as possible to the responsible person the time and location you last saw the miner.



Real Life Examples: During a mine fire at Beth Energy Mine No. 33 in western Pennsylvania, an escaping miner could not physically continue. The crew of seven men had to make the difficult decision whether to split up and leave the disabled miner behind or stay together. The crew decided to split up and left the disabled miner behind with two other miners. When the group of four miners reached fresh air, they told incoming rescuers where the downed miner and the two other miners were located. With the fire extinguished, rescuers immediately redirected air to quickly clear smoke. The three miners were successfully rescued [NIOSH 2000]. In this case, there were no refuge alternatives available in the mine.

Summary Teaching Point: Although it may be a very difficult decision, at some point during a mine escape you may have to leave a miner behind for the greater good of the group. If you must leave a miner behind, you might be able to leave the miner in a refuge alternative. However, you should only seek refuge when escape is no longer an option.

Discussion 2 Questions: Refuge Alternative. The following questions can be used to discuss some of the pros and cons of using refuge alternatives, which are detailed both in this instructor’s guide and in the training program.

Part A: Using refuge alternatives

1. *“Did anyone want to go to the refuge alternative?”*
 - If yes: *“Why did you want to go to the refuge alternative?”*
 - If no: *“Why didn’t you want to go to the refuge alternative?”*
2. *“When would you consider using a refuge alternative at your mine?”*
3. *“Can the refuge alternatives at your mine be used as a way station?”*

Note to Instructors: Some refuge alternatives may be used as way stations—temporary stop-off points to change SCSRs, rehydrate, rest, and try to obtain more information about the situation. Using a refuge alternative as a way station means that miners would enter the refuge alternative but exit after a period of time. It is important to note that not all refuge alternatives can be used as way stations. Some manufacturers’ refuge alternatives do not contain enough purge air to be used as a way station and later as a refuge alternative if miners find they cannot escape the mine. Make sure to check with mine policy and your refuge alternative manufacturer to see if the refuge alternatives at your mine can be used as way stations. It is important, however, to keep in mind that if miners use a refuge alternative as a way station, it will not only delay their escape, but it can reduce their escape options over time.

4. *“What is some important information to remember about refuge alternatives?”*
 - Rescuers know where the alternatives are located.
 - Breathable air will be available for at least 96 hours.
 - Supplies will be available - food, water, first aid.
 - Potential for communication with the surface is available in the refuge alternative.
 - Refuge alternative could be designated as a meeting location during escape.
 - Conditions may be uncomfortable—hot, cramped, and stressful.
 - Rescuers need acceptable conditions to reach the refuge alternative.
 - Refuge alternatives could be damaged by roof falls, fires, or explosions.
 - Miners cannot leave or reenter alternative without expending oxygen and shortening the time the alternative can sustain life.

Summary Teaching Point: Escaping the mine during an emergency should be your first priority. Only enter the refuge alternative as a last resort when all of your escape options have been exhausted. If the refuge alternatives at your mine can be used as a way station, you may wish to use it to develop an escape plan or change SCSRs.

Part B: Types of mine emergencies

1. *“What types of emergency situations could occur at your mine?”*
 - Fire
 - Roof or rib fall
 - Explosion
 - Water inundation
 - Gas inundation

2. *“What would you have to do to escape the mine during those emergencies?”*
 - Possible Answers:
 - Fire: Navigate through heavy smoke, high carbon monoxide (CO), and possibly heat while wearing SCSR; change escape route, manage injured miners, etc.
 - Roof/rib fall: Navigate around and/or over rubble to escape, manage injured miners, etc.
 - Explosion: Navigate through heavy smoke and possibly heat while wearing SCSR, clear rubble, manage injured miners, deal with disrupted ventilation, oxygen deficiency, increased methane, etc.
 - Water inundation: Navigate through rising water, strong water currents, debris in the water, and tripping/stumbling hazards; change escape route if water is too deep, seek higher ground if escape is not possible.
 - Gas inundation: Escape while wearing an SCSR; take gas readings to monitor the quality of the air.

3. *“What are some situations that would require entering a refuge alternative?”*
 - Possible Answers:
 - Incapacitating injury to you or a fellow miner
 - All possible escape routes are blocked



Real Life Example: On January 2, 2006 a methane ignition caused an explosion at the International Coal Group’s Sago Mine near Buckhannon in Upshur County, West Virginia. Although 16 miners were able to escape the mine, 12 miners were unable to escape and barricaded themselves behind a curtain at the face of the Two Left section. Approximately 41 hours following the explosion, mine rescuers found the trapped miners. Unfortunately, only 1 of the 12 miners was still alive; the others had succumbed to asphyxiation [McAteer et al. 2006]. If the Sago mine had been equipped with refuge alternatives and if the miners had entered a refuge alternative following the explosion, 11 lives may have been saved, and all 12 of the miners may have been rescued and returned home to their families [MSHA 2007]. If you find yourself in a similar situation when escape is not possible, entering a refuge alternative if one is available could save your life.

Summary Teaching Point: Escaping the mine during an emergency should be your first priority. Make sure you know how to deal with any emergency that could occur in your mine in order to make the best escape attempt possible. Only enter the refuge alternative as a last resort when all of your escape options have been exhausted.

Discussion 3 Questions: Communicating Information. Use the following questions to discuss the kind of information that is important to receive and relay to others when trying to escape a mine emergency. Information contained in this section was extracted from the Emergency Communication Triangle [NIOSH 1999].

Part A: Information about the mine emergency

1. *“What kind of information were you given about the mine emergency during the training simulation?”*
 - Possible Answers:
 - There was a fire
 - Everyone should escape
 - The fire was in the personnel and supply haulage entry

2. *“What is important to know when obtaining or providing information about a mine emergency?”*
 - Possible Answers:
 - **Who** you are talking to and who you are
 - **Where** the emergency is located
 - **What** type of emergency
 - **Miners**—location(s) and information about anyone who is injured, missing, etc.
 - **Event**—details about the event including its severity
 - **Response**—what is being done to manage the emergency

3. *“Why is it important to obtain information when trying to escape?”*
 - Possible Answers:
 - Reduce confusion
 - Increase confidence in decisions
 - Prevent transmission of incorrect information
 - Improve the likelihood of a successful escape



Real Life Example: From 1988–1990, three mine fires occurred in underground coal mines in western Pennsylvania. These included events at the Beth Energy Mine No. 33, Marianna No. 58 Mine, and the Mathies Mine. Although the fires were reported, critical information about the events was not effectively communicated to those who needed the information to make decisions during these mine emergencies. At other times, those on the receiving end of a warning did not think to ask the right questions. In each case, the location of the fire was known at the three mines but did not get communicated to many of those who had to evacuate. In some cases, even the nature of the problem was not clearly communicated, resulting in some miners evacuating knowing nothing about what was happening. Of the 48 miners interviewed by researchers, only 2 knew the location and extent of the fire. Miners delayed donning their SCSRs because they did not know how far they had to travel to reach fresh air. Not knowing where the fire was located also played a role in travel direction during escape. Most decisions about what direction to travel had to be made without miners knowing where the fire was and, therefore, the likely location of the smoke [NIOSH 2000].

Summary Teaching Point: It is important to get as much information about the emergency as possible so that you can make informed decisions during your escape. It is always best to try to escape; knowing the critical information about the emergency can assist you in making the best decisions.

Discussion 4 Questions: Using a self-contained self-rescuer (SCSR). Use these questions to discuss using SCSRs during a mine emergency.

Part A: When to don an SCSR

1. *“Did you don your SCSR during the emergency?”*
 - Prompt: *“Why or why not?”*
2. *“If you did don your SCSR, at what point did you don it?”*
3. *“When should you don your SCSR in an emergency such as a mine fire or explosion?”*
 - Possible Answers:
 - At the first sign of smoke
 - When the oxygen (O₂) level drops below 19.5% (oxygen deficiency)
 - When carbon monoxide (CO) is detected
4. *“How can CO (carbon monoxide) and oxygen deficiency affect you?”*
 - Possible Answers:
 - CO can lead to: headache, dizziness, restlessness, paresthesia (tingling), dyspnea (breathing difficulty), sweating, malaise (vague feeling of discomfort), increased heart rate, high blood pressure, coma, asphyxia, and convulsions
 - Too little oxygen (O₂) can cause you to lose consciousness with little or no warning. If oxygen levels become low enough, you can even die.

Summary Teaching Point: It is important to don an SCSR at the first sign of smoke, in the presence of CO, or if the oxygen level drops below 19.5%. Miners should not wait until they begin to feel the effects of inhaling toxic smoke and gasses to don their SCSRs; it may be too late.

Part B: Removing an SCSR

1. *“Did you remove your SCSR at any point during the exercise?”*
 - Prompt: *“Why or why not?”*
2. *“Once you have donned an SCSR, what are the only times you should remove the SCSR?”*
 - Possible Answers:
 - When you exit the mine
 - When you need to transfer to another SCSR to continue your escape
3. *“During escape, you may need to communicate with other miners. How would you communicate while wearing an SCSR?”*
 - Possible Answers:
 - Use cap lamp signals
 - Write notes to other miners
 - Use hand signals



Real Life Example: On May 20, 2006 an explosion occurred at approximately 1:00 a.m. in the Sealed A Left Section of the Kentucky Darby, LLC, Darby Mine No. 1. Two miners were killed from forces of the explosion. Four other miners, who were underground working in the B Left Section, heard the explosion and attempted to evacuate. The escaping miners encountered thick smoke approximately four crosscuts out by the section power center which prompted them to stop and don their SCSRs. As the miners continued to escape through smoke, at least two of the miners intermittently removed their SCSR mouthpieces to communicate. One miner survived and three died due to carbon monoxide poisoning with smoke and soot inhalation [MSHA 2007].

Summary Teaching Point: Once you have donned your SCSR, you should not remove it until you are out of the mine or you have determined that the air is safe to breathe. Be aware that breathing through an SCSR is not the same as breathing normally. Because of their design, you will experience some breathing resistance. This resistance will increase the longer the unit is worn. But, as long as you can breathe from the apparatus, it is still working. For chemical-oxygen SCSRs, it is important to know how to manually activate the unit in the event that the automatic activation malfunctions. Knowing what to expect and how an SCSR functions can facilitate your successful use of an SCSR.

Discussion 5 Questions: Alternate Escapeways. Use the following questions to discuss the use of different escapeways.

Note to Instructors: This point in the group discussion would be an excellent time to review with the trainees the mine's actual escapeway map.

Part A: Primary and secondary escapeways

1. *“How are the primary and secondary escapeways marked in your mine?”*
2. *“Did you stay in the primary escapeway the entire time during the training simulation?”*
3. *“If you were escaping from your mine, when would you consider moving from the primary into the secondary escapeway?”*
4. *“If necessary, how would you move from the primary to the secondary escapeway?”*
5. *“Are there other routes you can take when escaping from your mine besides the primary or secondary escapeway?”*
6. *“When would you consider using an escape route other than the primary or secondary escapeway?”*

Summary Teaching Point: Remember to consider all escape options. If conditions are too bad in the primary escapeway, try the secondary escapeway. Miners may even be able to escape via a route that is not a designated escapeway. Remember, don't spend too much time transitioning from one escapeway to another; the most important thing is to continue moving outby.

Part B: Navigating along escape routes

1. *“What are some techniques for navigating through heavy smoke?”*
 - Possible Answers:
 - Tethering escapees together
 - Using the lifeline and being familiar with the tactile signals
Note: The Appendix provides a diagram illustrating the various lifeline tactile signals for your reference (page 35).
 - Noting air direction
 - Following physical features such as stoppings, water lines, power cables, etc.
2. *“How can you determine which direction is outby if the lifeline is inaccessible or if there is not one in the escape route you choose to travel?”*
 - Possible Answers:
 - Look for reflective markings or signage that may indicate which direction is outby
 - Airflow direction: if you are escaping in an intake, you should be walking against the airflow; if you are escaping in a return, you should be walking with the airflow.
 - Pipe fittings: learn whether the male or female end of the pipe is on the outby side of joints in your mine
 - Examine the markings that have been made on the rib by the continuous miner



Real Life Example: Following a series of four explosions at the Willow Creek Mine in Helper, Utah, many miners found themselves disoriented and without their hard hats and camp lamps in a smoke and dust-filled mine. One miner was able to locate the 6-inch water line in the No. 2 entry and followed it as a guide to lead him out of the section. He made it to the mains by following the water line where he was picked up by a fellow miner driving a transport vehicle and was driven out of the mine to safety [MSHA 2001].

Summary Teaching Point: Do not let smoke (even heavy smoke) become a barrier to escape. You should don your SCSR and use your navigational skills, knowledge of the mine layout, and escapeway aids and navigational devices to continue to escape.

Part C: Using the mantrip

1. *“Did you use the mantrip?”*
 - Prompt: *“Why or why not?”*

2. *“When is it possible to escape using the mantrip?”*
 - Possible Answers:
 - When visibility is sufficient to allow the operator to tram the mantrip safely
 - When the haulage route is not blocked by debris
 - When methane levels in the haulage route are not in the explosive range of 5%–15%

3. *“When should the mantrip NOT be used for escape?”*
 - Possible Answers:
 - When visibility is such that the operator cannot see far enough to safely operate the vehicle
 - If the haulage route is blocked by debris
 - If the methane level along the haulage route is in the explosive range of 5%–15%

Summary Teaching Point: The mantrip can be the fastest method of escape from the mine. Riding out on the mantrip as far as possible, if conditions permit, will save time and reduce physical exertion.

Discussion 6 : Training Session Summary Statements. Use these reminders to make sure trainees understand that preparation and good decisionmaking are keys to a successful mine escape. These statements can also be used as an overall summary of the training if you do not have time to go through all of the discussion questions.

1. *“Become familiar with the mine map and mine layout, including escapeways and the locations of SCSR caches, mine phones, and refuge alternatives. Knowing this information will help you make informed decisions during an escape.”*
2. *“Make sure you know when and how to don your SCSR and how to transfer over to a new unit.”*
3. *“Try to get as much information about the emergency as possible so that you can make informed decisions while escaping.”*
4. *“Change your escape plan as conditions within the mine change.”*
5. *“The refuge alternative should be your last option, but it is an option if you are unable to escape. It is important to remember some important information about refuge alternative use including:*
 - *Rescuers know where the refuge alternatives are located.*
 - *Breathable air will be available for at least 96 hours.*
 - *Supplies will be available - food, water, first aid.*
 - *Potential for communication with the surface is available in the refuge alternative.*
 - *Refuge alternative could be designated as a meeting location during escape.*
 - *Conditions may be uncomfortable—hot, cramped, and stressful.*
 - *Rescuers need acceptable conditions to reach the refuge alternative.*
 - *Refuge alternatives could be damaged by roof falls, fires, or explosions.*
 - *Miners cannot leave or reenter a refuge alternative without expending oxygen and shortening the time the refuge alternative can sustain life.*

Evaluation of Training Session

- You can distribute the Refuge Alternative Computer-Based Training Evaluation form (on pages 33–35 and 31) if you would like to evaluate how the training program was received at the specific mine. Questions 1–7 assess the specialty areas within which trainees possess experience. Statements 1–6 determine if trainees think the training was interesting and informative. Statements 7–13 determine if trainees learned something new from the training that they can use on the job. Finally, questions 14–18 determine if trainees remember information that was covered during the training, such as how to respond in an emergency situation. You can use the trainees’ responses to all of the statements to decide if the training was helpful and if other groups of trainees should receive the same training. You can also use their responses to decide if any changes need to be made to the discussion section.
- *“Please fill out an evaluation form for this training session and return it to me when you are finished. There are no right or wrong answers.”*

Lesson Plan for Training with Abbreviated Discussion

- This lesson plan can be used when presenting the training to one large group or several smaller groups. Parts of the lesson plan can be used when the training is given to several individuals at one time.
- Ask the trainees the questions in *italics*.

Introduce the Training

- *“We are going to use a computer program to practice making decisions during a mine emergency. Decide on and select the option that you would most likely choose if this situation occurred in real life. If you are working in a group, you will need to work together to decide what to do at each step, and you can discuss your thoughts and opinions out loud. Because you would probably be wearing your SCSR during a real emergency—and would not be able to communicate verbally—this is a chance for you to practice discussion and decisionmaking skills as a group. If you are working alone, make the decisions that you think are best. If you want to return to the previous slide to make a different decision, you can select the Go Back button at any time.”*

Computer-Based Training Program

- Have the trainees begin the training program, and remind them that they must click a choice in the decision box in the lower right of each page to advance to the next page. If you are conducting the training for one large group, make sure to allow enough time for all trainees to read each slide and make a decision before going to the next one. This training program should take about 10–20 minutes to complete.

Group Discussion Session

The following discussion sets include a few essential discussion questions on important topics related to emergency escape, including the decision of when to use a refuge alternative. These questions can be asked verbatim to elicit discussion among the trainees. This abbreviated discussion guide concludes with a set of summary statements that can be read to conclude the training and highlight the important lessons trainees should take away from the training.

Discussion 1: Discussion Questions

1. *“Did anyone get a feedback slide?”*
 - Prompt: *“What did the feedback slide say?”*
 - Prompt: *“Did you learn anything from this feedback slide?”*
 - Prompt: *“Do you have any questions or comments about this feedback slide?”*
2. *“What new information did you learn about when to use refuge alternatives and emergency escape?”*
3. *“What questions or concerns do you have about when to use a refuge alternative or emergency escape?”*
4. *“When would you enter a refuge alternative?”*
5. *“What is some important information to remember about refuge alternatives?”*
 - Rescuers know where the alternatives are located.
 - Breathable air will be available for at least 96 hours.
 - Supplies will be available - food, water, first aid.
 - Potential for communication with the surface is available in the refuge alternative.
 - Refuge alternative could be designated as a meeting location during escape.
 - Conditions may be uncomfortable—hot, cramped, and stressful.
 - Rescuers need acceptable conditions to reach the refuge alternative.
 - Refuge alternatives could be damaged by roof falls, fires, or explosions.
 - Miners cannot leave or reenter alternative without expending oxygen and shortening the time the alternative can sustain life.

Discussion 2: Training Session Summary Statements. Use these reminders to make sure trainees understand that preparation and good decisionmaking are keys to a successful mine escape. These statements can also be used as an overall summary of the training if you do not have time to go through all of the discussion questions.

1. *“Become familiar with the mine map and mine layout including escapeways and the locations of SCSR caches, mine phones, and refuge alternatives. Knowing this information will help you make informed decisions during an escape.”*
2. *“Make sure you know when and how to don your SCSR and how to switch over to a new unit.”*
3. *“Try to get as much information as possible about the emergency so that you can make informed decisions while escaping (e.g., where, what, who, response, event details).”*
4. *“Change your escape plan as conditions within the mine change.”*
6. *“The refuge alternative should be your last option, but it is an option if you are unable to escape. It is important to remember some important information about refuge alternative use including:*
 - *Rescuers know where the refuge alternatives are located.*
 - *Breathable air will be available for at least 96 hours.*
 - *Supplies will be available - food, water, first aid.*
 - *Potential for communication with the surface is available in the refuge alternative.*
 - *Refuge alternative could be designated as a meeting location during escape.*
 - *Conditions may be uncomfortable—hot, cramped, and stressful.*
 - *Rescuers need acceptable conditions to reach the refuge alternative.*
 - *Refuge alternatives could be damaged by roof falls, fires, or explosions.*
 - *Miners cannot leave or reenter a refuge alternative without expending oxygen and shortening the time the refuge alternative can sustain life.*

Evaluation of Training Session

- You can distribute the Refuge Alternative Computer-Based Training Evaluation form (on pages 33–35 and 31) if you would like to evaluate how the training program was received at the specific mine. Questions 1–7 assess the specialty areas within which trainees possess experience. Statements 1–6 determine if trainees think the training was interesting and informative. Statements 7–13 determine if trainees learned something new from the training that they can use on the job. Finally, questions 14–18 determine if trainees remember information that was covered during the training, such as how to respond in an emergency situation. You can use the trainees’ responses to all of the statements to decide if the training was helpful and if other groups of trainees should receive the same training. You can also use their responses to decide if any changes need to be made to the discussion section.
- *“Please fill out an evaluation form for this training session and return it to me when you are finished. There are no right or wrong answers.”*

Refuge Alternative Computer-Based Training Evaluation

Age _____ Sex _____ Total Years Experience Mining _____

Total Years Experience at this Mine _____

Present Job at this Mine _____

Total Years Experience in your present Job _____

Please tell us about any specialized training and/or certification you have.

1. Have you ever worked as a section boss?
 - No
 - Yes: How long have you worked as a section boss? _____ years, _____ months

2. Have you ever worked as a fire boss?
 - No
 - Yes: How long have you worked as a fire boss? _____ years, _____ months

3. Have you ever been a member of a mine rescue team?
 - No
 - Yes: How long have you been a member of a mine rescue team?
_____ years, _____ months

4. Have you ever been a member of a mine fire brigade?
 - No
 - Yes: How long have you been a member of the fire brigade? _____ years, _____ months

5. Have you ever been a firefighter outside of the mine?
 - No
 - Yes: How long have you been a fire fighter? _____ years, _____ months

6. Are you a certified emergency medical technician (EMT)?
 - No
 - Yes: How long have you been an EMT? _____ years, _____ months

7. Are you a certified paramedic?
 - No
 - Yes: How long have you been a paramedic? _____ years, _____ months

Please circle the number which tells how much you agree or disagree with the following statements:

Statement:	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1. Overall this training was excellent.	1	2	3	4	5
2. Overall this training was interesting.	1	2	3	4	5
3. Overall this training was easy.	1	2	3	4	5
4. Overall this training was informative.	1	2	3	4	5
5. Overall this training was useless.	1	2	3	4	5
6. Overall this training was important.	1	2	3	4	5
7. This training was relevant to my job.	1	2	3	4	5
8. I liked the format of this training.	1	2	3	4	5
9. I feel better prepared to make decisions during a mine emergency escape.	1	2	3	4	5
10. I know when to use a refuge alternative.	1	2	3	4	5
11. The scenarios presented in the training could happen in real life.	1	2	3	4	5
12. I learned something new from the training.	1	2	3	4	5
13. The training will help me remember important points should I have to escape a mine emergency.	1	2	3	4	5

The following questions apply to decisionmaking during a mine emergency. Select either yes or no.

	YES	NO
14. It is necessary to use your SCSR at the first sign of smoke.	<input type="checkbox"/>	<input type="checkbox"/>
15. In a mine emergency, you should first try to escape.	<input type="checkbox"/>	<input type="checkbox"/>
16. If a group of miners are escaping together, they should tether themselves to each other.	<input type="checkbox"/>	<input type="checkbox"/>
17. Refuge alternatives provide 96 hours of breathable air, water, and food.	<input type="checkbox"/>	<input type="checkbox"/>
18. If a phone rings, you should only pick it up if you have time.	<input type="checkbox"/>	<input type="checkbox"/>

Answer Key for questions 14–18

Question 14 YES

Question 15 YES

Question 16 YES

Question 17 YES

Question 18 NO

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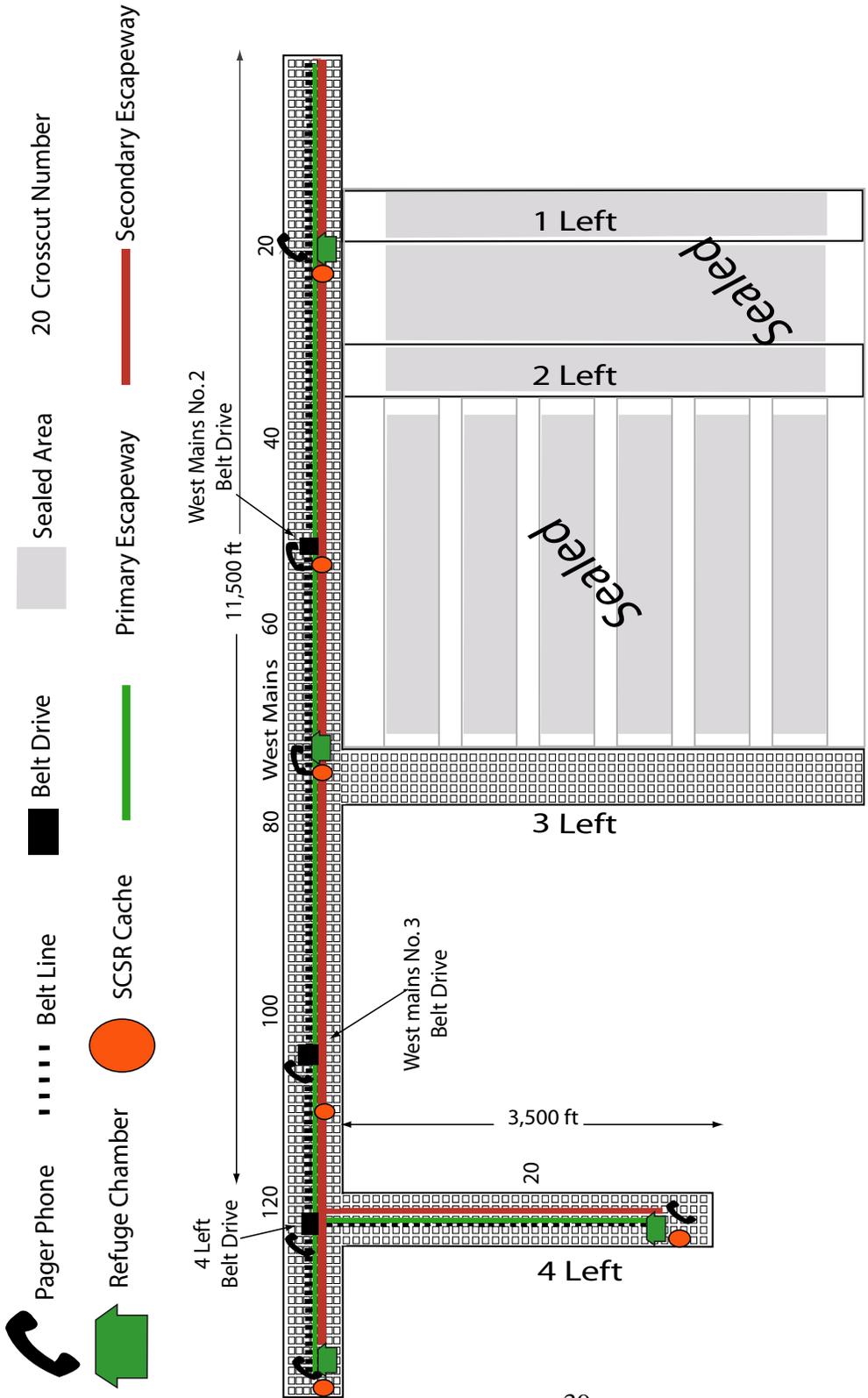
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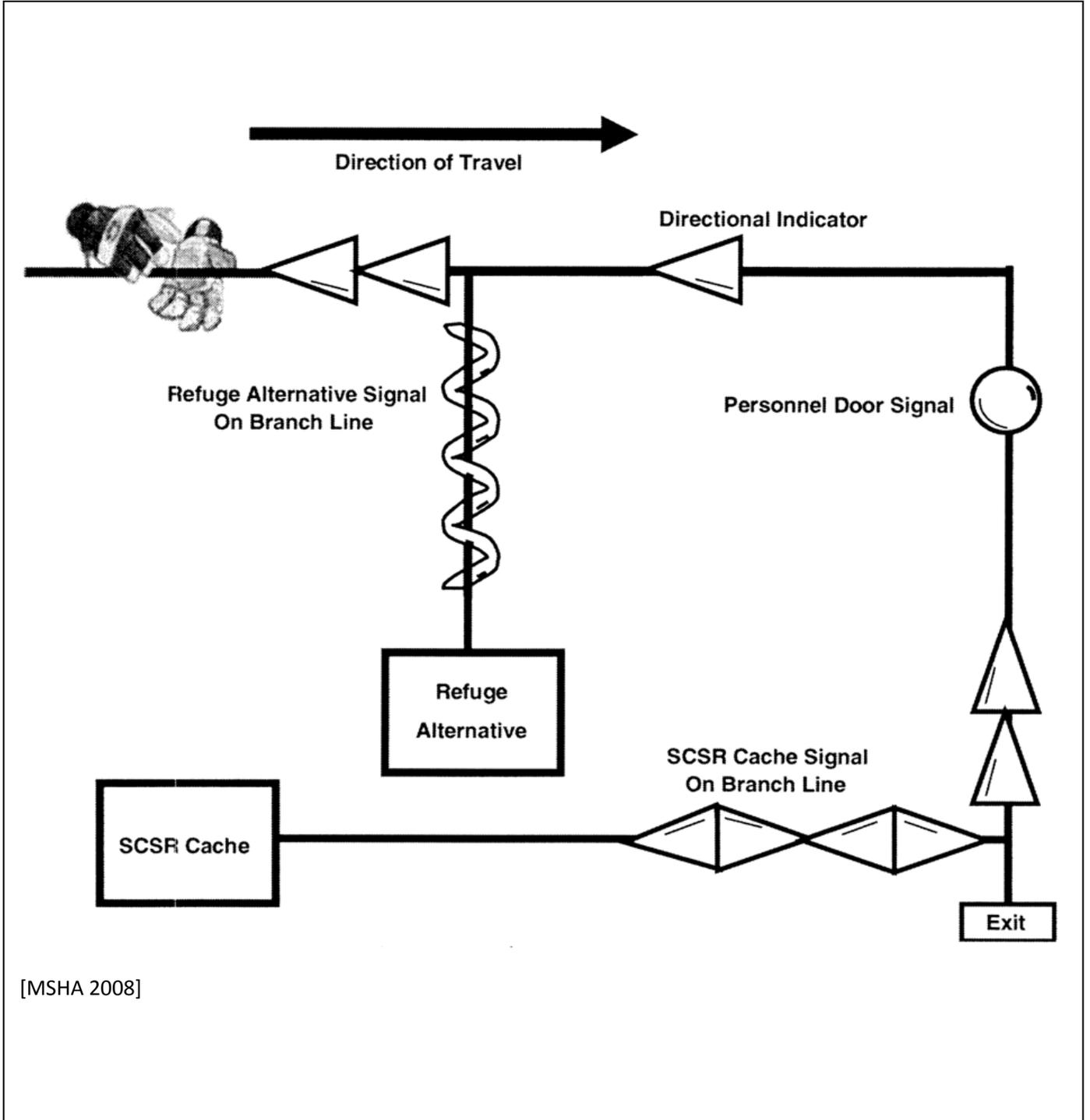
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Appendix: Handouts

Mine Map for CBT Exercise



Lifeline Tactile Signals



[MSHA 2008]



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