NIOSH Self–Escape and Mine Rescue
TRAM 2016

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Topics

• Overview of current self-escape research

• Required self-escape competencies

• Existing gaps in training, assessment and performance of critical self-escape competencies

• The role of the responsible person (RP)

• How can you get involved?
Post MINER Act: How are we doing?

Series of industry reports
(e.g. MSHA, MSTTC, NIOSH, NRC) 2006 - 2015

Critical need for
1) Evaluation of competencies
2) Improved training methods
3) New training content

“...despite training developments done by NIOSH, MSHA, some universities and some mine operators on the quality and quantity of escape training, there is still room for improvement to ensure that all mine personnel can effectively escape a mine emergency. This conclusion applies to almost every aspect of escape behavior training... (NRC, 2013, p. 99).
What can we do?

- What knowledge, skills, abilities, and other attributes (KSAOs) do miners need to self-escape?

- What do they know?

- Are there gaps in KSAOs?

- What can we do to fill those gaps?
<table>
<thead>
<tr>
<th>Specific Aims and Main Research Tasks</th>
<th>FY15</th>
<th>FY16</th>
<th>FY17</th>
<th>FY18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aim 1: Characterize the components of the mine emergency escape system</td>
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<tr>
<td>1.1 Conduct task analyses and create competency profiles</td>
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<tr>
<td>1.2 Study the role of responsible person</td>
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<td>1.3 Study communication and tracking systems</td>
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<td>1.4 Study decision-making under stress</td>
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<tr>
<td>Aim 2: Mine escape KSAO competency needs analysis</td>
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<tr>
<td>2.1 Measure current perceived self-escape KSAO competence</td>
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<td>2.2 Literature review/summary of training/competency gaps</td>
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<tr>
<td>2.3 Identify best practices in competency assessment</td>
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<td>2.4 Evaluate existing NIOSH emergency response training</td>
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<td>Aim 3: Synthesize and disseminate results</td>
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<tr>
<td>3.1 Provide evidence-based guidelines to the mining industry</td>
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<tr>
<td>3.2 Develop topic concept for further study based on results</td>
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<tr>
<td>Aim 4: Create modifiable immersive mine environment(s)</td>
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<tr>
<td>4.1 Plan simulated mine environment</td>
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<tr>
<td>4.2 Develop simulated mine environment</td>
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<tr>
<td>4.3 Test/validate simulated mine environment</td>
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</tbody>
</table>
Context of Current Work

Analysis: Characterization of escape system components
- Task Analyses **
- Role of Responsible Person**
- Communication and Tracking
- Decision Making Under Stress

Evaluation: Training needs assessment/gap analysis
- Literature Review
- Self-Escape Competency Survey**
- Existing NIOSH Training

Design, Development and Implementation: FY19:
- Constructs of interest/learning objectives**
- Types of materials/media selection
- Evaluation methods
- Goal statements
- Design document/functional specs

Systems Approach to Training
What KSAOs do miners need?

Preliminary Task Analysis (PTA)

• 2 underground coal mines
• 4 emergency scenarios
• 4 miner roles
• 23 general task areas (e.g., communications, SCSR, lifeline)
• 146 self-escape tasks
• 36 “critical” tasks
What are the gaps?

Survey Research
## What do miners know?

<table>
<thead>
<tr>
<th>Question</th>
<th>% confident</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Your mine’s emergency response plan (ERP)</td>
<td>N/A 0 10 20 30 40 50 60 70 80 90 100</td>
</tr>
<tr>
<td>2. The chain of command for reporting a mine emergency</td>
<td>N/A 0 10 20 30 40 50 60 70 80 90 100</td>
</tr>
<tr>
<td>3. The location of your mine’s primary and secondary escapeways</td>
<td>N/A 0 10 20 30 40 50 60 70 80 90 100</td>
</tr>
<tr>
<td>4. Where your mine’s escapeway maps are located</td>
<td>N/A 0 10 20 30 40 50 60 70 80 90 100</td>
</tr>
<tr>
<td>5. How to read a mine map (mine map symbols)</td>
<td>N/A 0 10 20 30 40 50 60 70 80 90 100</td>
</tr>
<tr>
<td>6. Where to report in the event of a mine emergency</td>
<td>N/A 0 10 20 30 40 50 60 70 80 90 100</td>
</tr>
<tr>
<td>7. Lifeline symbols</td>
<td>N/A 0 10 20 30 40 50 60 70 80 90 100</td>
</tr>
<tr>
<td>8. If or when to fight a fire</td>
<td>N/A 0 10 20 30 40 50 60 70 80 90 100</td>
</tr>
<tr>
<td>9. How to fight a fire</td>
<td>N/A 0 10 20 30 40 50 60 70 80 90 100</td>
</tr>
<tr>
<td>10. How to identify an explosive atmosphere with a gas meter</td>
<td>N/A 0 10 20 30 40 50 60 70 80 90 100</td>
</tr>
<tr>
<td>11. Your own role in your mine’s emergency response plan</td>
<td>N/A 0 10 20 30 40 50 60 70 80 90 100</td>
</tr>
<tr>
<td>12. Where your mine’s SCSR caches are located</td>
<td>N/A 0 10 20 30 40 50 60 70 80 90 100</td>
</tr>
<tr>
<td>13. When to don a SCSR</td>
<td>N/A 0 10 20 30 40 50 60 70 80 90 100</td>
</tr>
<tr>
<td>14. How to properly don a SCSR</td>
<td>N/A 0 10 20 30 40 50 60 70 80 90 100</td>
</tr>
</tbody>
</table>

How confident are you that you could correctly demonstrate or explain the following to a new miner?
Survey Feedback Example

How confident are you that you could correctly demonstrate or explain the following to a new miner?

- How to properly don a SCSR
- Explain where to report in a mine emergency
- Explain my mine's emergency response plan

average % confident

50 60 70 80 90 100
Is everyone at the same level?

How confident are you that you could demonstrate or explain the following to a brand new miner?

- Properly don a SCSR
- Explain where to report in a mine emergency
- Explain your mine’s emergency response plan

% of total responses

- 100
- 90
- 80
- 70
- 60
- 50
- 40
- 30
- 20
- 10
- 0
What about individual factors?

<table>
<thead>
<tr>
<th>Age:</th>
<th>18-24</th>
<th>25-34</th>
<th>35-44</th>
<th>45-54</th>
<th>55-64</th>
<th>65+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are you:</td>
<td>Male</td>
<td>Female</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are you?</td>
<td>Salary</td>
<td>Hourly</td>
<td>Contractor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time in current job:</td>
<td>Less than 1 yr.</td>
<td>1-5 yrs.</td>
<td>6-10 yrs.</td>
<td>10-15 yrs.</td>
<td>15-20 yrs.</td>
<td>20+ yrs.</td>
</tr>
<tr>
<td>Time in mine industry:</td>
<td>Less than 1 yr.</td>
<td>1-5 yrs.</td>
<td>6-10 yrs.</td>
<td>10-15 yrs.</td>
<td>15-20 yrs.</td>
<td>20+ yrs.</td>
</tr>
<tr>
<td>Time with current mine:</td>
<td>Less than 1 yr.</td>
<td>1-5 yrs.</td>
<td>6-10 yrs.</td>
<td>10-15 yrs.</td>
<td>15-20 yrs.</td>
<td>20+ yrs.</td>
</tr>
<tr>
<td>Work group:</td>
<td>Production</td>
<td>Maintenance</td>
<td>Safety</td>
<td>Engineer</td>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>Primary work location:</td>
<td>Working Face</td>
<td>Outby</td>
<td>Surface</td>
<td>Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General work schedule:</td>
<td>Set (start at the same time every day)</td>
<td>Varies (start at different times)</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Family mining history:</td>
<td>First generation mineworker</td>
<td>Multi-generation mineworker</td>
<td>(parents/grandparents are/were mineworkers)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education level:</td>
<td>Less than High School</td>
<td>High School</td>
<td>Trade</td>
<td>Associate’s Degree</td>
<td>Bachelor’s Degree</td>
<td>Master’s Degree</td>
</tr>
<tr>
<td>In general, what percentage (%) of your time at work is spent underground?</td>
<td>0%</td>
<td>10%</td>
<td>20%</td>
<td>30%</td>
<td>40%</td>
<td>50%</td>
</tr>
</tbody>
</table>
What can be learned?

• Are underground mineworkers confident in their ability to respond to a mine emergency?

• What critical KSAOs appear to be lacking?

• Where should we focus our efforts?

• Are there relationships between age, experience, position, motivation, etc. and confidence in self-escape KSAOs?
PITTSBURGH MINING RESEARCH DIVISION

The Responsible Person

Lead Researcher:
Blaine Connor, PhD
BConnor@cdc.gov
Why have Responsible Persons?

• Responsible Person
  – Takes charge of coal mine emergency response before others arrive and establish a command center

• Origin
  – Fatalities at Jim Walter’s No. 5 Mine, Alabama 2001

• MSHA mandated RP in order to
  – Achieve more effective initial response
  – Avoid risk of greater loss of life
30 CFR Part 75.1501 (Coal)

- The responsible person must have
  - current, mine-specific knowledge
  - annual training in mine emergency response

MSHA's RP training guide, IG 110 (2008)
Flexibility and Constraints

• Mines must comply, but have flexibility
  – Who to train
  – How to cover the required topics
  – Who to designate as RP on a given shift
  – How the RP coordinates with others at the mine

• Mines seek to do what’s best, but have constraints
  – Need to mine coal, not just sit in training!
  – Fewer safety trainers with less time
How can NIOSH help?

• NIOSH needs to **FIRST** understand how the industry is complying

• Preliminary fact-finding study
  – Review of RP training and other materials
  – Open-ended interviews (90-120 minutes)
    • 9 mines
    • Varying size, region, and union/non-union
    • Anonymous
How can you help?

• Software Development
  – New application ideas
  – Field test sites

• Self-Escape
  – Participate in KSAO survey
  – Receive customized feedback

• Responsible Person
  – Participate in interviews at your mine or over the phone
  – Share your RP training materials, ERPs, or experiences
References


BG 4 Benching Trainer Software
Software Features
Background

• Closed-circuit breathing apparatus are PPE used in mine rescue.
• It’s critical to understand how the device works and how the components are inspected, assembled, and tested (“benching”).
A supplement to existing training

- Hands-on training must be done routinely
- Virtual training allows:
  - Structured introduction to the unit and to benching tasks
  - Mental practice between hands-on sessions
  - Tool for introducing new team members to the apparatus
Inspecting BG 4 parts
Finding a flaw in a part
Installing BG 4 Parts
Testing the BG 4
Supports individual and group training
# Mine rescue team feedback

<table>
<thead>
<tr>
<th>% Agreed</th>
<th>Feedback Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>96.8</td>
<td>Included content relevant to mine rescue team members</td>
</tr>
<tr>
<td>90.3</td>
<td>Covered knowledge and skills needed during a real mine emergency</td>
</tr>
<tr>
<td>87.1</td>
<td>Reinforced knowledge and skills I learned during previous mine rescue training</td>
</tr>
<tr>
<td>83.9</td>
<td>Made me more confident that I could correctly bench a BG4 during a real mine emergency</td>
</tr>
<tr>
<td>67.7</td>
<td>Helped prepare me to handle a real mine emergency</td>
</tr>
<tr>
<td>71.0</td>
<td>Helped prepare me for a benching competition</td>
</tr>
<tr>
<td>93.3</td>
<td>Motivated me to learn more about benching a BG4</td>
</tr>
<tr>
<td>90.3</td>
<td>Motivated me to be generally more prepared for mine emergencies</td>
</tr>
<tr>
<td>90.3</td>
<td>Helped me learn something that could be helpful during a real mine emergency</td>
</tr>
<tr>
<td>90.3</td>
<td>Gave me new ways to think about benching a BG4</td>
</tr>
</tbody>
</table>

96% would recommend this to any mine rescue team member or mine rescue team benchmen
Where to download the software

http://www.cdc.gov/niosh/mining/Works/coversheet1877.html

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Mine Emergency Escape Training Software
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