Underground mine fire preparedness—Part 2

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Part 2 of 4—Preparedness to evacuate and miners' experiences with incipient fires

This is the second in a series of four articles that discuss underground fire fighting preparedness. As with the first article in the May-June issue, it is based on interviews with 214 miners conducted at 7 underground mines ("A" through "G") by researchers of the National Institute for Occupational Safety and Health's (NIOSH) Pittsburgh Research Center [Vaught et al. 1996]. In the first article, the authors presented an overview of the study conducted by NIOSH on mine fire response preparedness and provided a general perspective on underground mine fires. In this article, we will describe miners' preparedness to evacuate a fire and their experience with incipient fires.

Miners' evacuation experiences

Fire affects a significant proportion of miners at some time during their working lives. For instance, 180 of the respondents were asked if they had ever been notified to evacuate a mine because of fire. Almost 40% of these questioned answered in the affirmative:

> "That's been—well, a long time ago. They had a cutting machine caught on fire, but it's been several years ago. I don't know how long ago it was. They evacuated us for that."

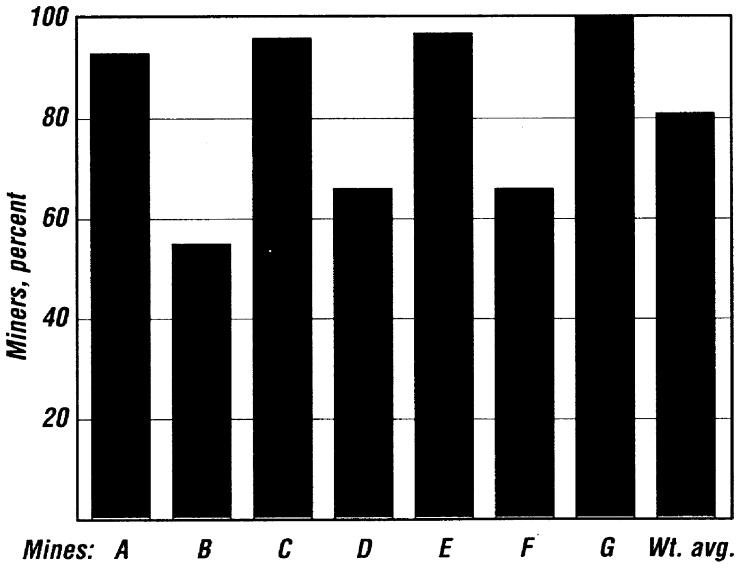
> "Yeah, it happened one time down here and that was just a few months ago. That was probably back in December. We had a hot spot back in our return. It was producing smoke and they immediately shut the mine down."

The proportion of respondents who have had to evacuate due to a fire ranged from slightly less than one-fifth at Mine E, which had a younger and less experienced workforce, to about two-thirds for mines F and G.

Considering such a potential for fire underground, it is important that miners know their escape routes and mine evacuation plan. Workers were therefore asked when they had last walked their escapeways. The percentages of miners who reported having walked their escapeway within the past year are depicted in Figure 1. The remainder reported having either walked their escapeway over a year ago, never walked it, or couldn't remember when they last walked it. Over 90% of the workers at Mines A, C, E, and G reported having walked their escapeways sometime during the previous year. For the remaining three mines (B, D and F) this percentage was less than 70%. Although rotational assignments for walking escapeways are required by regulation, it seems likely that four of the mines had such an actual practice in place while the other three did not.

Mitchell [1990] discussed escape from mine fires. He indicated that 30 CFR 57 and 75 gives the minimum standards for escapeways from U.S.

Figure 1.—Percentage of miners who had walked their escapeways within the past year



underground mines. The regulations do ***not***, however, answer questions such as: Are there immediate positive routes to safety? Are these routes likely to be contaminated by leakages or flow of fire-produced gases and tars while the fire is being fought? A study of fatalities during underground coal mine fires by the former Bureau of Mines (USBM) [Goodwin and Kissell 1990] identified the delay time required to detect the fire and leave the section as a key factor in an escape. Another factor, discussed in the USBM study, was inadequate knowledge of the escape routes. As Mitchell [1990] notes, this lack of knowledge, added to the shock of not being able to see your hand in front of your face, can lead to disorientation and possibly fear. Most miners depend on reflectors hung from roof bolts. However, when smoke rolls in, they might not be able to see these reflectors. They then depend upon such things as frogs and switches to indicate the way out if they are in a track entry, or use other techniques that are unique to their mine (e.g., the location of bottom rollers on a beltline) to help orient themselves. This suggests that threading a lifeline through plastic cones or metal cans with one end open and spaced about every 100 feet might do much to help miners find their way out. An important issue is that, until they are needed, escapeways are often ***assumed*** to be suitable for the safe evacuation of miners. Clearly, the opportunity to walk (test) escape routes is in the interest of all underground personnel.

Miners' participation in fire drills

Miners were also asked when their crew had last participated in a fire drill. Answers to this question suggest that, in at least some of the operations, fire drills were less than rigorous exercises:

> "From time to time some foreman would come in, and after they'd shut the face, they would [announce] 'I've discovered a fire here.' And we'd walk through a simulated type drill. Just basically, like I said, get to the phone, get to the fire box—nothing to really fine act—not too much realism involved either. I would say most people are pretty reluctant to participate. Its been awhile "
>
> "Oh, just Monday. I don't know what you'd call it... a fire drill or [what]. They got a paper. They read down the steps taken in case of a fire. You know your secondary escapeways, your neutral and your primaries, your in-take. We don't, I mean, we didn't actually go through a drill, 'Hey, there's a fire... Let's do something!'"

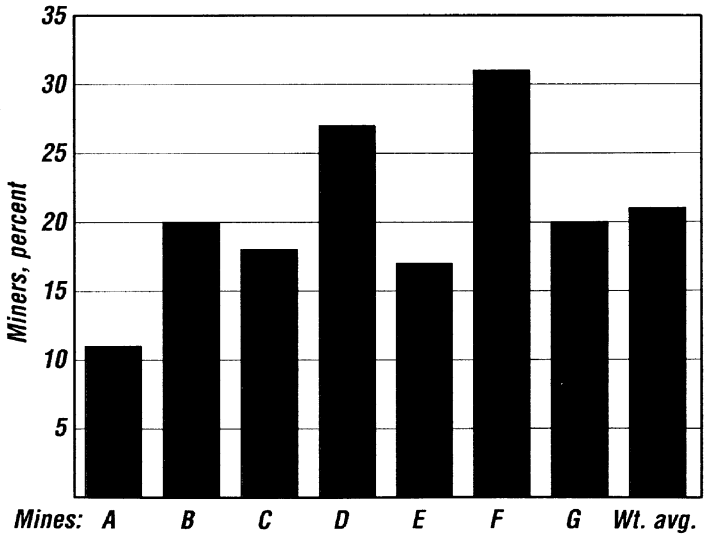
Overall, slightly less than 80% of the respondents reported participating in a fire drill at any time during the previous 12 months. Values for the past six months varied from a low of approximately 25% for Mine B to a high of about 85% for Mine G.

Miners' experiences with incipient fires

An interesting, although imprecise, indicator of encounters with fire is whether or not a miner was ever required to don a filter self-rescuer or a self-contained self-rescuer during a mine emergency. As illustrated in Figure 2, a sizable number of workers interviewed at the 7 operations said that they had done this at some time:

> "Smoke came on up in the unit. I think we were about to head on out anyway. Some of us were riding the trip. I went ahead and put [my filter self-rescuer] on and we got out. It was a jeep battery on fire... it had a belt on top of it and it caught this belt on fire."
>
> "The one time—that I put the [self-contained] self-rescuer on was a battery fire. It was on the longwall section in a charging station. The batteries shorted inside. So we went down in there. We put the self-rescuers on, because it was—stunk real bad in the battery fire... There was

Figure 2.—Percentage of miners who have donned a self-contained self-rescuer or filter-self-rescuer in an emergency



smoke."

The actual percentages having donned apparatus ranged from a low of 11% at Mine A to 31% at Mine F.

If there are occasions when workers must don their breathing apparatus, there are many more in which that potential exists. Table 1 summarizes for each mine the frequency with which miners reported seeing or smelling smoke underground ***for any reason***. These frequencies varied widely from mine to mine. For example, over 50% of the workers at mines D, E and F reported seeing or smelling smoke at least once a week, only about 30% of those at mines C and G reported smoke this often. The two remaining operations (A and B) fell somewhere in between. It appears from examining the data in Table 1, that smoke is a fact of life at most of the mines. In many instances, however, miners may well be aware of where the smoke is coming from and what is causing it.

Workers were thus asked when they were last *caught off guard* by the sight or smell of smoke underground. Their responses are presented in Figure 3. The cumulative frequencies indicate that, while less than 25% of the miners at mines A and D reported being caught off guard in the past 6 months, over 50% of the workers at mines C and F reported being caught off guard during the same period. As a follow up to this question, miners were then asked what the source of smoke was determined to be:

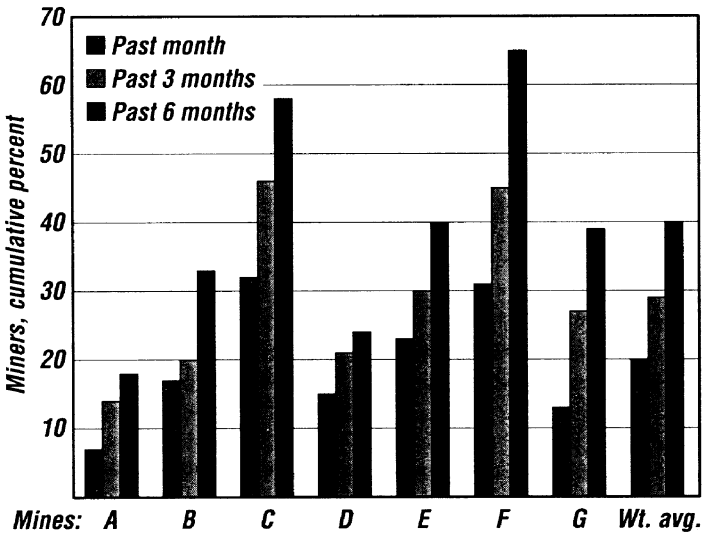
> "A couple of weeks ago... I smelled something that we didn't normally smell, and we got to looking for it, to try to find out what it was, from the smell... and then, a few minutes later, we noticed the smoke. [A plug back of a sub had overheated.] I knocked the power the sub, and let the foreman know about it."

Cumulative frequencies (in percent) with which miners reported either seeing or smelling smoke underground for any reason

Frequency	Mine A	B	C	D	E	F	G	Wgtd. avg. all mines
At least once per shift	4	7	4	18	16	20	7	11
At least once per week	37	37	32	[1]55	[1]55	[1]71	27	46
At least once per month	[1]63	[1]70	46	67	84	95	[1]67	[1]71
At least once per year	78	80	[1]89	79	100	97	90	88
Less than once per year	96	100	96	100	—	100	97	99
No response	100	—	100	—	—	—	100	100

[1]*Median frequency for the mine*

Figure 3.—Percentage of miners caught off guard by the sight or smell of smoke

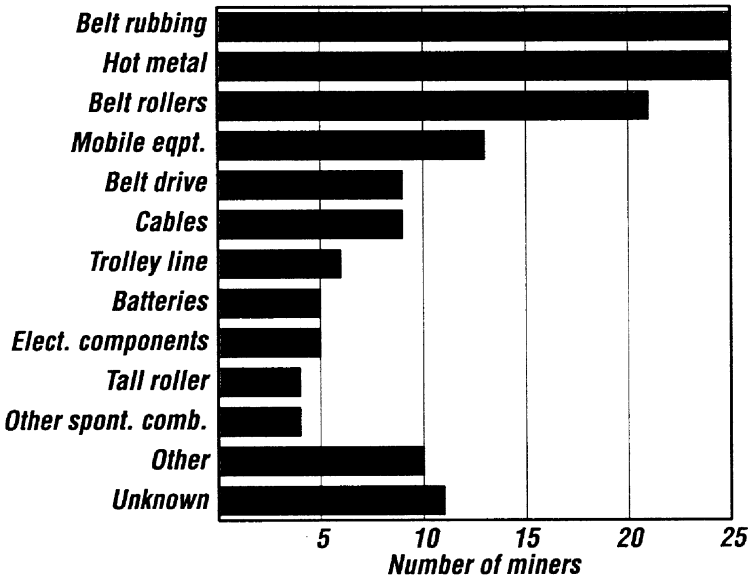


These known origins are listed in Figure 4 along with the number of miners reporting each one. The most commonly cited sources were belt rubbing and hot metal.

Of additional interest to investigators was how often miners were caught off guard by smoke whose source was not on their section, but rather had rolled in from some other location. Workers were thus asked when was the last time they were caught off guard by smoke that had its source at another location in their mine:

> "Yeah, about five years ago there was a roller on the belt—a big main roller. The belt had gotten jammed, and it was slipping inside the belt. Created a lot of smoke and we was notified that there was a

Figure 4.—Source of fire for miners caught off guard by smoke



fire outby and we were to proceed to the evacuation area at once. The proper measures were taken at the time. Everybody was okay. We used our self-contained rescuers at the time (I recall putting them on) until we got into the clear."

About one-third recounted that, sometime in the past, they had been caught off guard by smoke coming from somewhere off their section. In sum, although smoke may be a fact of life at most of the mines in this study, its presence often comes as a surprise to workers. If underground workers consider the presence of smoke to be commonplace at some mines, this could easily lead to complacency and delayed reactions because miners might consider it, perhaps at the wrong times, as an event that someone else is investigating. To reinforce this point, the reader is advised to review the reportable fire data summarized by Pomroy and Carigiet [1995] in the first article of this series. These data suggest that, at times, miners may be required to take action. Miners taking action to mitigate the effect of a small mine fire is the subject of the next article of this four-part series.

References

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