

# Inventory of U.S. Mine Rescue Training Facilities that Support Coal Mine Rescue Training



**Laurie Ruberg, Doug Moore, and Lisa McFarland**

Mining and Industrial Safety Technology and Training Innovation (MISTTI)

Center for Educational Technologies

Wheeling Jesuit University

<http://mistti.cet.edu>

Sept 28, 2013

## ABSTRACT

This report<sup>1</sup> provides an updated inventory of domestic underground coal mine rescue training facilities that provide emergency response preparedness training, command center training, and rigorous and standardized skills and equipment training for mine rescue teams. This facility inventory report builds upon and updates the previous research conducted by NIOSH and published in 2009. The Mining and Industrial Safety Technology and Training Innovation (MISTTI) researchers at Wheeling Jesuit University contacted staff at 12 of the leading mine rescue training facilities to develop this summary of each facility's geographic location, services and capacities, and training areas of expertise. We also compare 2013 mine rescue issues and concerns with those voiced in the 2008 survey. This report includes short profiles of each of the 12 training facilities with photos, a map showing the location of the 12 facilities and mine rescue team stations, and data tables displaying facility features for comparison. The report provides distinguishing features of U.S. coal mine rescue training facilities, highlights of notable improvements in training approaches, facility contexts, and recommendations for further enhancements to the mine rescue facility training capabilities and areas of focus.

## BACKGROUND AND RATIONALE FOR THIS STUDY

Coal miners working underground should be given the security and confidence that if a disaster occurs and they are trapped in the mine, other miners will make every possible attempt to rescue them. This is the mine rescue tradition.

In January of 2013, the most recent month for which data is available, coal accounted for nearly 40 percent of electricity consumed in the U.S. The National Mining Association estimates that 824.8 short tons of coal mined in the U.S. are purchased and consumed by electric power companies. Of the 1,871 active coal mines in the U.S. in 2012, about 500 were underground mines. The Mine Health and Safety Administration reports that there were 137,350 coal mining employees in 2012. Estimates indicate that 54,000 of these employees work in underground coal mines. MSHA<sup>2</sup> reports that in 2011, the fatal injury rate for mining as a whole was .0114 per 200,000 hours worked, and the all-injury rate was 2.73 per 200,000 hours worked, which represents a decrease from .0234 and 2.81, respectively, recorded in 2010. MSHA reports that 341 coal miners died in fatal work-related accidents between 2002 and September 4, 2013.

The trend is for improved mine safety practices. However, as the U.S. Bureau of Labor Statistics shows<sup>3</sup>, coal mining has the second highest rate of fatal work injuries among all U.S. industry sectors. Over the past 11 years, an average of 30 miners have died annually<sup>4</sup>. These occupational statistics show how many miners are potentially served by the mine rescue teams. This inventory reviews the 12 major training facilities available to serve the 105 mine rescue teams on call for 500 underground coal mines with a total of approximately 54,000 employees.

The National Institute for Occupational Safety and Health (NIOSH) requested the Mining and Industrial Safety Technology and Training Innovation (MISTTI) project to conduct a follow up study to its 2008 inventory of mine rescue training facilities (Bealko, et al., 2009). The MISTTI inventory research is

---

<sup>1</sup> This research was conducted as part of the Mining and Industrial Safety Technology and Training Innovation project, which was funded by the National Institute for Occupational Safety and Health (NIOSH) grant number 1H75OH009822. The opinions expressed herein are those of the authors and not those of NIOSH or any other company, government agency, or organization.

<sup>2</sup> Information retrieved from the MSHA article titled Injury Trends in Mining published June 2013 at:

<http://www.msha.gov/MSHAINFO/FactSheets/MSHAFACT2.HTM>

<sup>3</sup> Number and rate of fatal occupational injuries by industry sector, 2012. Source: U.S. Department of Labor, 2013 at: [www.bls.gov/iif/oshcfoi1.htm](http://www.bls.gov/iif/oshcfoi1.htm)

<sup>4</sup> Coal Mining Fatalities by State by Calendar Year as of 9/4/2013 published by MSHA at: [www.bls.gov/iif/oshcfoi1.htm](http://www.bls.gov/iif/oshcfoi1.htm)

designed to document current skill, service, and educational capabilities of mine rescue team training facilities based in the United States. As a follow up to the previous research, the MISTTI researchers have contacted existing mine rescue training facility staff to identify how training geographic locations, capabilities, professional services, and approaches have changed in the past five years. Two mine rescue training facilities that were listed in the 2008 study are now closed and two brand new company-managed miner training facilities were added to the Appalachian region.

The primary **purpose of this study** is to develop an inventory summary of domestic underground coal mine rescue training facilities that provide real-life and/or state-of-the-art emergency response preparedness training, command center training, rigorous and standardized skills and equipment training, and facility and staff support for mine rescue content competition that is based in a more realistic environment. Mine rescue training facilities are concentrated in the mid-Atlantic area because since 1970, 13 out of 21 coal mine disasters (defined as five or more fatalities in an accident) have occurred in the Central Appalachian coal field (Luo, 2013). The previous inventory recommendations suggested that an additional facility was needed in the Appalachian region. For these reasons, questions about proximal and remote audiences served are included in this research.

### **SCOPE, TARGETED AUDIENCE, AND VALUE OF FINDINGS**

Similar to the previous mine rescue training inventory research this update involves semi-structured interviews with staff at geographically distributed training facilities. The MISTTI inventory research was completed within a two-month period of August and September 2013. Telephone interviews and web-based content reviews of training centers were the principal sources of information, rather than site visits--with one exception. The Mine Training and Technology Center (MTTC) is less than one hour from the MISTTI research team, which allowed the researchers to have first-hand observation of many of the representational technologies and training practices that are used at nearly all of the centers.

The audience most likely to benefit from the findings and recommendations presented here are mine rescue teams, mine rescue team trainers, coal mining health and safety officers, miners seeking to advance their skill, knowledge, and certification levels, and coal company and researchers who seek innovative methods of improving their mine rescue capacities and awareness.

The researchers followed the informed consent and voluntary participation in research procedures outlined in the existing CDC/NIOSH MISTTI project exempt human subject research approved application. Included with the informed consent and invitation to participate in this research that was sent to all interviewees, was a list of survey questions specifically related to mine rescue training center features, capabilities, and skill-based exercises of particular interest in this study. Research findings from this report may be used in further NIOSH investigations to improve coal mine rescue training in ways outlined in the Summary and Recommendations section.

### **COMPARISON OF THE 2008 AND 2013 MINE RESCUE ISSUES AND CONCERNS**

The 2008 inventory of mine rescue training facilities involved geographically distributed stakeholder groups in a series of focus group interviews. The interviews were designed to investigate and identify pressing issues, concerns, barriers and suggestions for improved mine emergency response. Seventy-one coal mine emergency response expert practitioners and trainers, mostly from industry, participated. The following issues emerged from the 2007-2008 study:

- the need for more emergency response preparedness training,
- a disparity in standardization of skills and equipment,
- incident command shortfalls between teams and the command center,

## Inventory of U.S. Mine Rescue Training Facilities that Support Coal Mine Rescue Training

- the desire for more realism for mine rescue contests and rules, and
- a shortage of available mine rescue training facilities.

This study examines to what extent recommendations and plans for enhanced services identified in the 2008 study have been implemented in the 12 mine rescue facilities contacted in this inventory study.

### OVERVIEW OF U.S. COAL MINE RESCUE TRAINING FACILITIES AND PRACTICES

Regulations require all underground mines to have fully-trained, highly organized mine rescue efforts carried out by trained and skilled teams of individuals who are well equipped professionals available in the event of a mine emergency. The Mine Safety and Health Administration (MSHA) publishes a *Mine Rescue Instruction Guide (IG)* series<sup>5</sup> that is designed and disseminated to help U.S. coal mines meet mine rescue team training requirements under 30 CFR Parts 49 and 75. The materials in the MSHA mine rescue training modules include suggestions, handouts, visuals, and text materials to support effective mine rescue team training. Those materials can be used to either supplement existing mine rescue training, or can be tailored to fit mine-specific training needs. The table below, provides a summary of New Miner Act Requirements for underground coal mine operators and mine rescue teams, which are the focus of this article<sup>6</sup>

#### New Miner Act Requirements for Underground Coal Mine Operators and Mine Rescue Teams

Requirement	Type of mine rescue team			
	Mine-site	Composite	Contract	State-sponsored
Team members must participate at least annually in two local mine rescue contests	YES	YES	YES	YES.
Team members must participate in mine rescue training at each mine covered by the mine rescue team. A portion of the training must be conducted underground	Annually at Large Mines; Semi-annually at Small Mines	Semi-annually	Quarterly at Large Mines; Semi-annually at Small Mines	Annually at Large Mines; Semi-annually at Small Mines.
Team must be available at the mine within 1 hour ground travel time from the mine rescue station	YES	YES	YES	YES.
Team members must be knowledgeable about the operations and ventilation of each covered mine	YES	YES	YES	YES.
Team must include at least two active employees from each covered large mine and at least one active employee from each covered small mine	YES			
Team must be comprised of persons with a minimum of 3 years underground coal mine experience that shall have occurred within the 10-year period preceding their employment on the contract mine rescue team	YES			

<sup>5</sup> <http://www.msha.gov/MineRescue/Training/TeamTraining.asp>

<sup>6</sup> More information about final rule requirements for MSHA's existing standards for mine rescue teams for underground coal mines that implements Section 4 of the Mine Improvement and New Emergency Response (MINER) Act of 2006 to improve overall mine rescue capability; to improve mine emergency response time and mine rescue team effectiveness; and to increase the quantity and quality of mine rescue team training is available at [http://cfr.regstoday.com/30cfr49.aspx#30\\_CFR\\_49pSUBPART\\_B](http://cfr.regstoday.com/30cfr49.aspx#30_CFR_49pSUBPART_B)

## Inventory of U.S. Mine Rescue Training Facilities that Support Coal Mine Rescue Training

All mine operators must provide for two certified mine rescue teams. Large mine operators shall provide one team that is either an individual mine-site mine rescue team or a composite team.

The goal of this section of our report is to provide a collective overview and comparison of the technology and professional training strengths and variety of approaches available to support mine rescue training at twelve major training facilities. Mine rescue team trainers and team members can use these summaries to compare and contrast resources, technologies, approaches, and certifications available from the nationally distributed facilities. Figure 1 (below) shows where the facilities and mine rescue teams are located.

The numbers displayed on top of the pentagons in Figure 1, correspond to the list of coal mine rescue training facilities named and described in the following pages. A key defining the 12 facilities numbered on the map is provided immediately below the map.

The latest list of mine rescue teams and their affiliations is available at this MSHA website:

<http://www.msha.gov/MineRescue/MAP/ASP/minerescuehome.asp>

Inventory of U.S. Mine Rescue Training Facilities that Support Coal Mine Rescue Training

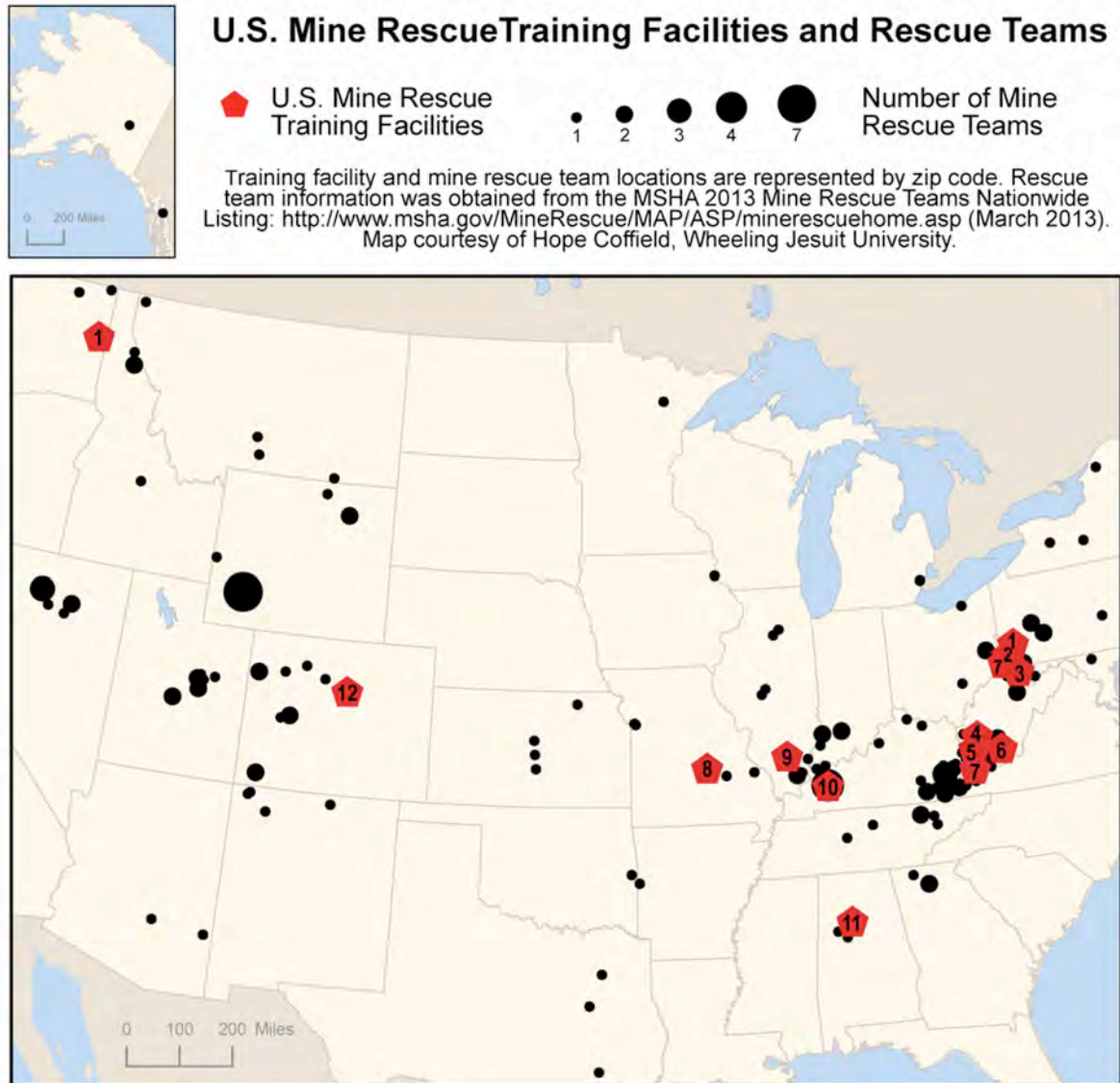


Figure 1 showing the locations of the U.S. Mine rescue training facilities and rescue teams

**Key for Mine Rescue Station Facilities 1-12**

- |   |  |
|---|--|
| <ol style="list-style-type: none"> <li>1. NIOSH (OMSHR) Bruceton and Spokane Research Labs Pittsburgh, PA and Spokane, WA</li> <li>2. Mining Technology &amp; Training Center (MTTC), Ruff Creek Campus, Prosperity, PA</li> <li>3. West Virginia University Academy for Mine Training and Energy Technologies (WVU E&amp;O), WVU Mining and Industrial Extension, Morgantown, WV</li> <li>4. Running Right Leadership Academy (RRLA), Alpha Natural Resources, Julian, WV</li> <li>5. Academy for Mine Training and Energy Technologies, Southern WV Community and Technical College (SWVCTC), Logan, WV</li> <li>6. National Mine Health and Safety Academy (MSHA MSL), Beaver, WV</li> </ol> | <ol style="list-style-type: none"> <li>7. Buchanan Mine Rescue Training Facility, CONSOL Energy, Grundy, VA and Bailey Complex, CONSOL Underground Training Facility, Greene County, PA</li> <li>8. Missouri University of Science and Technology (MS&amp;T), Mining Engineering, Rolla, MO</li> <li>9. Rend Lake College, Mining Technology Program (RLC), Ina, IL</li> <li>10. Kentucky Coal Academy, Mine Emergency Response Academy (KCA MERA), Madisonville Community College, Madisonville, KY</li> <li>11. Alabama Mining Training Consortium (AMTC), Bevill State Community College, Sumiton, AL</li> <li>12. Mine Safety and Health Program (MSHP), Colorado School of Mines, Golden, CO</li> </ol> |
|---|--|

**1. NIOSH Office of Mine Safety and Health Research:** <http://www.cdc.gov/niosh/mining/>  
**Bruceton Research Lab**, Cochran's Mill Rd., Pittsburgh, PA and  
**Spokane Research Lab**, 315 E. Montgomery Avenue, Spokane, WA

The NIOSH Office of Mine Safety and Health Research (OMSHR) work is primarily conducted at either the Pittsburgh, PA or Spokane, WA facility. Programmatic areas addressed by these two facilities include dust (coal and silica) monitoring and control, mine ventilation, hearing loss prevention and engineering noise controls, diesel particulate monitoring and control, emergency response and rescue, firefighting and prevention, training research, ergonomics and machine safety, mine ground control, electrical safety, explosives safety, surveillance, and technology transfer. The major active research programs address these topics (1) health hazards; (2) safety hazards; (3) disaster prevention; (4) catastrophic failure detection and prevention; (5) mining injury and disease prevention; (6) mining surveillance and statistical support; and mine safety training.

The OMSHR Pittsburgh site encompasses 180 acres and houses six different mine safety and health research laboratories: Safety Structures Testing, Acoustic Test Chambers, Motion Analysis, Full Scale Continuous Miner Dust Gallery, Safety Research and Experimental Coal Mines, and the Mine Rescue and Escape Training Theatre. The last two of these research labs have the strongest connections to mine rescue technologies and training research. Projects are primarily selected for research based on mine incident and surveillance data and mining stakeholder input.



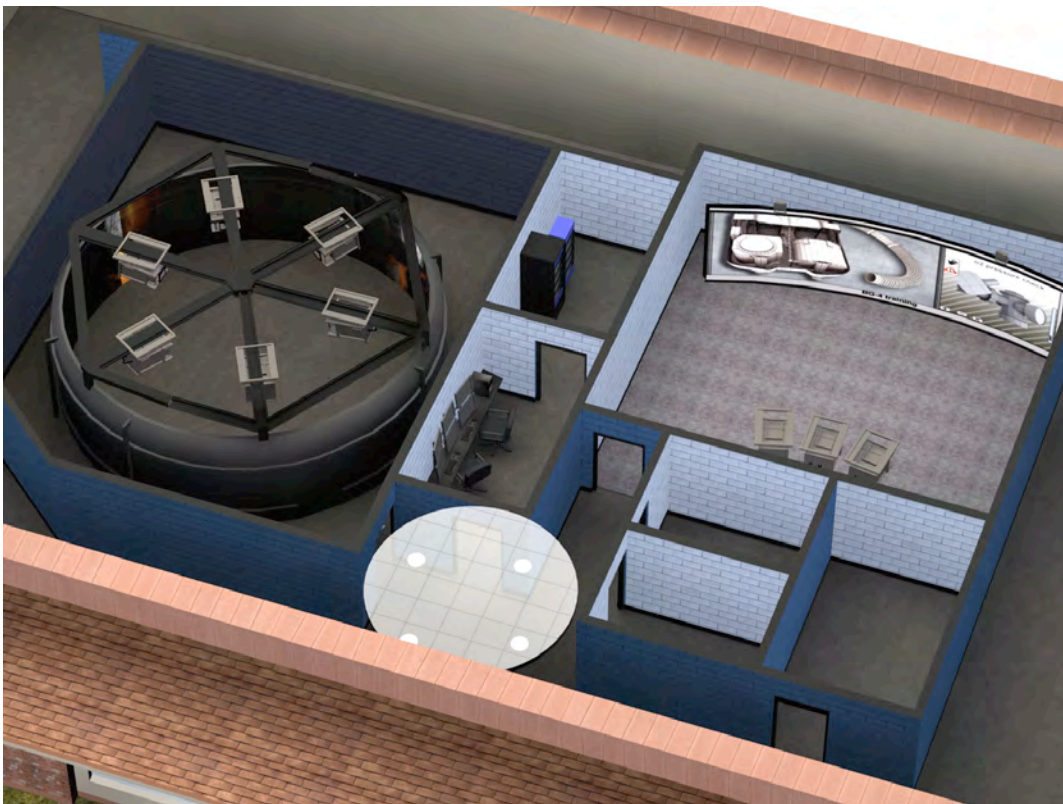
*The virtual reality mine rescue training developed by NIOSH researchers (shown in the image below) enhances mine rescue team training (illustrated above) with simulated emergency situations that would be too dangerous to do in hands-on practice exercises. Image credit: SWCTC*

The Safety Research and Experimental Coal Mines at the Pittsburgh OMSHR site is a multi-purpose four-mile, underground mine complex used to support research that works toward the development and evaluation of new health and safety interventions for mineworkers. The *Experimental Coal Mine* consists of two drift entries driven into the Pittsburgh coal seam developed to support full-scale mine explosion tests. The *Safety Research Coal Mine* is a room-and-pillar operation approximately the size of a working section and is utilized for research in areas such as ground control,

ventilation, fires, explosives use, materials handling, and environmental monitoring. This research mine also has a reversible fan, water hydrants, electric power and compressed air. Although it is not publicly available for regular use, the real life environment makes it an attractive venue to conduct mine rescue and fire brigade training research, including a variety of smoke training exercises and mine emergency response development (MERD) drills. If a MERD or mock event is staged, the command center is usually housed in a building located about 100 feet from the mine portal. The incident command center includes communications and mine rescue team staging areas. Neither of the two mines at the NIOSH research facilities were ever

production coal mines, but they include a staff of miners who can provide technical and physical assistance to in-house and contract researchers.

The Mine Rescue and Escape Training (MRET) tools at the Pittsburgh OMSHR site includes a three-dimensional display to construct a realistic, virtual environment for training miners and mine rescue teams. Using a virtual reality environment to simulate mine emergencies allows mine rescue teams to learn and practice emergency response practices in a scenario-based training simulation that would be dangerous and impractical to replicate in real life, but offers extremely valuable, applicable, and replicable learning experiences. Currently the staff is working on two scenarios, which will be pilot tested at one or more facilities in the 2014 fiscal year. The MRET research underway is designed to answer these questions: Can mine rescue teams learn/train in this environment? Can this type of training technology be used in lieu of or in addition to traditional instruction? And can the virtual reality system function as a portable training tool? If it is found that this approach is viable, the virtual reality training scenarios may be further expanded and made more widely available as a mine rescue training technology tool.



*Mine Rescue and Escape Training Theatre developed by the Pittsburgh OMSHR site. Image credit: NIOSH*

---

## **2. Mining Technology and Training Center (MTTC), UMWA Career Centers, Inc.**

197 Dunn Station Road, Prosperity, PA 15329 <http://themttc.com/>

The MTTC facility is located north of Waynesburg, PA and offers a complete Mine Rescue Team training curriculum, including classroom and hands on training. The Center's 40,000 square foot simulated mine has 6 entries, 7 crosscuts, 2 functioning overcasts, and an exhaust fan. The Center also has a 4-entry, 5-crosscut smoke mine, hose control pad, 1.4 million BTU "live burn" tunnel, and 3 outside mine rescue training fields. Additionally, MTTC has a fully equipped mine rescue staging area.





*The burn tunnel at MTTC. Image credit: MTTC*

The Center also makes use of virtual reality game technology; one exercise has each rescue team member log in to a virtual reality mine according to his or her role on the team. The exercise is designed to test the skills and knowledge of each team member. The mine rescue training curriculum consists of five courses designed by MSHA Certified Mine Rescue instructors, and can be customized to satisfy the needs of the participants. The course topics include:

- Understanding and application of the National Mine Rescue Rules.
- Understanding and application of the National Mine Rescue Mine Map Legend.
- Mine Disaster Training – Recovery and handling of deceased miners
  - a. Procedures/guidelines for water movement with large diameter hose.
  - b. Proper use of nozzles.
  - c. Victim recovery and proper BSI (Body Substance Isolation).
- First Aid for the First 1000 Feet.
- Draeger BG4. Level 1 and Level 2 Training.

Upon course completion trainees are CPR (cardiopulmonary resuscitation) and AED (automated external defibrillator) and Heartsaver First Aid Certified for two years.

MTTC also offers Mine Foreman and Assistant Mine Foreman training, underground diesel training, fire brigade training, new miner and refresher training, Responsible Person and Command and Control training. MTTC identified several goals in the 2008 report and has satisfied those goals with the construction of the simulated mine, fire pits and burn tunnel. The training curriculum now incorporates a majority of the “Primary Skills” recommendations of the 2008 report. The center conducts MERD exercises as part of its training regimen.

---

### 3. West Virginia University Academy for Mine Training and Energy Technologies (WVU E&O)

2870 Little Indian Creek Road, Core, WV 26541, West Virginia University Mining and Industrial Extension, Mineral Resources Building Room 311- Evansdale Campus

<http://www.statler.wvu.edu/mindex/mining/>

The WVU Academy for Mine Training and Energy Technologies (Dolls Run Facility) is located 10 miles from the WVU Evansdale Campus. The Academy specializes in Mine Emergency Response trainings, which includes specialty skills such as cross-training mine rescue and mine fire brigade teams in advanced firefighting. WVU Mining Extension also has instructors working out of the National Mine Academy in Beaver, WV to conduct these same trainings at this location as well. The Academy also offers classes and programs such as; apprentice miner (Underground & Surface), WV mine foreman, WV continuing education for mine foreman, and electrical certifications, to name a few.

The simulated underground mine lab at Dolls Run was dedicated on October 16, 2009. The simulated mine has the unique feature, that it can incorporate all aspects of ventilation, a flowable source of water, theatrical smoke, and a live fire in a training scenario.



*The simulated underground mine lab at Dolls Run.  
Image Credit WVU.*



*A live burn in the simulated mine.  
Image Credit. WVU*

The facility is steel in construction and can be set up in a typical 3-entry gate section approach, or turned sideways into a 5-entry sub main with a section breaking off to the left. The facility is ventilated with a high-volume, low-pressure diesel fan, which can be relocated depending on the approach, and can be set up for blowing, or exhaust ventilation. The simulated mine lab has a 4" water line installed along the conveyor belt, which is plumbed into a 10,000 gallon holding tank (exterior from the mine) and pressurized by a gasoline powered pump (also exterior from the mine), and is complete with fire taps and shut-off valves along its entirety. There is a state of the art burn area, within the simulated mine, where active firefighting is conducted. And, several theatrical smokers are staged throughout the simulated mine lab to provide another aspect to training.

The simulated mine has several mobile mine equipment props, an actual load center (non-functioning), several adjustable regulators, and an over-cast. There is lifeline installed in both the primary and secondary escape ways, and the simulated mine also has a Strata Fresh Air Bay training model.

The Academy is not limited to only firefighting activities, but has come up with an Emergency Response Training, which includes a full mine evacuation scenario, SCSR training, tethering, expectations, fresh air

bay, basic firefighting, and foam generating equipment. The academy has hosted both skills competitions and Mine Emergency Response Development drills (MERD) for coal mines, and has hosted metal-non-metal mines for mine rescue and fire brigade trainings for teams from an Alaskan gold mine and a New Mexican pot ash mine. WVU Academy for Mine Training has hosted miners from 11 different states, and even a mine rescue team from Australia.

---

#### 4. Running Right Leadership Academy, Alpha Natural Resources (RRLA)

431 Running Right Way, Julian, WV 25529

<http://www.alphanr.com/safety/Pages/RRLA.aspx>

The Running Right Leadership Academy, located in Julian, WV (see photo below), opened on the 20<sup>th</sup> of June 2013 to serve as a representation of the, state-of-the-art mining educational facility and comprehensive training ground for safety and operational excellence. The academy is a private facility, although it recently announced that opportunities for training are open to the public by appointment. The academy features:

- Classroom space for up to 300 people.
- A mine lab with 96,000 square feet to simulate real mine situations and conditions.
- A virtual reality lab with simulators to provide training on a continuous mining machine, roof bolter and haul truck.
- Multiple labs for electrical, maintenance and welding training.
- Facilities and equipment for supervisory leadership skills training.

As a command center for mine rescue and emergency preparedness training, the academy has the following mine rescue training capabilities:

- First aid and EMT training.
- Mine gases training.
- Dust and ventilation training utilizing a 70,000 cubic inch per minute ventilation system.
- Specialized firefighting training using outside pads and simulated belt fire. Foam generator.
- MERD Exercises, including command center training using the communications vehicle shown below.
- Annual Refresher for miners
- Annual refresher for electricians

Although the center's curriculum is evolving, through partnerships with institutions like Virginia Tech, West Virginia University and the University of Utah, the Running Right Leadership Academy is planning to offer a curriculum that includes technical skills, safety and leadership training in the near future that satisfies the 2008 (Bealko, et al.) recommendation in both primary and non-typical skills.



*Running Right Leadership Academy in Julian, WV.  
Image credit: Alpha Natural Resources*



*Alpha's mobile communications vehicle will serve as a command center during simulated mine emergency drills. Image credit: MSHA*

### 5. Academy for Mine Training and Energy Technologies (SWVCTC)

Southern West Virginia Community and Technical College, 301 Cole Street, Logan, WV 25601

<http://minetrainingacademy.com/>

The Academy for Mine Training and Energy Technologies is one of the workforce development programs housed at the Southern West Virginia Community and Technical College (SWVCTC). The Academy provides training for individuals who are interested in any of the mining certifications offered in the state of West Virginia. Courses, as well as customized, advanced MERD exercises are available to support miner safety training and mine rescue. Through the use of a repurposed historic downtown Logan manufacturing building with 53,000 square feet of usable space, as well as resources on the Logan/Mount Gay campuses, the SWVCTC facility houses fully functional mine training simulators and hands-on equipment labs. A unique and attractive training feature is that many of the industry certifications are transferable to academic credit hours. The academy operates at all Southern West Virginia Community and Technical College campus locations, as well as the academy facility located in Logan, West Virginia.



*Mine rescue rope training with stretcher and pulley system used as part of SWVCTC skill training at a mine site.  
Photo credit: Both images provided by SWVCTC*



*SatCom 1 mobile command unit supports mine rescue training in gas analysis & weather detection (lightning). It includes radio & video communications to support fully function MERD exercises.*

The SWVCTC academy is designed to simulate underground coal mines, with low, mid, and high-seam heights. It provides trainees the opportunity for hands-on training in a realistic environment. There is even a hoist elevator that is used for transportation and mine shaft evacuation training. This facility also utilizes state of the art 3D computer simulations, where trainees can be immersed in real-life situations. Mine rescue training exercises include:

- Navigation in smoke, water, and collapse hazards
- Advanced confined space and technical rope rescue, surface and underground
- Advanced trauma and medical training (EMT-M and recertification)
- Rapid transportation of injured miners to include large scale triage and aeromedical training
- Use of new mine rescue technology such as exploration techniques with thermal imaging cameras.
- Specialized firefighting training, surface and underground, on outdoor burn pads and a fire gallery
- Draeger Level I and II, BioMarine, Scott and MSA Breathing Apparatus, Advanced Smoke Diver

The Academy emphasizes incident command protocols and mobilization of emergency assets and integrates this

## Inventory of U.S. Mine Rescue Training Facilities that Support Coal Mine Rescue Training

expertise into mine rescue training in the form of MERDs. The facility operates an on-call 24/7 fleet of nine (9) mine emergency response and support vehicles that are partly funded by the state of WV. Given the name Task Force 1, the vehicles are specially designed to provide communications, rescue and fire service to mines in very remote locations. Rescue equipment includes light towers, rescue jaws and cutters, 816-t (900-st) airlift bags, specialized shoring and seismic monitoring equipment. The facility also has technical rope equipment for vertical rescue, self-contained breathing apparatus (SCBA), portable power systems, and advanced medical equipment. The Mobile Communications Unit (Command 1) is equipped with nine (9) computer workstations and an additional three (3) that are portable with fax/copy/scanner capabilities, and an advanced GPS, as well as three satellite communication systems. Most noteworthy, as Southern operates in conjunction with the State of West Virginia Office of Miners' Health, a bank of four (4) state-of-the art gas chromatograph systems, MSHA approved radio systems, two (2) portable mil-spec weather stations, as well as, helicopter communications and mobile landing-zone equipment. The two command vehicles can be deployed as incident command centers at any location that would require that need.

The Academy for Mine Training and Energy Technologies also has adjacent lodging and indoor practice fields located at the Chief Logan Conference Center. The center has theatre seating for a capacity of over 400 people for any type of seminar or training. At the college, several "smart" classrooms are available for global class instruction or distance learning communications.

---

### **6. The Mine Simulation Laboratory, National Mine Health and Safety Academy (MSHA MSL)**

1301 Airport Road, Beaver, West Virginia 25813-9426

<http://www.msha.gov/PROGRAMS/EPDMSL.HTM>, <http://www.msha.gov/PROGRAMS/EPD2.HTM>

The Mine Simulation Laboratory is an above-ground simulated mine that provides hands-on training for MSHA inspectors and mining industry personnel. The 48,000 square foot facility has a simulated coal mine with an indoor burn room on the lower level and a simulated metal/nonmetal mine on the second floor level. The coal mine represents a room-and-pillar setup with 4 entries and 9 crosscuts.

The trainers can also introduce smoke and make other changes in the laboratory to demonstrate different tactics and principles. A burn room is located on one end of the simulated coal mine. The simulated metal/nonmetal mine contains passageways, tunnels, stairways, and ladders to simulate different manways and other practical aspects of mine rescue problems. Fires are built, under controlled conditions, to teach students the principles of firefighting and emergency ventilation techniques that may be encountered in a mine emergency. A 100,000 cubic-foot-per-minute mine fan, controlled by solid-state electronics, can vary the volume of air delivered throughout the entries and crosscuts in the two simulated mines.



*A 100,000 cubic-foot-per-minute mine fan, controlled by solid state electronics, can vary the volume of air delivered throughout the entries and crosscuts in the two MSHA Academy simulated mines.*

*Simulated exercises provide realistic mine emergency and fire fighting scenarios, which provide a realistic context for learning how to handle and perform in an actual mine emergency situation.  
Image credit: MSHA*

## Inventory of U.S. Mine Rescue Training Facilities that Support Coal Mine Rescue Training

Other noteworthy features of this complex are dormitory space for 320 people, classrooms and laboratories that can accommodate 600 students, a cafeteria, library, auditorium, and wellness facilities. Mine rescue training includes:

- Problem solving and first aid classroom courses
- Outdoor firefighting drills
- Exploration and navigation in poor visibility
- Construction of temporary and permanent ventilation controls while under apparatus
- Breathing apparatus—donning and operations
- Mine gases—measurements, importance of, and regulations
- Map reading
- Communications—routine, emergency, and May Day



*Instructors can arrange different passageways, tunnels, stairways, and ladders to simulate different manways and other practical aspects of firefighting and emergency ventilation techniques, which are key components of the skills and knowledge needed by mine rescue team members. Image credit: MSHA*

(FEMA), Occupational Safety and Health Administration (OSHA) and the U.S. military. They also utilize a neighboring facility by partnering with The International Union of Operating Engineers (IUOE) to provide HAZMAT and Disaster Site Worker Training. MSHA's mine rescue resources could be used to respond to local and nationwide disasters.

The Mine Emergency Operations (MEO) Building and Mine Rescue Station is located next to the Mine Simulation Laboratory. The mine emergency command vehicles, office trailer, rescue capsule, ATV, emergency generators, and water pumps are housed in this building. Also, the mine rescue station for MSHA's Mine Emergency Unit (MEU) is located inside and contains a full complement of equipment for mine rescue/recovery.

The MEU has mutual aid agreements with the Federal Emergency Management Agency

---

### **7. Buchanan Mine Rescue Training Facility, CONSOL Energy Inc. Grundy, VA Bailey Mine Underground Training Academy, CONSOL Energy, Greene County, PA** <http://consolenergy.com>

Formerly the central maintenance shop of Island Creek Coal Company, the Buchanan mine rescue team began converting this building into a uniquely purposed, all-weather mine rescue training facility in 2007. It is privately owned and not available for public use. The most unique feature in this facility is the indoor

## Inventory of U.S. Mine Rescue Training Facilities that Support Coal Mine Rescue Training

mine rescue twin practice fields that are each 3 entries wide and 5 entries deep. The practice fields have coal blocks painted on the floor that are 4 × 5 m (14 × 16 ft.) wide. This area is large enough to allow two teams to practice for contests simultaneously. Being able to utilize this field all year long and during bad weather creates an efficient training schedule. This facility also includes a 33.5-m- (110-ft)- long smoke maze, where team members explore and navigate around obstacles in a simulated mine environment in which vision is highly compromised. Other features of this facility include a mine rescue equipment and benching room, first aid station, multiple classrooms (annual eight-hour refresher, electrical, smoke and new miner training, as well as other specialized training) and creative mine rescue artwork. Specialized fire fighting and foam training are not currently conducted at this site.



*CONSOL Central Appalachian Mine Recue Facility  
Image credit: [Virginia Coal Trail](#)*



*CONSOL Energy Buchanan Black Mine Rescue Team;  
Image credit: CONSOL Energy*

CONSOL Energy opened its new Underground Training (BMX) Academy in March 2012<sup>7</sup> in Greene County, Pennsylvania. The underground training facility is the first underground coal mining training facility in the United States. CONSOL projects that 350 miners will complete their training at the new facility by December of 2013. The first group to complete the program was CONSOL Energy's frontline supervisory workforce. In addition to two fully-equipped classrooms where students are provided on-the-job technical and hazard awareness training designed to improve their safety performance and compliance skills, the BMX Academy features a fully operational underground section of the Bailey Mine dedicated solely to the training and development of CONSOL mining employees. This aspect of the training provides hands-on equipment training in a controlled environment by experienced CONSOL employees. Over the course of the five day program employees are trained to operate a continuous mining machine, a miner bolter machine, a loading machine, a shuttle car and a section scoop. Attendees learn section standards and train using a structured, step-by-step process under the direction of CONSOL instructors who individually have over 30 years of safe and successful underground experience. The new BMX academy does not support specialized mine rescue team training at this time, but does provide self-escape and self-rescue as part of its miner, MERD exercises, and command center training activities.

---

### **8. Missouri University of Science and Technology Experimental Mine (MS&T)**

(Formerly University of Missouri (UMR) Experimental Mine) Rolla, Missouri

<http://mining.mst.edu> and <http://mining.mst.edu/research/depexpmine/>

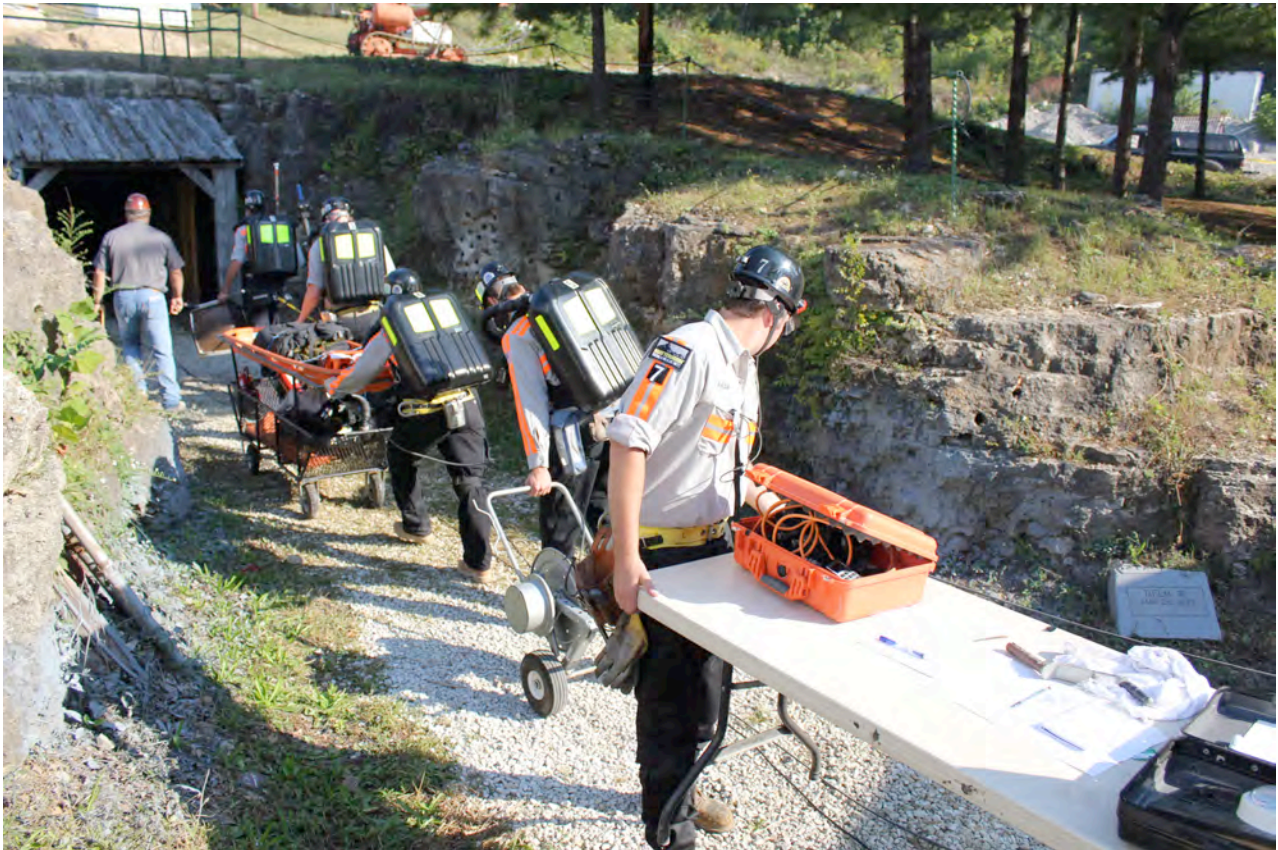
---

<sup>7</sup> Profile based on press release: <http://www.prnewswire.com/news-releases/consol-energy-unveils-the-countrys-first-underground-training-academy-219810211.html>

## Inventory of U.S. Mine Rescue Training Facilities that Support Coal Mine Rescue Training

The MS&T Experimental Mine is a real underground limestone mine and quarry originally developed for use by Missouri S&T's department of mining engineering for experiments, education and research. Located just minutes away from the University's main campus, the Experimental Mine includes a classroom extension to the mine office building along with a fourth shaft, a second underground mine for research purposes, two surface sites for blasting research and mining equipment. Also, in 2010 ground was broken for construction of a new mine building to house three new laboratories, mine rescue and mucking stations, separate mine dry houses for men and women, three new classrooms, offices, warehouse space, and a historic center for the mining industry.

Although the facility is primarily for university students, mine rescue teams in Missouri come to the Experimental Mine for practice and training as well. Additionally, MS&T, alongside MSHA officials, hosts a metal/nonmetal mine rescue contest every year, which takes place inside the underground mine, opposed to an outdoor open field or indoor floor. Students on the mine rescue team use the Experimental Mine to practice real life scenarios and compete against industry teams from across the nation. The training and mine rescue training at this facility is primarily oriented to metal/nonmetal and not coal.



*Training at the MS&T Research Mine. [Image credit: MS&T](#)*

The facility also has the ability for navigation in smoke training and training with live fires, but in most cases the training is limited to not under air (breathing apparatus) due to its cost, with the exception of putting a new team member under air just to be sure they are not claustrophobic.



## Inventory of U.S. Mine Rescue Training Facilities that Support Coal Mine Rescue Training

Students go through general mine health and safety courses before they can be a part of the student mine rescue team, similar to what an actual miner would go through. Students learn through mining safety courses, reinforced through activities in the Experimental Mine. Students train in a realistic environment, with scenario-based training models, using real equipment and have local EMTs and Fire Department personnel come out to the facility to assist in trainings so it is as real as possible. Most of the students on mine rescue teams also complete a drilling and blasting class.

Research Labs include:

- Experimental Mine
- Explosives Research Lab
- Mineral Processing Lab
- Mine Ventilation Lab
- Rock Mechanics and Explosives Research Center
- Waterjet Propulsion Lab
- Interdisciplinary Research

---

### 9. Rend Lake College (RLC) Coal Mine Training Center and Mine Rescue/ Fire Training Facility

Rend Lake Community College, 468 N. Ken Gray Parkway, Ina, IL 62846

<https://www.rlc.edu/asat/mining-technology>

The Rend Lake College's Coal Mine Training Center opened in the fall of 2009, with the Mine Rescue and Fire Training Facility following in 2010. The Center is often used for mine rescue and training drills for several occupational certificates and degrees for RLC students, and attracts students and miners from across the nation to learn and practice on-the-job safety and skills. The training facility is a 30-by-61 m (100-by-200 ft.) steel building that includes classroom and office space, coal mining equipment, and a small simulated mine. The north half of this facility is designed to resemble an underground coal mine for a variety of training purposes.



*Coal Mine Training Center at Rend Lake College.  
Image Credit (both images): RLC*



*Miners training on how to approach a large fire in the fire tunnel.*

The simulated mine is a metal building built on concrete slab and is approximately 10,000 sq. ft., with 4 entries and 4 crosscuts, removable walls, and a smoke machine to simulate limited visibility. Representative of a trend across several of the facilities, The RLC features removable walls that can be rearranged to suit specific training needs and MERD scenarios. There is also an outside area where fire safety training is performed with the unique advantage of using local fire fighters as instructors so students can learn from experienced professionals. The facility is open to the community, college students and any organization wanting to use it. Trainees from as far as Wyoming have travelled to Ina to use this state-of-the-art space.

### 10. Kentucky Coal Academy Mine Emergency Response Academy (KCA MERA)

Madisonville Community College, 2000 College Drive, Madisonville, KY 42431

<http://coalacademy.kctcs.edu/>

Located on the former Madisonville Community College technology campus, MERA is considered by many in the coal industry as a “one-of-a-kind” mine rescue facility. Having a state-of-the-art training facility for coal mine firefighting has filled a need in the mining community of western Kentucky. After years of planning and preparation, the Kentucky Coal Academy and Madisonville Community College were able to meet that industry need with the opening of MERA (Mine Emergency Response Academy) on March 25, 2011.

Because underground fires are unique in nature, MERA offers the opportunity to undergo intense training in an almost-real environment. Those who experience MERA training will become more familiar with the nature of an underground fire and will develop the necessary skills and experience to efficiently and effectively respond to them. MERA offers state-of-the-art training to coal miners on how to react to and extinguish fires erupting in confined spaces.

MERA contains a class “A” burn room that can be used by any fire department needing training for structure fires. Additionally, the simulated mine has a burn prop located inside the mine. Fighting this type of burn provides the necessary skills and tools to control and extinguish real mine fires. The Kentucky Coal Academy has also developed and improved three aboveground simulator mines as well as the nationally known Portal 31 Exhibition Mine.



*Fire Brigade Training at the Kentucky Coal Academy. . KCA provides mine rescue services across east and west Kentucky.  
Image credit: Kentucky Coal Academy*



*Tethered for safe, realistic exercises, the KCA mine rescue teams include miners from Advent Mining, Armstrong Coal, Ken American Resources, and Pleasant View Mining.*

---

### 11. Alabama Mine Training Consortium (AMTC)

Bevill State Community College, Sumiton, AL <http://www.bscc.edu/mining/>

The AMTC, located on the Bevill State Community College Sumiton Campus, offers a wide array of services to miners and mining companies seeking training certification. This facility is available for public use.

AMTC offers the following services:

- Mine Rescue Training
- New Miner Training (surface and underground)

## Inventory of U.S. Mine Rescue Training Facilities that Support Coal Mine Rescue Training

- Annual Refresher Training
- CPR/First Aid Certifications
- Impoundment Training
- MSHA Electrical Certification
- Underground Diesel Regulation Training (MSHA)
- State Underground Fireboss and Mine Foreman Certification Training
- Hazard Communications

A simulated mine consisting of 4 entries, 4 crosscuts, an overcast, beltline, and power center; a fan is used to conduct smoke training and firefighter training using foam for mine rescue teams. The Mine Emergency Command Center Training is conducted every two years and involves upper management from underground mines in the state. AMTC also involves MSHA and the State Department of Mine inspections in their command center training.



*AMTC Mine Emergency Command Center training facility (top left). Various types of gas detectors (bottom left). CO monitor inside the simulated mine. Credit for all three images: AMTC*

The Mine Emergency Command Center Training (MECCT), which was under construction in 2009, is now fully functional. MECCT fills a safety gap for underground coal mines in Alabama by providing training to mine emergency command center personnel. The training makes a positive contribution to the MSHA program goals of creating more effective training and training materials to improve safety.

Training is provided through a simulated command center that MECCT established at the College's underground simulated mine. Command center staff conduct a real-time disaster scenario in conjunction with the mine's mine rescue teams or state-sponsored rescue teams, who can receive their required annual

in-smoke training. This training brings together two partners of a mine rescue operation who have not trained together previously. Training also involves, where appropriate, the mine's safety director and staff in engineering, human resources, and public relations to train them in their roles during a crisis. Training involves seven-hour sessions, with the day starting with two hours of classroom instruction, followed by a four-hour simulation. The simulation requires the command center team to manage numerous variables, including instructional staff to simulate the chaos of a mine emergency. Scenarios are created so that each mine utilizes their own mine maps in the command center to make the training as authentic as possible. The team then spends the last hour of their training in a debriefing session to discuss positives and areas needing improvement.

Some of the unique strengths of this mine rescue training center are

- They have been in existence since 1980.
- At least one member of the AMTC staff has been involved with every rescue and recovery in Alabama.
- The AMTC staff has a good working relationship with all mine operators in Alabama.
- The AMTC serves as the home base for two mine rescue teams.

---

## 12. Colorado School of Mines

**Mine Safety and Health Program (MSHP)** <http://mshp.mines.edu/MSH-underground-SaR>,

**Edgar Experimental Mine** <http://inside.mines.edu/Mining-Edgar-Mine>

365 Eighth Avenue, Idaho Springs, CO 80452

The Colorado School of Mines (CSM) Mine Safety and Health Program (MSHP) was established in 1997 as a training resource serving the western states. The specific objectives for the MSHP during its most recent funding cycle (2010-2014) are to (1) reduce injuries and illnesses in mining operations through a focused and comprehensive training program that educates mine workers on how to best protect themselves from risks and hazards in the mining environment, and (2) to expand the number of qualified mine safety and health trainers in the United States. MSHP receives funding primarily from NIOSH and MSHA; these funds are supplemented with donations from industry and user fees.

The mine rescue training program offered by CSM is applicable to both underground and surface coal and metal/nonmetal mines, and offers several courses that focus on acquiring competence in communication and decision-making skills, as well as basic/advanced rescue skills relevant to mine emergencies. The training courses can be taken as stand-alone courses or combined for a comprehensive training experience and can be adapted to meet specific training needs of a mine site.

Specific courses include:

- Underground mine rescue exercises for one to three teams
- Technical rope rescues (high/low angle operations) that are compliant with NFPA Standards 1006 and 1670
- Heavy lifts using air bags
- Confined space entry and rescues
- Fire fighting and burn building exercises
- Computer mine rescue simulation exercises
- Dräger BG4 operations and maintenance
- Incident command center operations
- Construction of stoppings using a variety of materials, including Kennedy steel stoppings
- Extraction of multiple victims from a rescue chamber

- First aid and victim packaging



*Mine rescue team members preparing to lift a piece of equipment using air bags, and exiting the Edgar Mine with a victim after completing a rescue exercise. Image credit: Colorado School of Mines*

The mine rescue computer simulator is a portable system consisting of four laptop computers (three team computers and one instructor station) operated with game controllers. There are two mine models, a generic coal mine model and the Edgar Mine model (metal). If the rescue problem utilizes the Edgar Mine model, then after the simulator training is completed the same problem can be conducted underground allowing the students to experience the physical requirements of the exercise. The computer simulator allows for customized scenarios to include a variety of hazards, numerous victims, and varying levels of smoke, and it supports real-time scenario modifications and documentation of the rescue team route. The main advantage of the computer simulator is that it provides effective communication and decision-making training for mine rescue teams and incident command center staff. It can also be utilized to train mine rescue practices and procedures to novice teams.

In addition to mine rescue training, CSM also participates in research projects to benefit the entire mine rescue community. CSM has developed an ultra-light aluminum mine rescue stretcher cart, supported a project developing a through-the-earth text and voice communication system, and is currently developing techniques for utilizing a steel structural support system during mine rescue responses.

The CSM staff includes six professional trainers, who have numerous professional certifications including: MSHA-approved Part 48 surface and underground, MSHA-approved mine rescue, EMT Basic, Certified Mine Safety Professional, Certified Industrial Hygienist, Certified Professional Ergonomist, and Professional Engineer in Mining Engineering. CSM instructors are also qualified to teach NFPA technical rope and confined space rescue, as well as Red Cross first aid and CPR. The CSM staff also includes six undergraduate students, who are members of the CSM mine rescue teams.

The Mining Engineering Department supports three student mine rescue teams. Participating on mine rescue teams provides an excellent training opportunity for students, who will work at mine sites and participate on professional mine rescue teams following graduation. The three CSM teams complete approximately 2,000 training hours during a school year with over half of it at the Edgar Mine. Their training also includes participation in a regional mine rescue contest and a biennial collegiate MERD held at the Edgar Mine. Some of these students also train with professional mine rescue teams when completing internships during the summer break.

## Inventory of U.S. Mine Rescue Training Facilities that Support Coal Mine Rescue Training

The Edgar Experimental Mine, which once produced high-grade silver, gold, lead and copper in the 1870s, is a unique facility that has been used for training, education, and research for nearly 95 years. The Mine has both underground (equipped with Wi-Fi) and surface classrooms, advanced communications and ventilations systems, rubber-tired and rail sections, multiple raises and simulated production stops. The Mine has two miles of underground workings, multiple cross section entries, and an extensive confined space maze. A state-of-the-art MineArc 20-person built-in-place refuge chamber with a fully functional CO2 scrubber and a Jack Kennedy 12-person portable refuge chamber are used to train rescue teams and refuge chamber use.

The surface classroom includes a rebreather lab with an oxygen cascade system, bench testing equipment, dryer, and multi-gas testing instruments. Complete sets of Dräger breathing apparatus, vertical rope rescue/confined space equipment, supplied air system, ultra-light rescue carts/stretchers, and airbag heavy lifting equipment are available for mine rescue training. Five artificial (non-toxic) smoke generator machines can produce smoke to fill small areas of the mine or the entire mine. Ground control and ventilation control materials are provided to construct roof support, stoppings, barricades, and/or airlocks.

Onsite firefighting training can be conducted underground using a BullEx fire extinguisher training system. Above ground, firefighting training can be conducted using a large liquid fuel burn pan that can generate medium size fires. Additional surface propane firefighting props for larger fires will be available in the near future. CSM also has partnerships with several local fire departments for using their training facilities to conduct additional specialized fire training that may be needed.

Because the Edgar Experimental Mine is an authentic mine, very little simulation is needed to create realistic mine emergency training conditions. Mine rescue instructors strive to prepare teams for a wide range of mine emergency events and tailor training exercises to the specific needs of the mine rescue teams.

### **Other Facilities - Currently Closed**

**Lake Lynn Experimental Mine**, Fayette County, PA.

**Western Energy Training Center (WETC)**, College of Eastern Utah, Helper, UT

---

## DISTINGUISHING FEATURES OF U.S. COAL MINE RESCUE TRAINING FACILITIES



*CSM Silver Team develops a plan to extract patients from the mine refuge chamber. Image credit: 2013 Collegiate MERD at Idaho Springs, CO*

During this inventory research of twelve mine rescue training facilities several themes emerged as trends observable across all of the centers. Here are seven themes that we identified. These themes are also highlighted in the summary tables that follow in Appendix A.

*Partnership with higher education:* With the exception of the two government facilities, training center professional development is positioned within a higher education context, either a university or community college, so that the training provided can be associated with an associates degree, certification, or bachelor degree. Another exception to this rule is the MTTC facility, which is not based on a campus, but is strategically based to provide accredited training for mine union members. Nearly all of the facilities described certificates, certifications, courses, and degrees that were associated with the mine rescue training programs.

*Cross-training:* The mine rescue training facilities associated with universities offered opportunities for mining engineering students to serve on mine rescue teams and complete mine rescue training as part of their degree programs. In many cases these academic mine rescue teams completed one or more

courses at the mine training simulated mine facility as part of their program electives. These teams participated in mine rescue team competitions, but individuals ultimately would not be eligible to continue mine rescue team activities when fully employed as a mining engineer at a production facility.

*Integration of advanced health and safety training:* In nearly all of the mine rescue training programs facilities are offering and encouraging team members to have advanced health training such as the emergency medical technician (EMT) certification. This reflects the ability of the facilities to offer this advanced training and follows recommendations of advancing the practice that higher level of health and safety training is needed and advantageous for mine rescue team members.

*Greater integration of reality and authenticity into training:* The previous mine rescue training facility research (Bealko, 2009) recommended that team training be more based on MERD exercises. All of the facilities contacted are now doing this, and many of the training programs are adapting the MERD exercises to include data from recent mining accidents—especially as related to mine fires, explosions, ventilation control, and ground control issues, which are the most frequent causes of mine tragedies (involving the death of five or more miners).

*Configurable and portable training:* The technology to support mine rescue team response to mine accidents is now being used in more innovative and adaptable ways to support the use of scenario-based training. WVU E&O, MTTC, SWVCTC, and RLC facility staff described examples of the configurable training strategies they use. MTTC uses computer laptops with a scenario based game, built just for a particular client, and then takes this computer-based simulation on the road to the client so the training is done at client's facility. The MSHP mine rescue team described their latest approach that includes taking portable equipment with them and offering command center training at the mine facilities. This is one strategy that greatly helps getting mine management involved in the mine rescue training exercises.

*Company-based mine rescue training:* Much of the scenario-based mine rescue training can be adapted and with up-front planning can be offered at the mine site. Being able to offer “portable training” is an excellent alternative that allows trainers to use the authentic mine context, include upper management in the command center training, and use the equipment, procedures, and landscape of the actual production mine for the contextual training.

*Computer-based training shifts towards virtual reality and gaming:* Many of the facilities are incorporating desk-top and immersive virtual reality training technologies that allow trainees to work through different levels of mine emergency scenarios. The NIOSH Bruceton Research Center is leading research applications of the virtual reality training technologies to determine: (a) How well mine rescue teams learn in this environment, and (b) If the mine rescue teams view this area as a valuable training tool. The objective of this project is to identify the optimal use of virtual reality (VR) technologies for training and assessing mine emergency responders. Responders include specially trained individuals, such as mine rescue or fire brigade team members, and also managers and miners who may be called upon to respond to an emergency situation. Self-protective actions are also considered responses. The NIOSH facility has a fully immersive virtual reality theatre, which actually puts people into gear and simulates environment. Several of the mine training facilities describe their use of a variety of virtual reality levels from a computer game-based context to the fully immersive virtual reality 3D. Further research would help trainers understand when to use which technology to help mine rescue teams gain the greatest skill and knowledge for application in a crisis situation.

In contrast to the NIOSH virtual reality training technologies, the MTTC facility has developed a computer-based game, which is used to make the introductory skill and content training more engaging. The game is scenario-based and prepares the trainees for the fully engaging, MERD exercises that are designed to further prepare the mine rescue teams for application of skills and knowledge in emergency scenario contexts set up within their own simulated mine facility.

## **NOTABLE IMPROVEMENTS IN MINE RESCUE TRAINING FACILITIES**

*This section describes the extent to which the recommendations and plans for enhanced services identified in the 2008 study were fulfilled. Tables 1 and 2 provide summary descriptions of how each of the 12 facilities responded to their specific goals and objectives as well as to the five needs identified in the previous study (presented on page 3).*

The shift to integrate mine rescue skills and knowledge training into an academic setting has led to more rigorous certification opportunities. The increased offering of EMT as part of the health and safety training is an example of this. The increased use of MERD exercises and a reality focus in the training suggests that mine rescue training professionals can benefit by closer ties with academic, government, and industry researchers who are identifying new technologies, methods, and practices to improve mine safety practices. These ties are especially useful in the areas where the most common and most dangerous accidents occur.





*The above image shows miners learning hose stream practices to suppress fire and utilize mine ventilation for rescue tasks. Image credit: SWVCTC*

Recommendations from other NIOSH-funded research may be relevant to mine rescue training programs and technologies. Here is an example of how recent NIOSH research has improved mine rescue techniques and related fire fighting training. A study by Smith, Fredley, Lauriski, and Thimons (2009) showed that fire-blocking gel can be an effective addition to mine firefighting techniques through

end-of-hose education, this technology is now incorporated into mine rescue advanced fire fighting training as shown above in the image provided. *The Multiple-Seam Mining Interactions in Underground Coal Mines: Regulations and Technical Studies* report by Yi Luo and Gary L. Winn at West Virginia University (<http://mistti.cet.edu/research.html#multiple-seam>) suggests that more case study research is needed to refine the underground subsidence modeling system these researchers have developed. Perhaps the academic mine rescue stations that have access to underground mines for simulated mine rescue training exercises could contribute to this area of research by building physical models for testing as part of a mine rescue skill and knowledge building training activity. This suggestion would have to be given careful consideration by a collaborative group that includes researchers, trainers, and mine rescue team members.

## SUMMARY AND RECOMMENDATIONS

Mine rescue training is critical and has the on-going challenge of staying up to date with the technology enhancements to mining production. This challenge could be addressed by having a stronger relationship between mine rescue trainers, mine rescue facility managers, and NIOSH-affiliated technology researchers. The mine rescue team members may be the ideal groups to engage in hands-on as well as case study research regarding new technologies designed to improve the health and safety of miners.

Other areas for further research include exploring the use of mine rescue team training as first responders who can bridge the gap between virtual reality mine management tools and extensive, real time data monitoring systems. Investigation of these tools may lead to greater possibilities for mine rescue teams to accurately predict and prevent explosion, compromised ventilation, and collapses in underground mines.

Each of the centers use face-to-face debriefing at the conclusion of a training program and use of individual, anonymous feedback surveys as their methods for evaluating their training services. We recommend that the training facilities consider collaborating with each other (and perhaps having occasional meetings) to develop a method for long term evaluation of mine rescue training. Ultimately it would be extremely helpful to find out from the mine rescue team members what features and components of their training were most helpful and least helpful to them when they were engaged in responding to an emergency incident in the mine.

## REFERENCES

- Alexander, D.W., Bealko, S.B., Brnich, M.J., Kowalski-Trakofler, K.M. and Peters, R.H., 2010, *Best Practices for Escape and Rescue from Under-ground Coal Mines*, Pittsburgh, PA: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH), #IC-9522 (in revision).
- Bealko, S.B., Alexander, D.W., Chasko, L.L., Holtan J., 2010a, "New simulated gas detector offers realistic training for mine rescue teams," *13th United States/North American Ventilation Symposium*, 2010, Hardcastle & McKinnon (eds.) © MIRARCO, June 2010.
- Bealko, S.B., Alexander, D.W., Chasko, L. L., & Grayson, R.L. (2009) Society of Mining Engineers (SME) Annual Meeting and Exhibit, February 22-25, Denver, Colorado, preprint 09-101. Littleton, CO: Society for Mining, Metallurgy, and Exploration, Inc., 2009:1-7
- Holtan, J., 2010, "Develop a miner confined space entry and evacuation training program incorporating real-time gas detection simulation, scenarios, and theoretical E-Learning," Final Report, Lights On Safety Solutions, NIOSH Contract Number 200-2009-32458, Pittsburgh, PA, August 2010, available at <http://lightsonss.com/category/publications/>.
- Luo, Y. and Winn, G., 2013, Multiple-Seam Mining Interactions in Underground Coal Mines: Regulations and Technical Studies. Contractor report to MISTTI.
- Mine Safety Technology and Training Commission, 2006, "Improving mine safety technology and training: establishing U.S. global leadership," December 2006, pp. 55-77.
- MSHA, Mine Safety and Health Administration, MSHA's Mine Rescue Contest Home Page, <http://www.msha.gov/MineRescue/CONTEST.htm>
- MSHA, Mine Safety and Health Administration, MSHA's PhotoGallery, From the Assistant Secretary's Desk: Alpha Training Center. Downloaded from: <http://www.msha.gov/FromtheDesk/FromtheDesk6282013/PhotoGallery6282013.asp>
- MSHA, Mine Safety and Health Administration, Mine Simulation Laboratory. Downloaded from: <http://www.msha.gov/PROGRAMS/EPDMSL.HTM>
- Smith, Fredley, Lauriski, and Thimons (2009). Available for download at: <http://www.cdc.gov/niosh/mining/UserFiles/works/pdfs/eoanfb.pdf>
- U.S. Department of Labor, Mine Safety and Health Administration. (2013). Advanced Skills Training (AST): Activities for Coal Mine Rescue Teams. Instruction Guide Series IG 7a. DRAFT. Downloaded 26 September 2013 from <http://www.msha.gov/MineRescue/Training/TeamTraining.asp>



TABLE 1

	1. OMSHR	2. MTTC	3. WVU E&O	4. RRLA	5. SWVCTC	6. MSHA MSL	7. CONSOL	8. MS&T	9. RLC	10. KCA MERA	11. AMTC	12. MSHP
Rescue and fire fighting equipment	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Roof and rib control	Research	Yes	No	Yes	Yes	At Academy	Yes	Yes	Yes	No	Yes	Yes
Shoring and cribbing standing support	Research	Yes	Yes	Yes	Yes	At Academy	Yes	Yes	Yes	No	Yes	Yes
Sources of ignition	Research	Yes	Yes	Yes	Yes	At Academy	Yes	Yes	Yes	Yes	Yes	Yes
The Importance of adequate rock dusting	Research	Yes	Yes	Yes	Yes	At Academy	Yes	No	Yes	Yes	Yes	Yes
Equipment safety	Research	Yes	No	Yes	Yes	At Academy	No	Yes	Yes	Yes, in virtual reality training	Yes	Yes
Electrical dos and don'ts	Research	Yes	Yes	Yes	Yes	At Academy	No	Yes	Yes	Yes	Yes	Yes
Advanced First-aid and life support	No	Yes	Yes	No	Yes	No	No	Yes	Yes		No	Yes
Hands-on equipment labs	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Training simulator	Research	Game type	Yes, Digital BullEx System	Yes	Yes	No	No	No	No	Yes	Yes	Yes
3D Simulator	Research	No	No	Yes	Yes	No	No	No	No	Yes	Yes	No
Management training for mine emergency response	No	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
International miner training	No	Yes	Yes	No	Yes	Yes	No	No	No	No	Yes	Yes
New miner training	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Refresher training	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Self-escape simulation & scenario training	Research	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Industry certifications, transferable to academic credit hours	No	Yes	No	Industry certifications, not transferable	Yes	No	No	No	Yes	Yes	Yes	No

TABLE 2

<i>Facility</i>	<i>The need for more emergency response preparedness training?</i>	<i>A disparity in standardization of skills and equipment?</i>	<i>incident command shortfalls between teams and the command center?</i>	<i>the desire for more realism for mine rescue contests and rules?</i>	<i>a shortage of available mine rescue training facilities?</i>
<b>1. OMSHR</b>	Initiating research to explore use of VR as an alternative training media	Support multi-disciplinary research to provide the technical and scientific basis for improvements in conditions, work systems and technologies.	Initiating research to explore use of VR as an alternative training media	Initiating research to explore use of VR as an alternative training media	The Spokane OMSHR researchers track trends in mining injuries, fatalities, and disease and conducts hazard surveillance concerning the use of new technologies in the mining industry
<b>2. MTTC</b>		Addresses learning objectives for skill, ability, and decision-making w/o investment in specific mine equipment	Working hard to get leadership involved in MERD exercises	Using computer-based games to get individuals and teams started on learning the basics and getting useful experience before starting the MERD	
<b>3. WVU E&amp;O</b>	Partner with area mining industries to identify training needs			Finding ways to make scenarios for emergency response more realistic and inclusive of interacting multiple problem sources	
<b>4. RRLA</b>		Create a training facility that features the most current technology tools for mining production and integrate these into mine rescue and safety training			This is a new facility established to address mine safety shortfalls.
<b>5. SWVCTC</b>	Continuing to add training based on needs assessments with coal industry	Developing a mine management education program that includes certifications that are transferable for academic credit	Working with mine management in advance to address mine-specific needs in exercises	Requiring coal companies to include their MERD preparedness plan for auditing as part of the command center training exercises	Conducting an increasing number of training programs; Making the facility available 24 hours per day, 7 days a week.
<b>6. MSHA MSL</b>		Work with outstanding trainers in the field to create MERD and command center training activities that are realistic rigorous	Making realistic and meaningful instructional materials available for free download on the web--in module format		
<b>7. CONSOL</b>					Enhancing miner training capabilities at the work site
<b>8. MS&amp;T</b>				Integrating mine rescue training skills, knowledge, and contest experiences and part of mining engineering curriculum	

TABLE 2

<i>Facility</i>	<i>The need for more emergency response preparedness training?</i>	<i>A disparity in standardization of skills and equipment?</i>	<i>incident command shortfalls between teams and the command center?</i>	<i>the desire for more realism for mine rescue contests and rules?</i>	<i>a shortage of available mine rescue training facilities?</i>
<b>9. RLC</b>		Encourage mine rescue training facilities to include walls and other structures that can be rearranged to suit specific training needs		Incorporate the expertise of local professionals--like fire fighters who have many years of experience	
<b>10. KCA MERA</b>	Integrating the resources of a mine rescue station with the goals of a mine rescue training facility				
<b>11. AMTC</b>				Integrating mine rescue training skills, knowledge, and contest experiences and part of mining engineering curriculum	
<b>12. MSHP</b>		Working collaboratively with local emergency response teams and facilities	Going to mine site rather than requiring teams to come to the training facility for command center training		Going to mine site rather than requiring teams to come to the training facility for command center training