

How to Operate a Refuge Chamber

A Quick Start Guide



Information Circular 9524

**How to Operate a Refuge Chamber: A Quick Start Guide
Instructor Guide and Lesson Plan**

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How to Operate a Refuge Chamber: A Quick Start Guide Instructor Guide and Lesson Plan

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Instructor Guide

Overview

How to Operate a Refuge Chamber: A Quick Start Guide was created by researchers at the National Institute for Occupational Safety and Health (NIOSH) to teach miners how to operate refuge chambers if it became necessary in a mine emergency. The presentation is intended for group-based training and was created using Microsoft PowerPoint. It is designed to be used as a template for mine instructors to modify based on the refuge chambers used at their mine.

Background Information

Refuge chambers are portable chambers that are either made of steel or are tents that inflate from a steel skid. They provide water, food, toilet, breathable air, and a seal to protect occupants from the outside environment for at least 96 hours, or 4 days. Although states and mines refer to refuge alternatives by different names, this guide will refer to those nearest to the face as refuge chambers, whether inflatable from a skid or constructed from steel. Other popular terms for refuge chambers are rescue shelters and refuge shelters. Refuges that are toward the mine entrance or shaft, whether a prefabricated refuge chamber or one built into a crosscut, will be referred to as outby refuges because of their location in the mine. Outby refuges can be permanent, semipermanent, or portable and are usually located at every other self-contained self-rescuer (SCSR) cache. Outby refuges are sometimes called hardened rooms, outby shelters, and in-place shelters. The term “refuge alternatives” is used to describe both refuge chambers and outby refuges.

This training is intended for refuge chambers that are prefabricated by manufacturers. This presentation may, however, be useful for other types of refuge alternatives as long as the instructor adapts the Quick Start Guide to fit the operation of the refuge alternative.

Purpose

The purpose of this training presentation is to teach underground miners how to operate a refuge chamber using a Quick Start Guide. Refuge chambers are a technology that may be new to miners. Therefore, this training will assist the instructor in developing a quality training tool to teach miners how to operate refuge chambers based on Quick Start Guides. It is designed to be used as a template for mine instructors to modify based on the refuge chambers used at their mine.

Target Audience

This material has been designed for underground miners at all skill levels. It can be integrated into required new miner training courses, annual refresher courses, or any other mine site training.

Requirements for Teaching This Module

- If this training is part of a Mine Safety and Health Administration (MSHA) required course, an approved instructor and/or content expert must deliver the training.
- Basic computer skills (keyboard, mouse, connect computer to LCD projector).
- Knowledge of the mine's emergency response plan (ERP).

Intended Use

This presentation is intended to be used as a template and guide for mine instructors to use in creating their own customized presentation that reflects the refuge alternatives being used at their mine. The presentation is intended for group-based training, and it is recommended that the instructor allows for discussion at any point before advancing to the next slide.

Room Setup and Equipment

- Arrange seating so that everyone has a clear view of the screen.
- Equipment required for large group training:
 - One computer equipped with Microsoft PowerPoint
 - LCD projector
 - Large screen
 - *How to Operate a Refuge Chamber: A Quick Start Guide* package (customized to be mine- and chamber-specific)

Advance Preparation

- The instructor should be thoroughly familiar with the operation and use of the specific refuge chamber used in the mine where training is taking place. Read the information provided by

the refuge chamber manufacturer/supplier about the specific refuge chamber(s) used at the mine.

- The instructor should customize the presentation for the specific refuge chamber(s) in use at his/her mine. This involves tailoring the operational process to fit into the structure of the Quick Start Guide. The instructor should also document the operational tasks by taking detailed photos and then inserting them into the presentation. For additional resources in creating a tailored Quick Start Guide, see <http://www.cdc.gov/niosh/mining/pubs/pubreference/outputid3169.htm>.
- The instructor should evaluate the particular refuge chamber at the mine where training is conducted. Some refuge chambers can be used as way stations and others cannot without compromising the chamber. Refuge chambers used as way stations can provide a place to rest, to change SCSRs, to care for any injuries, etc. Consult with the refuge chamber manufacturer and the mine management for specifics about using the refuge chamber as a way station.
- Double check all computer and audio/visual equipment before the training.
- Familiarize yourself with the lesson plan included in this guide.
- Familiarize yourself with the mine's emergency response plan (ERP).

Photo Editing Tips

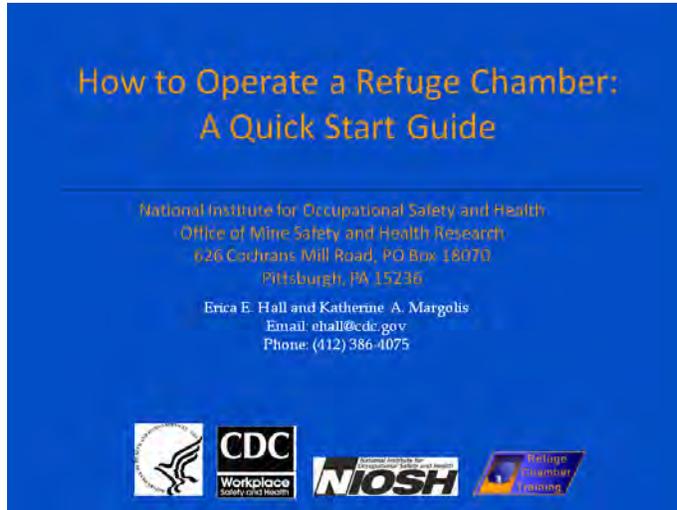
- Take photos of the refuge alternatives specific to your mine to include in the presentation. Be sure to take detailed photos and also zoom in on small features (instruction decals, valves, settings, etc.).
- Use a variety of photos to illustrate each step.
- Insert arrows to accentuate features.
- Document the entire process; photos are essential to providing a clear overview of the operational task.
- Use the photos to customize the presentation to fit the refuge chambers used at your mine.

Refuge Alternatives as Way Stations

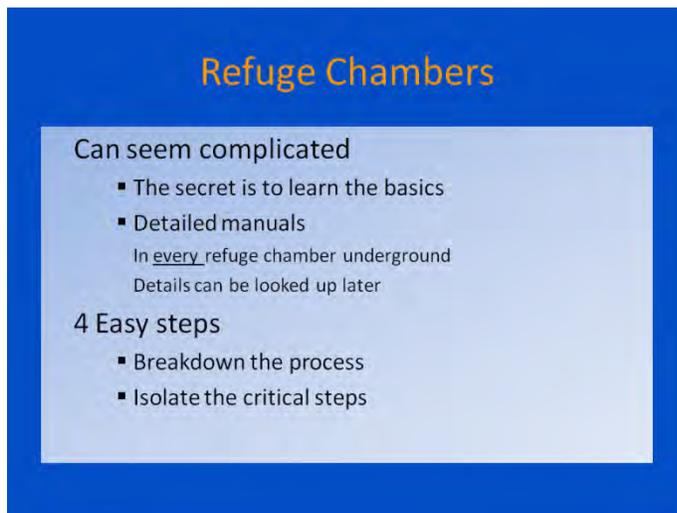
Some refuge alternatives can be used as way stations and others cannot without compromising the air inside the refuge alternative. Refuge alternatives used as way stations can provide a place to rest, to change SCSRs, to care for injuries, etc. Consult with the refuge alternatives manufacturer and the mine management for specifics about using the refuge alternatives as a way station.

Lesson Plan

The following lesson plan offers discussion questions and notes for each slide of the presentation. The instructor can use these notes and additional information relevant for their class.



Introduce the training.
“What do you currently know about operating refuge chambers?”
“When would you deploy a refuge chamber?”
Use this opportunity to correct misperceptions, state benefits, and stress the use of a refuge chamber as a last resort.



Discussion. “Refuge chambers can seem complicated to operate, but operation involves 4 easy steps.” (Discuss slide.)
Additional information. Quick Start Guides are designed to simplify tasks and isolate the critical steps necessary to operate a refuge chamber. They can be made into a reflective sticker for hardhats and the exterior of a refuge chamber.
The more familiar a miner is with the operating process, the more likely he or she will successfully activate it during an emergency.

The Main Steps: D-POS

Deploy

Purge

Oxygen

Scrubber

Discussion. “Refuge chambers operate on four key steps: DEPLOY the unit, PURGE the system, activate the OXYGEN, and activate the SCRUBBER system.”

“Standardized formatting allows for workers (particularly contractors) who change mines to easily adapt to operating different refuge chambers.”

“This method can be used for refuge chambers and outby refuges. A refuge chamber is used as an example throughout this presentation.”

Quick Start Guide DPOS

1. **Deploy** Unit
2. **Purge**
3. Activate **Oxygen** Flow
4. Hang **Scrubber** Curtains



Discussion. (refer to slide) “This Quick Start Guide reminds us of the four operational tasks in setting up a refuge chamber.”

Personalize it. Some chambers list in their procedures turning on the scrubbing unit prior to the oxygen, while others say oxygen should come first. Most likely, these operations will be performed simultaneously. Customize the example to the operating procedures for the refuge chamber at your mine.

DPOS Step 1
DEPLOY

Discussion. Remind the class that DPOS means Deploy, Purge, Oxygen, and Scrubber. “Each of the four tasks in the Quick Start Guide may have one or more subtasks.” “The first task is to deploy the unit.”

Personalize it. The following slides contain photos and instructions for deploying a tent that inflates from a steel skid. If necessary, change the photos and instructions to reflect the operational tasks for the refuge chamber at your mine. See “Photo Editing Tips” section in the *Instructor Guide*.



[Sample: Change photos and instructions if necessary.]

Discussion. “For the refuge chamber in this slide, deployment involves 3 subtasks: (1) remove safety pin and then (2) open door (by pulling the large red lever). Watch for the door to open, make sure deployment area is free of obstacles and debris, then (3) pull red deployment knob.



[Sample: Change photos and instructions if necessary.]

Discussion. “Once the lever is pulled, the tent will start to unroll; you may need to help unroll the tent.”



[Sample: Change photos and instructions if necessary.]

Discussion. “Next, the tent will start to fill with air.”



[Sample: Change photos and instructions if necessary.]

Discussion. “The tent will continue to fill with air. Help expand the tent. Be sure to keep it straight.”



[Sample: Change photos and instructions if necessary.]

Discussion. “It will take approximately two minutes for the tent to fully inflate.”



[Sample: Change photos and instructions if necessary.]

Discussion. “Once fully inflated, the tent will be approximately 36” tall.”

DPOS Step 2

PURGE

Discussion. Remind the class that DPOS means Deploy, Purge, Oxygen, and Scrubber. “The second task is to purge the system.”

“In this case, to ‘purge the system’ means to clear the air inside of the air lock of carbon monoxide (CO). This step is important because it prevents the air in the main chamber from getting contaminated with CO.”



[Sample: Change photos and instructions if necessary.]

Discussion. “This is the entrance to the unit. It is clearly marked in reflective material.”



[Sample: Change photos and instructions if necessary.]

Discussion: “Three miners can fit in the purge air lock. Many chambers require miners to crawl into the purge air lock space.”



[Sample: Change photos and instructions if necessary.]

Discussion. “The entering miner yells when the next should enter.”



[Sample: Change photos and instructions if necessary.]

Discussion. “After the last miner has entered, close the door and seal the purge air lock completely. Be sure that the door to the main chamber remains closed until after air lock has been purged AND the CO levels are found to be below 200 ppm.”



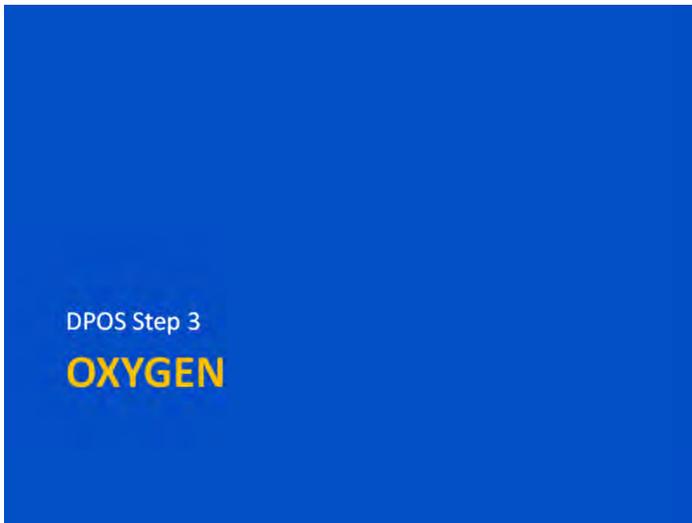
[Sample: Change photos and instructions if necessary.]

Discussion. “It is important to simplify and isolate the critical operational steps needed to get a refuge chamber set up and activated. Once safely inside a refuge chamber the details can be looked up. Detailed instructions will be posted inside the chamber and a complete operational manual will be located inside of the chamber.”



[Sample: Change photos and instructions if necessary.]

Discussion. “Open the purge valve. This will release the purge air and will dilute any CO in the air. It is also important to take air readings to make sure the CO levels are below 200 ppm. Do not proceed into the main chamber until these levels have been achieved; repeat the purge process if necessary.”



Discussion. Remind the class that DPOS means Deploy, Purge, Oxygen, and Scrubber. “The third task is to activate the oxygen. By activating the oxygen it allows clean, breathable air to flow into the main chamber. It is critical to read the charts and set the airflow to the correct setting to ensure that a) there is enough air for the number of miners in the chamber and b) so that there isn’t too much air. Too much oxygen can be just as harmful as too little in a sealed environment (it can cause an oxygen enriched environment).”



[Sample: Change photos and instructions if necessary.]

Discussion. “The oxygen flow meter is located on the wall inside the chamber. The four subtasks are (1) set the tube fill valve to the OFF position, (2) set the door purge valve to the OFF position, (3) set the oxygen supply valve to the ON position, (4) then set the flow according to the chart (see next slide).”

Oxygen Flow Meter Chart	
# of Men	Flow Meter Setting
1	0.5 LPM
2	1.0 LPM
3	1.5 LPM
4	2.0 LPM
5	2.5 LPM
6	3.0 LPM
7	3.5 LPM
8	4.0 LPM
9	4.5 LPM
10	5.0 LPM
11	5.5 LPM
12	6.0 LPM
13	6.5 LPM
14	7.0 LPM
15	7.5 LPM
16	8.0 LPM

Set flow meter accurately. Too much O₂ is just as bad as not enough.

[Sample: Change photos and instructions if necessary.]

Discussion. “Using the Oxygen Flow Meter Chart, posted in the refuge chamber, determine the ‘flow meter setting’ based on the number of people in the refuge chamber. Set the oxygen flow to the appropriate setting. Remember, too much oxygen can be just as harmful as too little in a sealed environment (it can cause an oxygen enriched environment).”

“It is important to conserve the oxygen supply.”

DPOS Step 4

SCRUBBER

Discussion. Remind the class that DPOS means Deploy, Purge, Oxygen, and Scrubber. “The fourth task is to activate the scrubber.”

Note. Every refuge chamber does use a scrubber system. However, it varies from manufacturer whether the system is comprised of lithium hydroxide curtains or soda lime cartridges. The purpose of both types of scrubber systems is to absorb the carbon dioxide (CO₂) expelled from people’s bodies when they breathe. Without absorption, the environment would become CO₂ enriched and people would die.



[Sample: Change photos and instructions if necessary.]

Discussion. “The scrubber curtains are located in the rear of the chamber.”

Note. Lithium hydroxide curtains are used as an example in this presentation. Change and adapt the following slides accordingly to reflect your chamber.



[Sample: Change photos and instructions if necessary.]

Discussion. “Read the chart and set up the correct number of boxes according to the number of people inside the chamber. Refer to the chart to determine how often to add curtains.” (Amount and frequency will vary, please refer to specific manufacturers’ charts.)

Note. Not all refuge chambers use lithium-hydroxide curtains; some may use soda lime cartridges. Replace this slide to reflect the system used by your refuge chamber.



[Sample: Change photos and instructions if necessary.]

Discussion. “An operational manual can be found inside the main chamber and contains troubleshooting information for the scrubber system.”

Your refuge chamber will have detailed instructions, but in an emergency remember your QUICK START!

- Deploy
- Purge
- Oxygen
- Scrubber

Discussion. “Escape is always the first option. If it becomes necessary to operate a refuge chamber, remember DEPOS: DEPLOY the unit, PURGE the system, activate the OXYGEN, and activate the SCRUBBER system.”

Additional information. Quick Start Guides are not stand-alone training tools. Miners need more detailed hands-on training during non-emergency situations. Miners should be made aware a Quick Start Guide isolates the four basic steps: Deploy, Purge, Oxygen, and Scrubber.

Additional Resources

NIOSH has created a Web page containing a suite of refuge chamber training products and guidance documents. These products and documents can be downloaded directly from the internet. <http://www.cdc.gov/niosh/mining/topics/training/refugechambers.htm>

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 _____

Normal shift _____

Present location in the mine _____

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

Statement	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
Overall, this training was excellent.	1	2	3	4	5
Overall, this training was interesting.	1	2	3	4	5
Overall, this training was easy.	1	2	3	4	5
Overall, this training was informative.	1	2	3	4	5
Overall, this training was useless.	1	2	3	4	5
Overall, this training was important.	1	2	3	4	5

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

Statement	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
I feel better prepared if I ever find myself in a refuge chamber.	1	2	3	4	5
I am more aware of what it would be like in a refuge chamber.	1	2	3	4	5
I have a better idea of how to use a refuge chamber.	1	2	3	4	5
This training was relevant to my job.	1	2	3	4	5
I liked the format of this training.	1	2	3	4	5



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