Do You Understand Mine Emergencies?

Are You Prepared for a Mine Emergency?

Instructor's Guide

MODULE 1: MINE EMERGENCIES

PENN STATE MINER TRAINING PROGRAM
UNIVERSITY PARK, PA
2008

PENNSTATE

MINER TRAINING PROGRAM

DO YOU UNDERSTAND MINE EMERGENCIES?

ARE YOU PREPARED FOR A MINE EMERGENCY?

MODULE 1: MINE EMERGENCIES

Mark Radomsky
Joseph Flick
Joeseph DeSalvo
Larry Grayson
&
Raja Ramani

Funded by DOL, Mine Safety and Health Administration (MSHA Grant 00331235)

12/31/2008

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Acknowledgements

This material was produced under grant number 00331235 from the Mine Safety and Health Administration, U.S. Department of Labor. It does not necessarily reflect the views or policies of the U.S. Department of Labor, nor does mention of trade names, commercial products, or organizations imply endorsement by the U.S. Government.

This training program was made possible by funding through the MSHA Brookwood-Sago Grant, and through the generous support of:

Amfire Mining Co., LLC
Rox Coals, Inc.
West Point Mining

Very special thanks are extended to the following management and employees of Black Wolf Coal Company who graciously shared their mining facilities, employees, resources, equipment, time and talents in the making of the videos associated with this project.

Mr. Dave Rebuck
Mr. Dave Keller
Mr. Bob Bence
Mr. Larry Summerville
Mr. Greg Walker
Mr. LeRoy Lepley
Mr. Ed Mackel
Mr. Mike Hadu
Mr. Joe Kostyk, Jr.
Mr. Joe Kimmel
Mr. Dave Harkleroad

We are grateful to the following panelists who participated in the Miners' Town Hall Meeting, and graciously gave of their time and expertise to help save lives in our industry.

Dr. Kathleen Kowalski-Trakofler, National Institute for Occupational Safety and Health
Dr. R. Larry Grayson, The Pennsylvania State University
Mr. Michael Brnich, Jr., National Institute for Occupational Safety and Health
Mr. David Chirdon, Mine Safety and Health Administration
Mr. Thomas MacLeod, Mine Safety and Health Administration
Mr. Joseph Main, United Mine Workers of America, Ret.
Mr. James Pablic, Amfire Mining Co., LLC
Mr. William Ponceroff, Mine Safety and Health Administration
Dr. Raja Ramani, The Pennsylvania State University
Mr. Jeffrey Stanchek, Pennsylvania Bureau of Mine Safety
Mr. Bill Brown, WJAC-TV
Mr. Joe DeSalvo, The Pennsylvania State University

The Penn State Miner Training program also gratefully acknowledges the support and assistance of the following organizations for sharing their facilities, personnel, professional expertise, photographs, time and talents.

Exponent Events
Mercury Business Development Systems
Four Points by Sheraton—Greensburg, PA
TJS Mining, Inc.
MSHA District 2, Coal Mine Safety and Health
PA-Department of Environmental Protection, Pennsylvania Bureau of Mine Safety
ChemBio Shelter, Inc.
Mine ARC Systems America
Venture Design Services, Inc.
National Institute for Occupational Safety and Health
National Mine Health & Safety Academy

Rosebud Coal Co.
Strata Safety Products LLC.
United States Mine Rescue Association
WJAC Television
Department of Energy and Mineral Engineering, The Pennsylvania State University

Every effort has been made to include all the people and organizations that have helped us in this project. We sincerely apologize if any person or organization has been omitted. Our thanks go out to you for your help!

Please note that any mention or use of pictures of commercial products associated with mine emergencies does not constitute an endorsement by Penn State, MSHA, or the authors.

Preface

The history of underground coal in the United States is notable for its successes and failures. In the distant past, coal fueled and played a prominent role in our industrial revolution, rail transportation, iron and steel making, and heating needs. Most recently, it has been the source for affordable electricity, and for a myriad of other fuels and products. Extracting and processing coal is challenging, and the miners who work in the industry work in one of the Nation's most hazardous occupations.

Mine emergencies, such as mine explosions, fires, and inundations have been all too common. Too many miners have lost their lives over the years, and many more have suffered serious injuries doing the job that typically provides challenge, high wages, and good benefits. Mining stakeholders, such as the industry, government, organized labor, the academic community, those who supply products and equipment, and the miners themselves have worked diligently by applying technology, engineering, best work practices, standards, and training to make the mines a less hazardous occupation.

The tragedies of recent mine emergencies, such as Jim Walter Resources No. 5 Mine, Sago Mine, Aracoma Alma Mine No 1, and the Darby Mine No. 1 have reminded us that continuous safety vigilance is our vision, and continuous safety improvement is our goal—a challenge to every new generation. The Mine Improvement and New Emergency Response Act of 2006 (MINER ACT) is the latest example of a multi-faceted, and focused attack on underground coal mining hazards. Essentially, it seeks to enhance mine emergency preparedness and response through improving emergency planning, mine rescue capabilities, mine emergency equipment, technology, and training, specifically through the competitive Brookwood-Sago grant program.

The training program, titled, *Do you understand mine emergencies? Are you prepared for a mine emergency*? is the result of a 2007/2008 Brookwood-Sago Mine Safety Grant. This grant, one of several awarded in 2007 by the Mine Safety and Health Administration, was awarded to the Penn State Miner Training program on September 30, 2007.

The program was the result of a cooperative effort between many mining stakeholders (See Acknowledgements), and consists of an achieved webcast, titled, *Escape and survive*, and the training program referred to above. This program includes Instructor's and Participant's Guides. We believe that frequent, quality training is the key to better identify, avoid, and prevent hazards in an around the mines, and that through the use of this program, miner survivability—as they response to an emergency—will be enhanced.

These materials are available for a limited time at www.minerstownhall.org, or through the MSHA Academy at www.msha.gov.

We encourage your use and evaluation of this program. We look forward to your comments and suggestions. Please don't hesitate to contact us at 814.865.7472, or by contacting any of the authors (See Appendix C).

INTRODUCTION

Purpose

The training program, titled, *Do you understand mine emergencies? Are you prepared for a mine emergency?* was prepared for miners. The purpose of the training program is to enhance a miner's capability to survive a mine emergency, primarily through mine emergency preparedness (MEP). Survivability will depend on many factors, such as size of the mine, location of miners, the scope of the incident, amount of energy released, availability/use of emergency technology, emergency plans, training on MEP, and decision-making. The physical factors of the incident may often be beyond the control of those who manage and mine the coal. What we can control is our knowledge of and skills in emergency preparedness and response. By enhancing a miner's knowledge of emergency principles, standards, laws, procedures, policies, and best practices, combined with excellent performance and practice on emergency skills, and decision-making capabilities, more miners will be able to survive mine emergencies.

Format/content

This innovative training program uses webcast technology (Internet and CD ROM based), combined with PowerPoint presentations, Instructor's and Participant's Guides. The webcast is a multi-media resource that can be accessed through the Internet at www.minerstownhall.org or played from a CD. During the webcast panel commentaries, PowerPoint slides are used to summarize and supplement most of the main points made by the panelist. In addition, a series of high definition (HD) video clips are embedded within the webcast and "rolled in" at the appropriate times. This realistic clips, shot on location at a working mine, represent a simulated mine emergency and response, and feature donning/switching of the SCSR, and the use of directional lifelines.

This training program consists of six training modules that address the following major mine emergency preparedness issues:

- Mine emergencies
- Emergency response plans
- CSE SR-100 Self-contained self-rescuers
- Emergency communications and miner tracking
- Escape and evacuation
- Breathable air safe havens/refuge chambers

Instructors using these modules are encouraged to tailor the material to their needs. This may mean omitting some of the information, and in some cases, adding site-specific or supplemental information (e.g., pictures, video clips, group activities, quizzes, etc.) other than the ones included in the Participant's Guide. To supplement the content on mine emergency preparedness contained in the modules, the hour-long webcast—featuring an expert panel—is used to introduce and comment on important topics, concerns, and issues, such as the key provisions of the MINER ACT, progress in mine rescue and mine emergency preparedness technology, miner tracking, miners' stress in response to emergencies, decision making, innovative training, and barricading. In the next section, more detailed information is provided on using the materials contained in the training program.

SUGGESTIONS ON USING THIS TRAINING PROGRAM

Planning, Development and Presentation

Quality training results from a combination of good training material, and competent instructors. The first responsibility of the instructor is to design and develop a lesson plan that is based on a good training needs assessment, and pre-assessment. Essentially, the purpose of the needs assessment defines the training content. The best content is practical, relevant, and selected to meet the needs (both skill- and knowledge-based) of the miner. Typically, miners are willing to open up to learning if they are convinced that the material and information being presented—in short the curriculum—will enhance their safety, and help them achieve their goals. Another way of stating this is to remind instructors to always bear in mind that today's adult learners are tuned in to only one channel—WIIFM**—"What's In It For Me."!** Further, today's miners are well informed, highly trained, and better educated than previous generations of miners. Today's younger miners—whose ranks are increasing daily—respond best to training that is interactive, image-rich, and lean on lecture-type instructional methods.

Miners should pay attention to training on mine emergency preparedness, and take it very seriously. Part of the responsibility for achieving that rests with the miner. No one learns if they are not ready or willing to learn. The other part of the responsibility lies with the instructor and mine management. The most effective training should always be well-planned, and structured. Ample time and resources should be available to ensure quality training.

Instructors need to also be reminded that the greatest potential for learning (understanding) and retention occurs when the instructional methods provide an opportunity for active participation through doing/demonstrating the skills/knowledge they have been presented and demonstrated to them. With that in mind and what has been already been said regarding the importance of planning and preparation, here are some specific suggestions for presenting this training course:

1. Thoroughly prepare yourself by finding out about your mine's most important training needs in mine emergency preparedness.

2. Read over and study the lesson plans, and make notes to yourself about information you want to emphasize, and specific examples and materials (your ERP plan, information on your mines communication and tracking system, etc.) that you want to use and include in the discussions.

3. The information on the PowerPoint slides is to be used as "talking points." You must master the information (the details of instruction) and be prepared to ask a variety of questions to spur discussion or achieve other participant learning objectives, such as test knowledge of requirements, analyze a problem, explain how things differ, or to understand how things fit together to form the "big picture." The lesson plan consists of instructor objectives, key points to cover (column 1), details of instruction (column 2), and instructor notes (column 3). **You may choose to omit some of the details of the instruction (column 2). Some of this information falls into the category of "nice to know" information. While it is important information, it is not critical to the goal of the training program, i.e., providing the miners with the information and skills that are directly relevant to successfully escaping dangers associated with mine emergencies.** However, it was included in the modules for the benefit of the instructor who may need or want such information and the level of detail provided if he/she is training supervisors, management, responsible persons, etc.

   Column 3 contains reminders to the instructors regarding ways to make the training more site-specific, suggestions for getting the students to participate by involving them in the discussions, and additional key points that are not addressed in column 1. The instructor who is adept at asking questions will be better able to get the participants

involved, and consequently have more success in meeting their training needs and goals. Questions are tools that can be used to achieve specific objectives. Generally, if you want to encourage discussions, then use open ended questions. A well prepared instructor will maximize student learning by:

a) discussing the purpose of the lesson, and how the information and/or skills learned will help them (e.g., enhance their chance of surviving an emergency by remaining isolated from toxic atmospheres, enable them to get accurate information to those who need it…to those who can help them escape the mine, etc.);
b) sharing the learning objections with the participants;
c) using group activities if time permits (e.g., using their mine map to get out of the mine in the most efficient way); and
d) encouraging discussion of mine-specific issues and concerns (e.g., improving ERPs, clarifying policies, procedures, etc.).

Application

Opportunities to apply the knowledge and skills learned in class can be demonstrated in class or out of class. Skills (behaviors) and knowledge and attitudes (SKAs) that are learned and retained for the purpose of emergency response are unique. They must be learned and frequently relearned as a proactive strategy to reduce loss due to injury and property damage if an emergency occurs; however, everyone hopes that the only application of the SKAs stay strictly in the "classroom." This type of training can become repetitious and participant and instructor motivation and enthusiasm can wane. Therefore, everyone must make a concerted effort to do their part to contribute to the training experience so that the necessary skills and knowledge are learned and retained, and ever ready should the need arise.

Evaluation of Effectiveness

Training should always be evaluated. It can be evaluated on several different levels, including reaction (satisfaction of the participants with the material, instructor, etc.), learning (did the participants learn a knowledge/skill/attitude in the classroom and can they demonstrate that they learned it?), behavior/performance (was a new behavior of set of skills learned that can be observed outside the classroom, such as donning a SCSR in response to an actual emergency at the mine?), and outcomes or results (are more miners able/capable of evacuating or surviving a mine emergency as a result of the training?). This training program gives the instructor a means to evaluate the training in terms of reaction and learning. This training program includes an evaluation form that should be distributed to the participants at the end of the course, or at the end of a lesson. Summarizing these results will give the instructor data on how well the training program was received and whether the participants were satisfied with the experience (see Appendix A). The training program also includes pre- and post-tests. These tests are intended to measure learning. The pre-tests (limited to five questions) were designed to get a baseline of a participant's knowledge prior to training. The questions that have been prepared evaluate only knowledge. However, instructors are encouraged to include a pre-test of a skill (e.g., donning/switching an SCSR, decision-making when confronted with an escape problem or challenge). The post-tests (include the pre-test questions and several additional questions) are designed to measure (when results are compared with the results from the pre-test) changes in learning resulting from the training. Instructors are encouraged to evaluate changes in behavior or performance that may have resulted from the training.

Summary

- Quality training results from a combination of good training material, and competent instructors.
- Instructors must take the time to prepare for presenting the training by studying the material, and personalizing/tailoring the lesson plan to their mine.

- Lesson objectives are statements about what you want the participants to know and/or do; they should always be shared with the participants at the beginning of the lesson.
- Instructors need to discuss how the information being presented and the skills being learned will help them in their daily lives to better achieve their goals.
- Participants learn best when a variety of their senses are engaged in the leaning; therefore, instructors need to use a variety of instructional methods and choose several methods that actively involve the participants.
- While it varies depending on experience, adult learners possess a wealth of knowledge and skills; instructors need to plan for ways to acknowledge and tap into this valuable training resource.
- One of the best strategies for ensuring participant involvement is to make liberal use of questions.
- During lesson implementation, instructions should summarize often; not only does it allow the instructor to reinforcement the most important points of the lesson, it gives the participants an opportunity to reflect on and digest what is being covered, and that in turn often leads to questions by the participants.
- Remember to evaluate the training. Asking questions during the presentation—aside from enriching the curriculum through participant input and involvement, it also gives the instructor the opportunity to gage how well the material is being understood.
- In addition, oral and written quizzes, and observation of skills (e.g., switching SCSRs) are proven ways to measure learning and changes in performance.
- Be enthusiastic about what you are presenting, and how you present it. Earn the respect of those you train by mastering the material.
- Finally, show that you care…participants respond best to the training when instructors demonstrate that they care about them by taking an interest in their safety and health. People can teach you how to elevate and enhance your training skills, but no one can teach how you care.

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Module 1

Mine Emergencies

Instructor's Guide

Purpose of the Module

To increase the knowledge and skills of miners to identify and understand emergencies, their causes, and control and enhance the miners' understanding of

1. Accident prevention concepts
2. Mine fires
3. Mine explosions
4. Massive ground collapse

Outline

- Definition of an emergency
- Anatomy of a mine disaster
- Emergency/accident prevention
- Examples of mine emergencies
- Fires
- Explosions
- Inundations
- Other emergencies – power loss, ground failures, equipment failures

Lesson Objectives

1. Describe the types of emergencies and discuss MSHA's definition of an accident
2. Explain the difference between local emergencies and mine-wide emergencies
3. Describe how hazards lead to emergencies
4. Describe how hazard control leads to control of incidents, accidents, disasters, and emergencies
5. List three traditional types of hazard controls

Additional Objectives [As time permits]

6. Describe causes, classes, and control of fire
7. Describe the causes/control of methane and coal dust explosions
8. Describe the causes and control of mine inundations, and massive ground collapse

Using the Module

- **Instructor PowerPoint slide presentation consists of bulleted talking points**
    - Familiarize yourself thoroughly with the detailed information in this lesson and elaborate on key points as needed
    - Involve the group by following up on suggestions in the Instructor Notes
- **Use site-specific examples whenever possible**

- Introduce mine-specific examples when possible
    - Use mine maps, emergency response plans, and corporate policies to tailor this information to your own mine.

- **Pre-test**
    - Have adequate tests available.
    - Allow 10 minutes for completion of test.
    - Each trainee takes his/her own test.
    - Explain purpose of pre-test: Pre-test will establish baseline of pre-existing knowledge.
    - Collect and score pre-test before completion of this module

- **Present the Lesson**
    - Using the slides, introduce the purpose of the module (Slide 1-2)
    - Review the lesson objectives (slides 3-4)
    - Present the information in the module

At the end of the lesson administer the post-test

- Allow 15 minutes for completion of the test

SLIDE 5
WHAT IS AN EMERGENCY

SLIDE CONTENTS

- *Webster*
- *Legal*
- *MSHA*
- *Types of Emergencies*
- *Local vs. Mine Wide Emergencies*

Important Points	Details of Instruction	Instructor Notes
Explain technical definitions of emergencies	• We have incidents, accidents, disasters, etc. Is there a ***legal*** definition of emergency? We have an emergency response plan. When do we use it? During an emergency. We often use commonsense understanding of an emergency • An ***unforeseen combination of circumstances*** or the resulting state ***that calls for immediate action*** [Webster's Collegiate Dictionary]. • To correct or to protect lives and/or property [legal-explanations.com]. • Emergencies are crises that disrupt the normal process.	Ask the group for their definition of an emergency.
Describe concept of mining emergencies	• ***Mining emergency*** An unforeseen happening in a mine or unforeseen combination of circumstances or the resulting state in a mine that calls for immediate action to correct and/or to protect lives and/or property.	Ask the group to describe what they think could be potential emergencies in their mine.

	▪ Emergencies can happen fast. ▪ Emergencies usually have little warning. In an emergency, time is not your friend.	
Describe recent mining emergencies	• Emergencies can be deadly • Sago – mine explosion • Alma – mine fire • Crandall canyon – massive ground fall	Provide basic details of the causes of the emergency
Describe various types of mining emergencies and disasters **Discuss how mine emergencies can be varied and diverse**	• Emergencies arise from major happenings [Part 50 MSHA definition of "accident." • Major injury or fatality • Fires • Explosions of gas and dust • Suffocations [toxic or irrespirable gases] • Inundations of water or gas • Massive collapse of ground • Landslides [waste piles, impoundments] • Other emergencies include subsidence, health, massive equipment failure, and drought	Review 30 CFR, Part 50 MSHA definitions of "accident"
Describe how emergencies can affect miner's health & safety	1. Emergencies can poison your atmosphere. Inundations of toxic gases [e.g. hydrogen sulfide, carbon monoxide] or non-life supporting gases [e.g. carbon-dioxide, nitrogen, etc causing oxygen deficiency] 2. Emergencies [fires, explosions, ground falls, etc can	

	destroy mine safety provisions [ventilation, escapeways, etc] and threaten safety as well.	
Explain that emergencies can lead to life-threatening situations	1. Inundation of water – trapped miners, bad water, bad air, oxygen-deficiency 2. Major ground falls – pillar collapse, bumps, roof collapse – physical damage/hurt, trapped miners, bad atmosphere, combination [diesel equipment and ground fall] 3. Major equipment failures – Fan stoppage, Power failure, Hoist failure	
Describe the concept of Local vs. mine-wide emergencies	1. Emergencies whose effects are local [face or one section] or global [mine-wide]. 2. Methane explosion or dust explosion can be both. 3. Dust explosions are often mine-wide. 4. Mine fires for example is generally local but a fire in main intake can be global 5. Inundations and collapse of ground – generally local, can be more extensive, even global 6. Equipment [fan, hoist, etc], power failures, others – local or mine-wide 7. There is no such thing as an acceptable emergency	Ask the group to describe several examples of local and global emergencies. Describe how: ▪ Emergencies can be at the face or on a section ▪ Emergencies can be mine-wide How you react to an emergency could mean the difference of life and death

SLIDE 6
RELATIONSHIP OF HAZARDS, INCIDENTS AND ACCIDENTS TO EMERGENCIES

SLIDE CONTENTS

- *Hazard*
- *Hazard Source*
- *Incident*
- *Accident*
- *Disaster Potential*
- *Disaster*
- *Examples*

Important Points	Details of Instruction	Instructor Notes
Define the concept of hazard and hazard source	• ***Hazard*** A "potentially" dangerous condition – e.g. accumulation of methane gas in the explosive range which can cause an explosion hazard ; excessive concentration of carbon dioxide gas which can cause a suffocation hazard due to lack of oxygen • ***Hazard source*** Is the background condition, while itself not posing a danger, can give rise to a hazard • Example: methane gas is a hazard source. When not	Hazards are situations where something COULD go wrong. Hazard sources – methane gas, bodies of water in old or abandoned workings, ground pressure and roof pressures, etc – are always present in a mine

	properly controlled, under suitable conditions, it can create methane "explosion" or suffocation hazards	
Define the concept of incident	• ***Incident*** Also called "near miss" or "near hit", is the realization of the hazard with no injury or property damage. In an incident, something DID go wrong but there were no bad consequences	Ask the group to describe several examples of near hits where there were no consequences. Ask the group to speculate why there were no consequences.
Define concept of accident	• ***Accident*** The realization of the hazard with an injury, property damage, or production loss. • An accident is an incident with BAD consequences. • There is no difference between the causes of an incident and an accident; the difference between the two is only on the consequences and the severity of the consequence – property damage, injury, death or disaster	Ask the group to describe a close call that they have experienced. Ask the group to describe how a fraction of a second or a fraction of an inch could have changed the consequences.
Define the concept of disaster potential	• ***Disaster potential*** Means the hazard poses substantial threat to human life and property, such as a high concentration of methane which can lead to explosions or suffocations. • ***Disaster*** Occurs when the disaster potential is realized [methane explosion or death due to suffocation.]	
Review use of terms using example of a surface mine waste pile collapsing	• ***Hazard source*** Properly planned, designed, constructed and maintained waste pile is generally not a hazard source and therefore not a hazard. However, coal piles, waste piles, overburden piles, etc can constitute hazard sources due	Ask the group to describe a similar chain of events for: Mine roof

	to the high potential energy they carry. Elements of climate and weather can cause them to become hazards with disastrous consequences as the following example shows. • **Incident:** The pile begins to slough: Signs of erosion and runoff and small slope failures. • **Accident** The pile fails resulting in excessive run-off, property damage, etc. • **Disaster potential** Potential to affect extensively people and property if there is a failure. • **Disaster:** waste pile collapse associated with horrific and disastrous consequences [Buffalo Creek.]	Pump Belt drive
Describe the "indirect" (symptom) causes of accidents with several examples	• Almost all the accidents have been attributed to substandard practices [Unsafe acts] or substandard conditions [Unsafe conditions] or both. ***Unsafe acts*** (Sub-standard practices) Acts of commission or omission by individuals – miners or management or both – personnel factors – substandard practices. ***Unsafe conditions*** (Sub-standard conditions) Poor design, poor maintenance, too much wear, water, roof, noise etc – job factors –substandard conditions.	Ask the group to describe five unsafe actions in a mine. Ask the group to describe five types of unsafe conditions in a mine.

Describe the origins of unsafe acts and conditions **Describe the root causes of mishaps** ***Explain the importance of "engineering safety" into the design, operation and maintenance of equipment and methods.*** ***Explain the importance of Job Safety Analysis and Job Safety Procedures in eliminating sub-standard practices.*** ***Value of using SLAM (Stop, Look, Analyze, Manage)***	Unsafe acts and conditions develop for a variety of reasons that are cultural in nature…lack of knowledge and skills, poor motivation, inadequate maintenance and/or design. Depending on the situation, these could include, but not be limited to, inadequate safety programs, specifically, lack of standards, inadequate standards, failure to enforce standards…a lack of control for all the activities that are necessary to achieve safe production and safe performance (hiring, training, inspection, communication, purchasing, maintenance, engineering, etc.)	

SLIDE 7
DISASTER PREVENTION STARTS WITH HAZARD CONTROL

SLIDE CONTENTS

- *Traditional approaches*
  - *Engineering controls*
  - *Education and Training*
  - *Enforcement*
- *Culture*

Important Points	Details of Instruction	Instructor Notes
Overview traditional approaches to accident or disaster prevention – the so called THREE E's of safety	1. **Engineering:** Build it correctly for employees 2. **Education**: Teach employees 3. **Enforcement** (monitoring and control): Watch employees	Ask the miners to comment on each? Which approach is the most effective?
Describe the first element: Engineering controls	• Safety engineering is the application of engineering principles to the identification and control of hazards. • Basic procedures include: 1. Identify hazards 2. Identify, select, and implement preventive actions to control the hazard. a. Eliminate b. Reduce the level of the hazard	Identify hazards Fix hazards Minimize hazards Guard hazards Work safely around hazards Isolate yourself from hazards

	c. Provide safety devices (guards) d. Provide warnings e. Develop safe work procedures f. Provide personal protective equipment, (PPE)	Report any hazards you see!
Describe examples of engineering controls	• Shaft, slope, pillar, entry, and roof support design: engineering design for methods stable structures. • Mining equipment: safe mechanical and electrical systems, such as for hoists, elevators, electrical motors and circuits, guards. • Mine atmospheric environment: design and operation of ventilation systems, methane and dust control.	Ask the group to list five types of engineering hazard controls in the mine'
Describe the second element: Education and training	• Education is provided to increase *knowledge*: to know more about why and what of things. • Training is provided to develop the ***skills***: to know more about how to do things. • Worker task training is one of the most important aspects of education and training.	You must know the WHAT, WHY and HOW of your job!
Describe the third element: Enforcement	• Enforcement is management exercising control. • Planning and control go hand in hand. It involves checking and taking action as necessary. I.e., monitoring and control should ensure that all actions have predictable results, i.e. no incidents, no emergencies, otherwise make changes.	Management must make sure that all safety procedures are being followed. Regulatory agencies like MSHA enforce the existing rules and regulations.

	• Government inspectors or company personnel should ensure that the mining system is carried out according to mining laws and company requirements.	
Discuss an emerging fourth element: SAFETY CULTURE	• Reasons other than engineering, education and training, and enforcement have been found to be dominant in accident causation [e.g. transportation industry, nuclear industry, aerospace industry, and even mining industry]. These include values, attitudes, beliefs, behaviors, corporate climate, etc. • **These are collectively called *Organizational factors* and deal with how we should develop in people the desire to work safely and develop *Safe habits*.** • ***Safety culture – not easy to define but the qualities needed for the development of a good safety culture can be recognized.*** • Organizations with effective safety cultures [1] **share** a constant commitment to safety as a top level corporate goal that is well understood and followed by the entire organization, [2]) **acknowledge** the high risk, error-prone nature of the activities of organizations' activities, [3] **promote** a blame-free environment where individuals are able to report substandard conditions, substandard practices, near hit or near miss, and so forth without punishment, [4] **collaborate** across organizational ranks to seek solutions to health and safety problems, and [5] **direct** resources to address health and safety concerns.	There is only one way to do a job-the safe way!

	• **Safety culture also deals with** how you feel about yourself, your job, co-workers and the organization and how it has an effect on your safety and safety of others. Here we want to feel good about yourself, job, fellow workers, and the organization.	

SLIDES 8
KNOWLEDGE, SKILLS AND DESIRE SHAPE THE HABIT OF AN INDIVIDUAL

SLIDE CONTENTS

Slide shows the diagram of how a "Habit" is formed

Important Points	Details of Instruction	Instructor Notes
Describe how a habit is formed Describe the organization factors that give rise to unsafe habits Describe the organization factors that give rise to unsafe habits	Development of "Habit"…the result of an interaction between knowledge, skills, and desire • Habit is at the intersection of knowledge, skills and desire – we want to develop safe habits. • ***Poor organizational aspects*** – poor people interactions, tolerance for bad practices/poor conditions, no clear idea of goal or vision, no rewards or recognitions, no idea of near-miss or near hits, etc. – can create and spread bad habits [habit is automatic pattern of behavior]. • Positive organizational aspects—good relationships built on trust, respect, and open communication, good conditions, clearly communicated vision/goals, rewards for safe performance, etc.	Good Discussion Issue: Everyone at the mine must work to develop safe habits…we can form safe habits as easily as unsafe one, but we must study what is it about the org. environment that is rewarding the unsafe habit, and what is rewarding the safe one

SLIDES 9
DISASTER PREVENTION STARTS WITH HAZARD CONTROL

SLIDE CONTENTS

- *ELIMINATION OF THE HAZARDS*
- *REDUCTION OF HAZARD POTENTIAL*

Important Points	Details of Instruction	Instructor Notes
Discuss ways to achieve continuous safety improvements	• All possible hazards must be eliminated through engineering design and for hazards not eliminated, protection must be afforded. These can be: 1. administrative procedures and 2. personal protective equipment. • ***"Safety always, not safety first."*** Each person should regard safety as a thing of intrinsic value; management must insist and demonstrate: • A value is a core fundamental belief that reflects by how you view and live in the world. • A value is more important and secure than a priority because priorities can be rearranged, but values never change.	Ask the group to describe several other "values" that guide them in daily life. Ask the group to describe the difference between several types of safety priorities and safety values.

SLIDES 10
SUMMARY

SLIDE CONTENTS

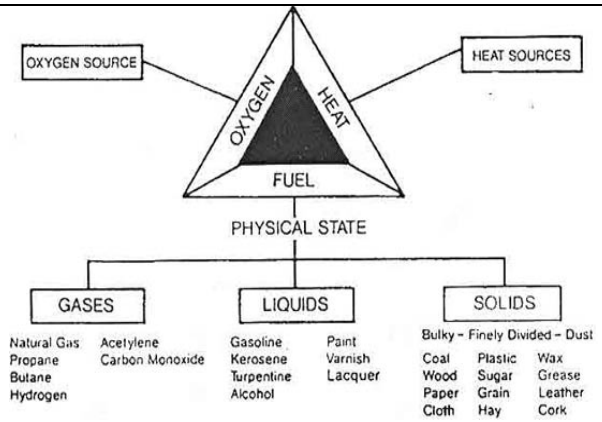
- *HAZARDS LEAD TO INCIDENTS, ACCIDENTS, AND DISATERS*
- *EMERGENCIES ARE THE RESULT OF THE REALIZATION OF HAZARDS*
- *HAZARD ELIMINATION, HAZARD MINIMIZATION/REDUCTION IS THE KEY*
- *ALL APPROACHES – ENGINEERING, EDUCATION AND TRAINING, ENFORCEMENT AND SAFETY CULTURE DEVELOPMENT ARE ESSENTIAL*
- *IMPACT MINIMIZATION IS ESSENTIAL IF HAZARDS ARE NOT ELIMINATED*

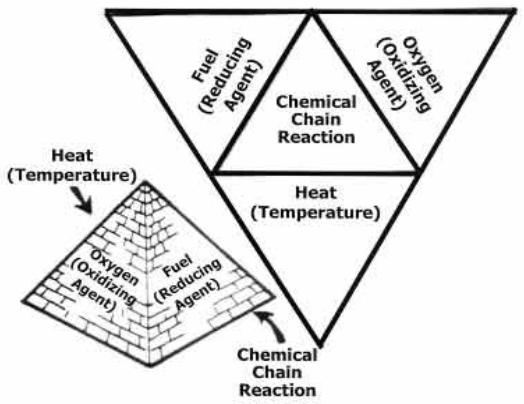
Important Points	Details of Instruction	Instructor Notes
Everyday…take advantage of opportunities to prevent emergencies…be ready if they do occur…		

SLIDES 11-12-13
MINE FIRES CAUSES AND CONTROLS

SLIDE CONTENTS

- *Components of Fire*
- *Fire Triangle*
- *Fire Tetrahedron*
- *Classes of Fires*

Important Points	Details of Instruction	Instructor Notes
Describe the three necessary ingredients are necessary for a fire	1. Oxygen supports combustion. 2. Fuel is what burns. 3. Heat (Ignition source): is what starts and propagates the flame.	
Describe concept of the fire triangle		Kindling point for solids Flash point for vapors

	• If there is not enough of one of the three ingredients, the fire will not start. • If enough of one or more of the three ingredients are removed, the fire will go out. • For a fire to start there must be 16% oxygen	
Describe concept of fire tetrahedron	 • A fire has to propagate or continue to burn. The fire tetrahedron brings in the concept of a fire being a chemical reaction. • In order for a fire to continue burning, the chemical reaction must continue. If it does not, or if something interrupts it, the fire will go out.	
Describe classifications of fires	• ***A (ash)*** Carbon- paper, wood, coal • ***B (boil)*** Liquids- gasoline, diesel fuel	Ask the group to give several examples of each class of fire.

	• ***C (current)*** Electrical- cables, motors • ***D (ding)*** Metals- magnesium, titanium	
Discuss basic fire control procedures	• Different classes of fires require different ways to extinguish them. • Smoldering fire: cut off one of the three elements • Flaming fire: cut off one of the four elements – oxygen or air, fuel, ignition source or heat, or chemical reaction • Different fires might require different methods	Ask the group what types of extinguishing agents they would use on A-B-C-D fires.
Describe the concept of direct firefighting	• Going directly after a fire. • Putting the extinguishing agent directly on the fire. • High volume of water is recommended • Use of wide angle fog for team safety and steady steam for direct contact with fire • Hazards include: electrocution, toxic and asphyxiating gases, explosive gases, heat, smoke and steam	Ask the group to describe how their safety could be jeopardized during direct firefighting
Firefighting equipment: Decsribe different types of hand held extinguishers	***A-B-C Dry Chemical*** • Most common. Rated for ABC fires, interrupts the basic chemistry of fire. Not recommended for D fires. (Red body & pressure gauge). ***Carbon Dioxide CO_2*** • Rated for BC fires, will only extinguish surface area,	Ask the group what type of fire extinguishers they have in their work area.

	heated core may reignite. (Red body & horn, no gauge) ***Halon*** • Rated for BC fires, used mainly in electronics, dangerous because Halon displaces oxygen. (Red body and gauge) ***Pressurized Water*** • Rated for A fires only, usually a baking soda charge. (Stainless steel body)	
Describe the concept of using water in fighting fires	***Advantages of Water*** • Water is plentiful • Water is cheap • Water is effective on A type fires • Water removes heat from the fire • At most mines, water is usually in plentiful supply. • Water is highly effective on Class A fires, by cooling down the fire and surrounding atmosphere. • Can be used to cool down the firefighting team to prevent heat exposure. ***Disadvantages of water*** • Water not to be used to control a B or C fire. • Inadequate pressure or too high pressure	Ask the group to describe the types and locations of water lines and hoses in their mine. Ask the group to describe how they maintain hose nozzles. Ask the group to describe how to activate the fire hoses.

	• The volume of water can be restricted to the length of water lines and hoses [head loss] • The fire nozzle can clog, reducing flow • Hydrogen can be produced by applying water to super hot fires.	
Describe the concept of using foam in fighting fires	Foams form a film over the fire keeping oxygen from reaching the fire and thus disrupting the chemical reaction of the fire. ***Types of Foam*** 1. Protein - Animal protein from entrails or blood (Class A & B fires) Burn back protection, not film forming, adheres well to roof 2. Fluoroprotein - Animal protein with fluorinated surfactants (Class A & B fires) Burn back protection, film forming 3. Aqueous Film Forming Foam (AFFF) - Synthetic (Class A & B fires) 4. Expansion Foam - Special detergent concentrate, expands 1000 times its own volume (Class A fires) No burn back protection, not film forming	

SLIDES 14
METHANE AND COAL DUST EXPLOSIONS

SLIDE CONTENTS

- *Conditions that lead to explosions*
- *Causes of methane accumulations*
- *Airborne coal dust*
- *Sources of ignition*
- *Frictional sparking*

Important Points	Details of Instruction	Instructor Notes
Conditions that can lead to explosions	***Accumulations of explosive materials*** • Methane is colorless, odorless and tasteless. • Methane will explode in air in concentrations between 5% and 15% • Methane is roughly half the weight of air and will rise toward the roof. • Coal dust can act just like gunpowder! • Detected or undetected airborne coal dust (75 g/m3) • Detected or undetected Methane and coal dust mixtures	Ask the group to describe the chemical properties of methane. Explain the concept of specific gravity.
Describe causes of methane accumulations	1. Insufficient ventilation	Ask the group to describe when and where methane tests are

	2. Improper or damaged ventilation control 3. Methane outburst 4. Undetected methane	conducted.
Airborne Coal Dust: Explain why coal dust control is so important	***Coal dust factors*** • The finer the coal dust, the more explosive it becomes. • Smaller particles of coal absorb heat and transfer heat faster than larger particles. • Size of dust, less than 20 microns • Concentration: > 75 g/m^3 • Presence of methane lowers the minimum explosive concentration of coal dust	Ask the group to describe where coal dust accumulations exist.
Describe various sources of ignition	• Electrical arcing • Improper blasting technique or non-permissible explosives • Frictional sparking • Lightning	
Describe why reducing frictional sparking is so important	***Frictional Sparking Sources*** • Machine cutting bits • Drill bits • Drill steel striking iron frame of drill machine	

	• Sandstone striking other sandstone during a roof fall ***Frictional Sparking Facts*** • Most methane ignitions in the U.S. occur within 1 m of the face and are initiated by frictional sparks from cutting bits. • The most effective preventive measure for frictional sparking from cutting bits is a water spray system.	

SLIDES 15
METHANE AND COAL DUST EXPLOSIONS

SLIDE CONTENTS

- *Preventing explosions*
- *Limiting size and extent of explosions*
- *Function of rockdusting*

Important Points	Details of Instruction	Instructor Notes
Discuss common ways to Prevent explosions	• Dilute and render harmless all methane through ventilation! • Minimize the amount of dust generated. • Loose coal dust is an explosion waiting to happen. ***A. Monitor ventilation*** 1. Adequate ventilating capacity 2. Properly installed and maintained ventilation controls 3. Regular airflow measurements ***B. Make regular examinations for methane*** ***C. Do not allow coal dust to accumulate*** 1. Minimize generation of dust	Ask the group to describe various methods used in their mine to prevent explosions.

	2. Suppress dust at sources 3. Cleanup loose coal dust 4. Rockdust airways ***D. Remove sources of ignition*** 1. Electrical arcs: Use and maintain permissible equipment. 2. Sparks from cutting bits: Sufficient and well maintained water sprays 3. Improper blasting techniques: Use only permissible explosives.	
Discuss ways to limit the size and extent of ignitions and explosions	1. Machine-mounted water sprays at the cutting bits 2. Rockdust airways 3. Separate ventilating air currents for each working section	
Describe the purpose and function of rock dusting	• Rock dust absorbs heat. • To render dust mixture noncombustible, and to absorb heat. Rock dust makes it much more difficult for a particle of coal to absorb or transfer heat to another particle. • Requirements 1. 65% incombustible content in intake airways 2. 80% incombustible content in return airways 3. Increase incombustible content with increase in gas %	

SLIDES 16
INUDATIONS OF GAS OR WATER

SLIDE CONTENTS

- *Causes of Inundations*
- *Control of Inundations*

Important Points	Details of Instruction	Instructor Notes
Discuss various causes of inundations	• Inundations can include gas or water. • • Working under bodies of water or gas filled areas [sea, river, lake, old adjacent mines, etc]. • Inaccuracy of mine plan and old mine plans (maps). • Inadequate mine procedures for approaching water-logged areas or abandoned areas. • Regional and local stability of mine strata, faults and weak zones – conduits for water/gas. • Inadequate barriers [seals, pillars. • Gas emissions and accumulations – e.g. gob areas [carbon dioxide, methane] or sudden outbursts of gas.	
Describe various ways to control of inundations	• Assess inundation conditions and prepare plans to eliminate adverse effects. • Leave barriers or build seals against old mines/workings.	

	• Drill in advance to locate old mines/workings • Train personnel to recognize hazards and take evasive measures	

SLIDE 17
MASSIVE GROUND COLLAPSE

SLIDE CONTENTS

- *Causes of ground collapses*
- *Control of ground collapses*

Important Points	Details of Instruction	Instructor Notes
Describe major causes of ground collapse	• ***Geological stresses*** Too high for mine structures to withstand – regional stability affected • ***Induced stress*** • ***Mining methods*** Creates high stress concentrations – pillar squeezing, rib failures, roof falls • ***Pillar failure*** Progressive/massive • ***Geological structures*** Outbursts of coal, coal bumps, outbursts, coal and rock	

Discuss methods to control massive ground failures	• ***Mining methods*** To avoid geological stresses, induced stresses and geological structures excessive stress build-up. • ***Mine design*** Pillar size, entry width, pillar recovery plans, roof support, etc all consider the. • ***Mine operations*** Monitor ground pressures, relieve stresses.	

SLIDES 18
SUMMARY

SLIDE CONTENTS

- *EMERGENCIES CAN HAPPEN FAST, WITH LITTLE WARNING*
- *EMERGENCIES CAN BE LOCAL OR MINE-WIDE*
- *EMERGENCIES CAN INCLUDE IGNITIONS, EXPLOSIONS, FIRES OR TOXIC ATMOSPHERES*
- *HAZARDS LEAD TO INCIDENTS, ACCIDENTS AND DISASTERS*

Important Points	Details of Instruction	Instructor Notes
Review important points to summarize content of module		Ask the group for questions and/or explanations to material covered.

SLIDES 19
SUMMARY

SLIDE CONTENTS

- *UNSAFE ACTIONS AND CONDITIONS LEAD TO INCIDENTS*
- *ENGINEERING/DESIGN IS THE FIRST METHOD USED TO REDUCE/ELIMINATE HAZARDS*
- *A SAFETY CULTURE IS A BELIEF THAT THE ONLY WAY TO DO A JOB, IS TO DO IT SAFELY*

Important Points	Details of Instruction	Instructor Notes
Review important points to summarize content of module		Ask the group for questions and/or explanations to material covered.

SLIDES 20
SUMMARY

SLIDE CONTENTS

- *A FIRE NEEDS HEAT FUEL AND OXYGEN IN ORDER TO BURN*
- *IF A FIRE'S CHEMICAL REACTION IS INTERRUPTED, THE FIRE WILL GO OUT*
- *THE FOUR CLASSES OF FIRE ARE A-B-C-D*
- *THE A-B-C DRY CHEMICAL FIRE EXTINGUISHER IS THE MOST COMMON TYPE OF EXTINGUISHER*

Important Points	Details of Instruction	Instructor Notes
Review important points to summarize content of module		Ask the group for questions and/or explanations to material covered.

SLIDES 21
SUMMARY

SLIDE CONTENTS

- *METHANE AND COAL DUST MUST BE CONTROLLED*
- *FRICTIONAL SPARKING MUST BE CONTROLLED*
- *INUNDATIONS CAN INCLUDE GAS OR WATER*

Important Points	Details of Instruction	Instructor Notes
Review important points to summarize content of module		Ask the group for questions and/or explanations to material covered.

APPENDIX A

MODULE 1
MINE EMERGENCIES

PRE-TEST—INSTRUCTOR'S ANSWER KEY

1. What is the ***best*** method by which to control hazards?
    a. By using PPE
    b. Through planned inspections
    c. Ventilate all areas of the mine
    d. Eliminate through design

2. Airborne coal dust can be:
    a. Poisonous
    b. An ignition source
    c. Made harmless
    d. Explosive

3. What is the ***best*** method by which to limit ignitions to face areas?

    a. Well maintained water sprays
    b. Regular airflow measurements
    c. Listening for methane outbursts
    d. All of the above

4. What is the ignition source of *most* methane explosions?

    a. Electrical arcs
    b. Improper blasting
    c. Frictional sparking
    d. None of the above

5. When using a fire extinguisher, you should aim:
    a. In the air to allow the extinguishing agent to settle on the flames
    b. At the base of the flames
    c. At the closest miner to provide protection
    d. None of the above

MODULE 1

MINE EMERGENCIES

POST-TEST—INSTRUCTOR'S ANSWER KEY

1. What is the ***best*** method by which to control hazards?
    e. By using PPE
    f. Through planned inspections
    g. Ventilate all areas of the mine
    h. Eliminate through design

2. Airborne coal dust can be:
    e. Poisonous
    f. An ignition source
    g. Made harmless
    h. Explosive

3. What is the ***best*** method by which to limit ignitions to face areas?
    e. Well maintained water sprays
    f. Regular airflow measurements
    g. Listening for methane outbursts
    h. All of the above

4. What is the ignition source of *most* methane explosions?
    e. Electrical arcs
    f. Improper blasting
    g. Frictional sparking
    h. None of the above

5. When using a fire extinguisher, you should aim:

   a. In the air to allow the extinguishing agent to settle on the flames
   b. At the base of the flames
   c. At the closest miner to provide protection
   d. None of the above

6. When welding or using oxygen-acetylene you should always:
   a. Conduct an inspection of the area before beginning work
   b. Have a fire extinguisher in the immediate area
   c. Post a fire watch
   d. All of the above

7. ***Common*** sources of ignition include:
   a. Sustained friction
   b. Electrical arcing
   c. Sparks from welding
   d. All of the above

8. The safest method to use when mining close to abandoned mines or worked-out areas is:
   a. Drill boreholes in advance of the face.
   b. Drain water from overlying strata.
   c. Dig sumps at low elevations in the mine.
   d. Maintain extra pumping capacity.

9. When should PPE be used?
   a. Only when hazards cannot be eliminated by other controls
   b. At all times
   c. As a substitute for engineering controls
   d. Never

10. Methane action levels
   a. require immediate response when methane reaches the respective levels.
   b. are above the lower end of the explosive range of methane.
   c. should be implemented at the end of each production cycle.
   d. must involve all available personnel immediately.

11. ***Most*** methane ignitions are initiated by
    - ***a. frictional sparks from cutting bits.***
    - b. miners smoking underground.
    - c. electrical equipment that has not been recently inspected.
    - d. striking sandstone with a steel hammer or bar.

12. Poorly constructed or damaged ventilation controls can:
    - a. Reduce entry cross-sectional area
    - ***b. Allow methane to accumulate***
    - c. Allow coal dust to settle
    - d. All of the above

APPENDIX B

Post-Training Evaluation Form

Do You Understand Mine Emergencies?
Are You Prepared for a Mine Emergency?

1. Was the material covered relevant to your needs, interests, and expertise?
   _____Very Much So _____To Some Extent _____Needs More Work _____No

2. Were the objectives of the course met?
   _____Very Much So _____To Some Extent _____Needs More Work _____No

3. Were the instructors knowledgeable and competent in the subject area(s)?
   _____Very Much So _____To Some Extent _____Needs More Work _____No

4. Was the course content logically organized?
   _____Very Much So _____To Some Extent _____Needs More Work _____No

5. Was the length of the course adequate?
   _____Yes, keep as is _____Not long enough _____Shorten it

6. Was there an adequate opportunity for discussions and questions?
   _____Yes, keep as is _____Allow more time for discussions and questions

7. Was the use of audiovisuals adequate and appropriate for the course materials?
   _____Yes _____No (If no, why?)

8. Do you believe that today's training help you survive a mine emergency?
   _____Very Much So _____To Some Extent _____No

SUGGESTIONS/RECOMMENDATIONS TO IMPROVE THIS TRAINING:

APPENDIX C

MARK C. RADOMSKY
E-mail: mcr4@psu.edu
Address: 0212 RES BL WEST
UNIVERSITY PARK
Telephone Number: +1 814 865 6335

JOSEPH P FLICK
E-mail: jpf1@psu.edu
Address: 0213 RES BL WEST
UNIVERSITY PARK
Telephone Number: +1 814 865 7472

JOSEPH NICHOLAS DESALVO
E-mail: jnd10@psu.edu
Address: 0213 RES BL WEST
UNIVERSITY PARK
Telephone Number: +1 814 865 7472

ROBERT LARRY GRAYSON
E-mail: rlg19@psu.edu
Address: 0103A HOSLER BUILDING
UNIVERSITY PARK
Telephone Number: +1 814 863 1644

RAJA V. RAMANI
E-mail: rvr@psu.edu
Address: 0209 RES BL WEST
UNIVERSITY PARK
Telephone Number: +1 814 863 1617