

# Injury Analysis of Pennsylvania Small Surface Coal Mines

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## **Introduction**

This paper is a descriptive analysis of injuries and fatalities at small surface bituminous coal mining companies in Pennsylvania. The purpose of analyzing a specific industry sector and location is to identify issues that might be missed in a wider analysis. Other studies of small mine safety (e.g., Peters and Fotta, 1994, Randolph and Boldt, 1997) have shown that the relationship between safety and mine size is not a simple one. Some injury types occur at higher rates at small mines, while others occur at lower rates. Consequently, an analysis limited to a specific type of mining can help identify hazards and issues specific to that sector. The results of this analysis will be useful for directing training, intervention, and research efforts towards the most prevalent causal factors and incident types.

## **Procedures and Definitions**

### **Data sources**

The primary sources of data for this analysis were files provided by MSHA containing information collected under Title 30 Code of Federal Regulations, Part 50. These files, commonly referred to as “Part 50 data”, are provided through MSHA’s Program Evaluation and Information Resources directorate. Two primary types of injuries were selected from the Part 50 data: *Fatalities* (MSHA “degree of injury” code 1) and *lost-time injuries*, otherwise known as *nonfatal with days lost* (MSHA “degree of injury” codes 2 through 5). Lost-time injuries involve either actual days away from work or days of restricted activity or both. Fatality and lost-time injury *incidence rates* were calculated using the standard MSHA formula: Number of injuries per 200,000 employee-hours. Additional information on company sizes and mine ownership was provided by the Pennsylvania State University College of Earth and Mineral Sciences.

### **Time span**

A five-year time span was selected for this study. More than a single year of safety experience is usually needed to capture a broad range of incident types. Many types of injuries, especially fatal injuries, can be extremely rare, and may be missed if too short a time span is selected. However, a time span that extends too far back may begin to suffer historical threats to validity. That is, incidents that occurred several years ago may be caused by hazards that have since been remedied or may be related to mining practices and conditions that no longer exist. A five-year span offers a practical compromise between these two concerns. Consequently, the MSHA Part 50 data files from 1993 through 1997 were used. The 1997 file was in “preliminary” form at the time of the study, so small variations from the final 1997 “close out” file can be expected. Based on past experience, we do not expect the close-out variations to have a significant impact on the findings.

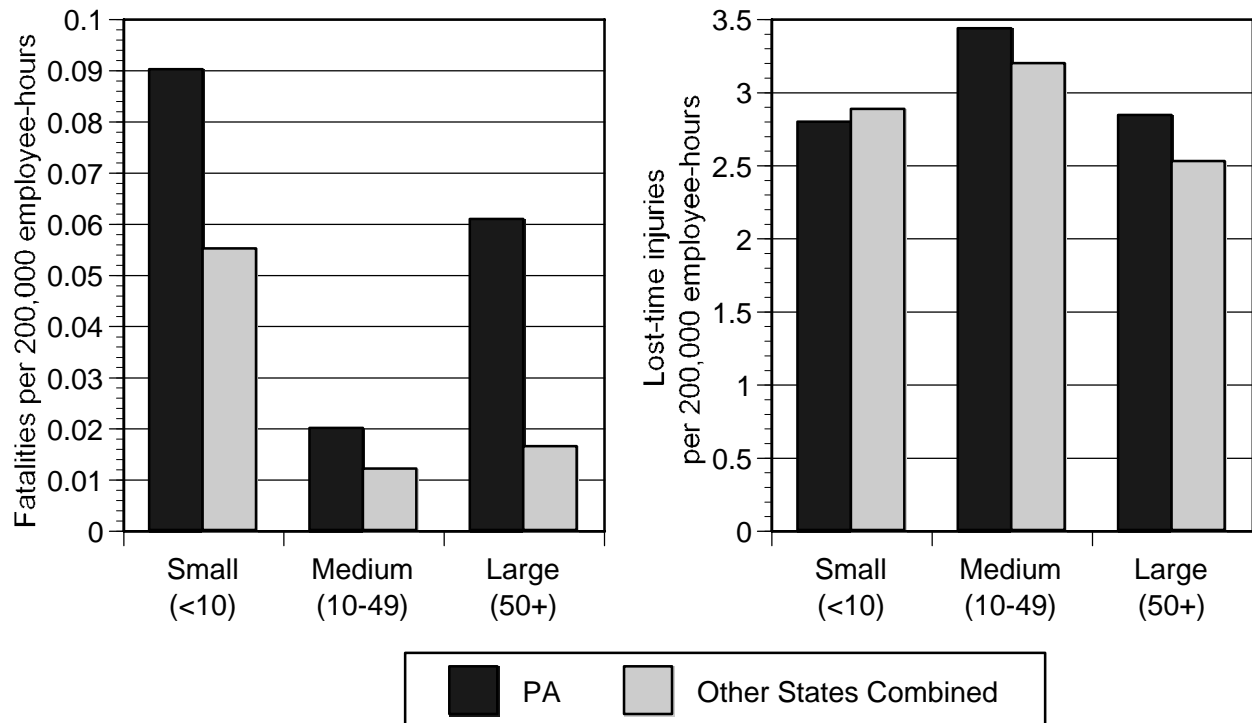
## Use of “accident” terminology

The word “accident” is often used, and misused, in describing safety problems. Unscientific popular views of accidents sometimes overlook the causes of events, and conclude that “accidents happen.” This fatalistic view of the inevitability of accidents is anathema to safety professionals. Wherever possible, we have avoided the term “accident” in favor of more specific terms like “injury” or “incident”. “Accident” will be used only when following official definitions or strong tradition. In those cases, “accident” should be taken to mean “an unexpected negative event” whose causes and eventual solution we hope to understand and solve scientifically.

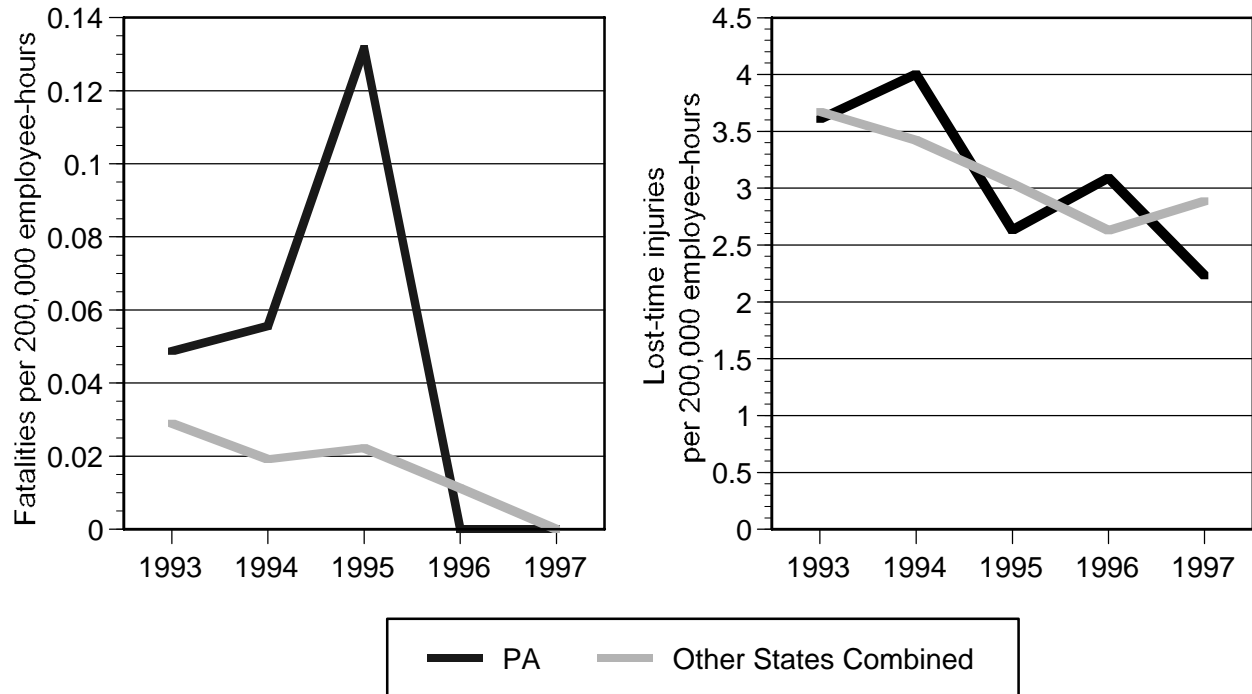
## Pennsylvania and US Safety Statistics

The relationship between mine size and incidence rates for surface bituminous coal mines in Pennsylvania and other states combined is shown in figure 1. Fatality rates for Pennsylvania were higher than the combined rates of all other states for all mine sizes. The smallest (less than 10-employee) mines had the highest fatality rate for both Pennsylvania and all other combined states, and the PA small mines rate of 0.09 was higher than the 0.06 rate at other U.S. small mines. The mine size and location differences were somewhat smaller for lost-time injuries. The highest injury rate was for Pennsylvania 10-49 employee mines, while the lowest rate was for large non-Pennsylvania mines.

An additional analysis was performed on the five-year trends in fatality and injury rates at surface bituminous mines during the five year span of 1993-97 (figure 2). There has been a



**Figure 1.** Fatality and lost-time injury rates for small, medium, and large surface bituminous coal mine sin Pennsylvania and other states, 1993-1997.



**Figure 2.** Fatality and lost-time injury rates for surface bituminous coal mines with fewer than 50 employees in Pennsylvania and other states, 1993-1997.

downward trend in fatality and lost-time injury rates at these mines during the last five years. Pennsylvania mines have dropped to zero fatalities for both 1996 and 1997. Fatalities for the rest of the U.S. also dropped to zero for 1997. Lost-time rates declined from 3.6 to 2.2 in Pennsylvania, and from 3.7 to 2.9 in other states combined. Credit for these improvements is difficult to assess with precision, but is most likely due to a variety of influences, including government research and regulation, industry and workforce safety efforts, mining safety and health organizations, and general technological improvements.

These analyses of injury rates do not include independent contractors despite their increasing role in U.S. mining. In surface coal, independent contractors have risen from 7.9% of the workforce in 1987 to 20.1% in 1997. Unfortunately, we do not have data on which mines or states contractors are working in, or whether they are mining bituminous or anthracite coal. Consequently, it is impossible to include independent contractors in calculations of injury rates by state or type of coal mined. However, we can determine the number and proportion of injuries and fatalities involving contractor fatalities, and these statistics are useful for identifying the most prevalent safety issues.

### **Pennsylvania Safety Statistics by Company Size**

Most discussions of small mines define “small” in terms of the number of employees working at a mine site. However, some small operations are actually owned by large companies with hundreds of employees. When a small operation is owned by a large company, it is no longer as appropriate to include them along with other small mines. The reason for this centers around the importance of resources in enabling mining operations to pursue improved safety and

health. Specifically, small mining companies, like other small organizations, have limited capital to upgrade equipment. They are unlikely to have dedicated safety and health personnel, and may be less able to attend safety seminars or seek out training materials.

This next series of statistics examines fatalities and lost-time injuries at Pennsylvania surface bituminous coal mines by company size. The “small company” mines are those where the entire mining company has fewer than 50 employees. These mines were identified by Garold L. Russell of the Pennsylvania State University College of Earth and Mineral Sciences. Mines operated by companies with 50 or more employees are considered “large companies” for this analysis.

During the 1993-1997 period covered by this analysis, there were three fatalities at the small company sites, and four at large company mines. All seven of the fatally injured miners were operator employees. Independent contractors made up just 7.5% of the 146 lost-time injuries at small company mines, while 14.6% of the 316 large company injuries involved contractors.

### **Fatality and injury rates**

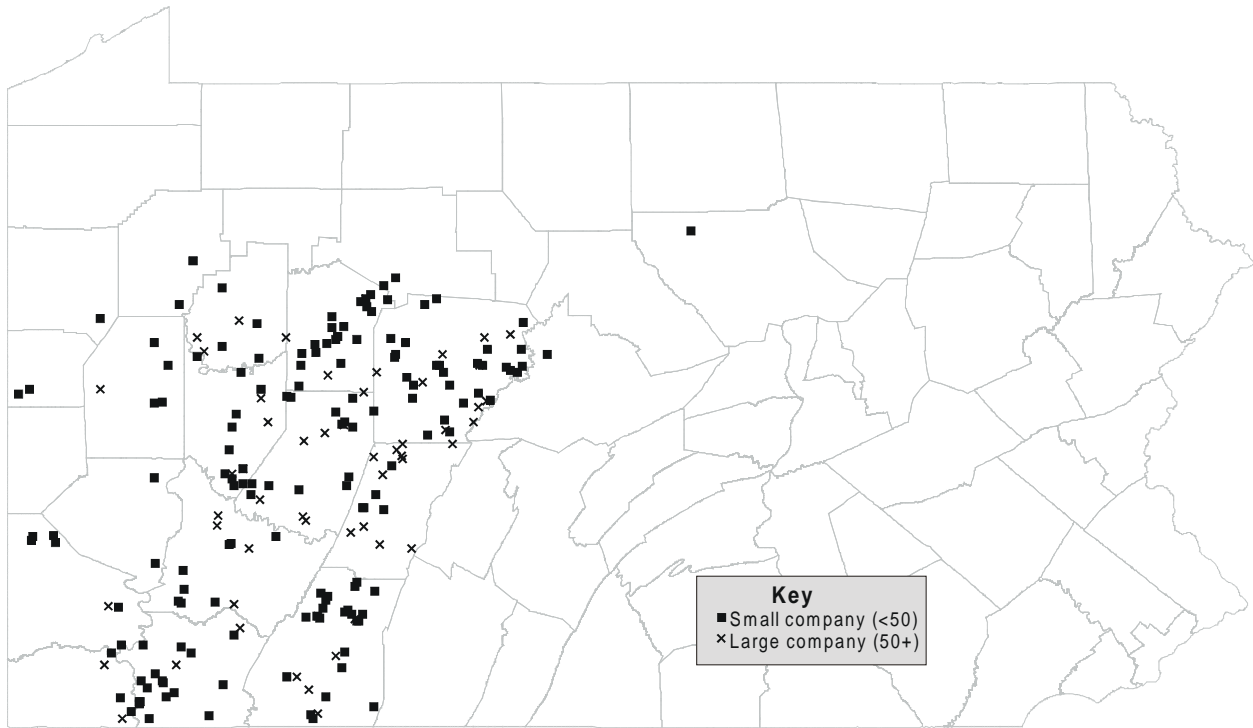
Fatality and lost-time incidence rates were calculated for injuries to mine operator employees at the small and large company surface bituminous mines. Contractor injuries had to be excluded from this calculation of rates because we lack information about contractor hours worked specifically in Pennsylvania or in bituminous coal. The small company mines had a fatality incidence rate of 0.059 fatalities per 200,000 employee-hours, which was slightly higher than the large company rate of 0.050. However, the small company lost-time injury rate of 2.64 was actually lower than the large company rate of 3.31.

### **Mine location**

The locations of mines in the U.S. can be mapped using latitude and longitude using data from MSHA’s Master Index File (MIF). The map in figure 3 shows the locations of surface bituminous mines in Pennsylvania based on the MIF file dated July 18, 1998. Each mine associated with a small company is indicated on the map with a square symbol while each large company mine is marked with a small “x”. The map shows that companies of both sizes are dispersed throughout the bituminous mining region in western and central Pennsylvania, but the more numerous small company mines extend slightly further east, north, and west.

### **Mining type (subunit)**

The MSHA “subunit” code was used to distinguish between strip, auger, and culm bank operations as three different types of mining. All of the three small company and four large company fatalities occurred at strip mines. Figure 4 shows that most of the lost-time injuries also occurred at strip mines. Although the number of injuries at auger mines was small (three for small companies and eleven for large) it is notable that all of the victims were independent contractors. Independent contractors accounted for 19.8% of the hours worked in U.S. auger operations during 1993-97. Assuming that the distribution of employee-hours at Pennsylvania



**Figure 3.** Geographic distribution of surface bituminous coal mines in Pennsylvania.

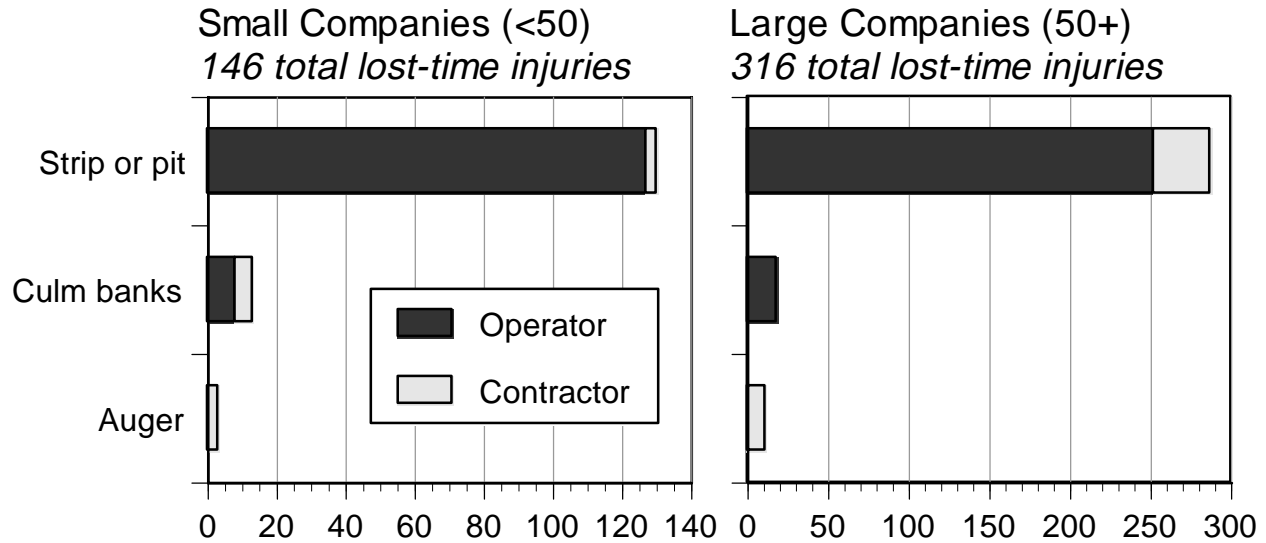
operations mirrors the U.S. average, these injuries may indicate a disproportionate risk for Pennsylvania auger contractors.

### **Accident classification**

Fatalities and injuries are assigned an “accident classification” by MSHA based on the “accident code” field on form 7000-1 and the narrative description of the incident. The small and large company groups each had two fatalities classified as “machinery” and one as “powered haulage”. The fourth large company fatality was classified as “other.” Slips and falls were the most common lost-time injury, followed by handling material, powered haulage, machinery, and handtools (figure 5). The large companies had higher percentages of materials handling injuries (25.9%) than small companies (20.6%), but lower percentages of powered haulage, machinery, and explosion injuries.

### **Occupation**

The injured employee’s occupation or job title is useful as an indication of the type of work they commonly do and the types of hazards to which they may be exposed. The seven 1993-97 fatalities were spread among six occupations, with both small and large companies having a truck driver fatality. Small companies fatalities also included a mechanic/repairman and a dozer operator, while large company fatalities included a drill helper, a power shovel operator, and an outside foreman. Dozer and tractor operators were the largest group among the lost time injuries, followed by mechanics, truck drivers, and laborers (figure 6). Also, none of the injured dozer



**Figure 4.** Lost-time injuries at Pennsylvania surface bituminous coal mines by mining type and company size, 1993-1997.

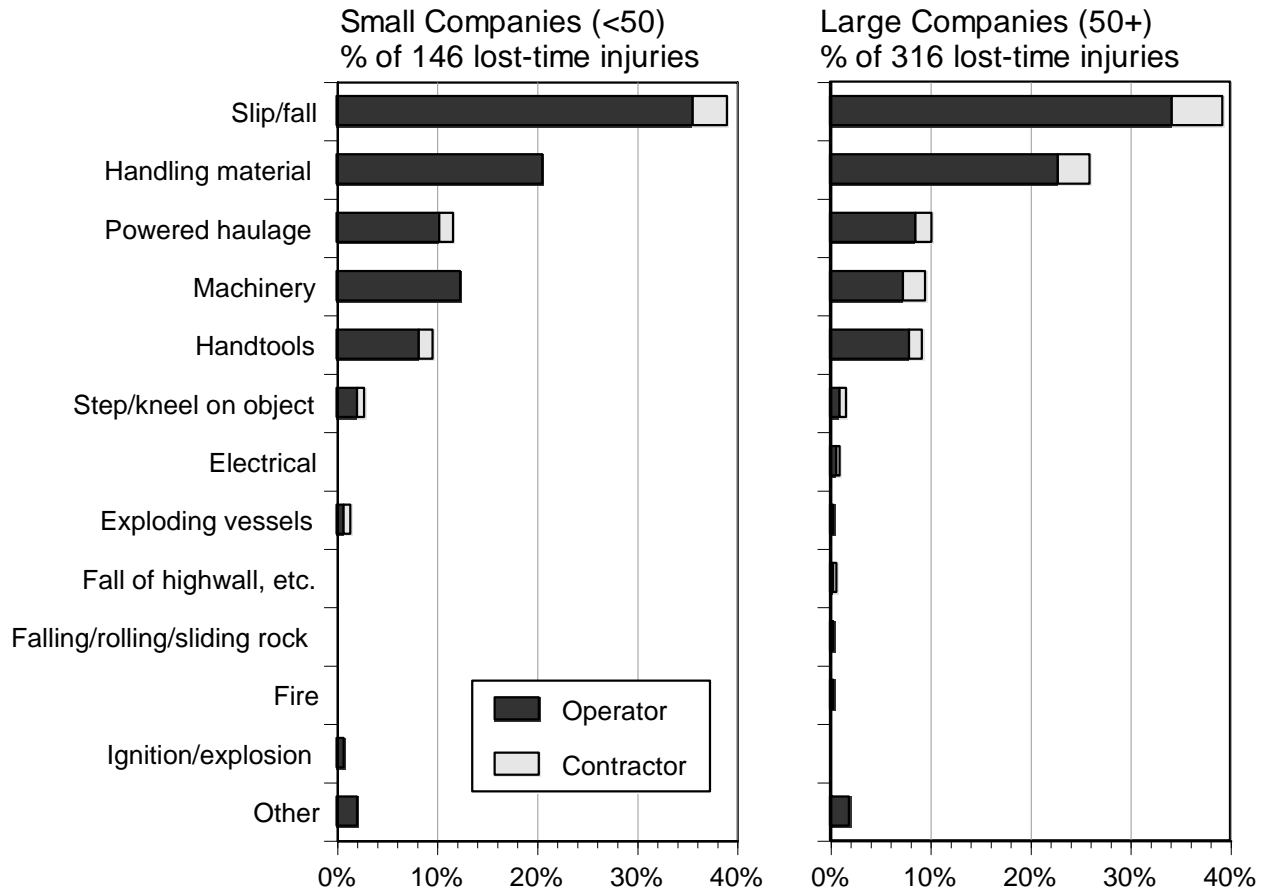
operators were independent contractors. The greatest difference between small and large companies shows up for dozer/tractor operators: Small companies had 30.1% of their injured employees listed as dozer/tractor operators compared to 20.9% for large companies. However, small companies had a lower proportion of mechanic/repairman injuries (13.7%) than large companies (16.1%).

### Mine worker activity

Mine worker activity provides a useful indication of the type of work the injured miner was performing at the time of the incident. The seven fatalities involved five different activities, with haulage truck operation and walking/running repeated for both company sizes. Small companies also reported one machine maintenance fatality, and large companies reported a shovel/dragline/backhoe operation fatality and one activity listed as “other”. Machine maintenance and repair was the most common activity associated with lost-time injuries at small companies (25.3%), while getting on or off equipment was the highest (22.5%) by a small margin at large companies (figure 7). The higher level of maintenance injuries at small companies is consistent with the speculation that they use older, less reliable equipment. Small companies also had a higher percentage of bulldozer injuries (6.8%) compared to large companies (1.9%), which is consistent with the occupation findings for dozer operators.

### Part of body

Reflecting the serious nature of fatal incidents, the affected body parts were commonly multiple parts or systems, or severe head injuries. Small companies had two body trunk-related fatalities and one involving multiple body parts. Large companies also had a multiple part fatality, and one each involving the head, multiple head injuries, and “body systems”. The back was the most common injured body part among lost-time injuries for both small and large companies (figure 8). This is also consistent with the finding that materials handling was the



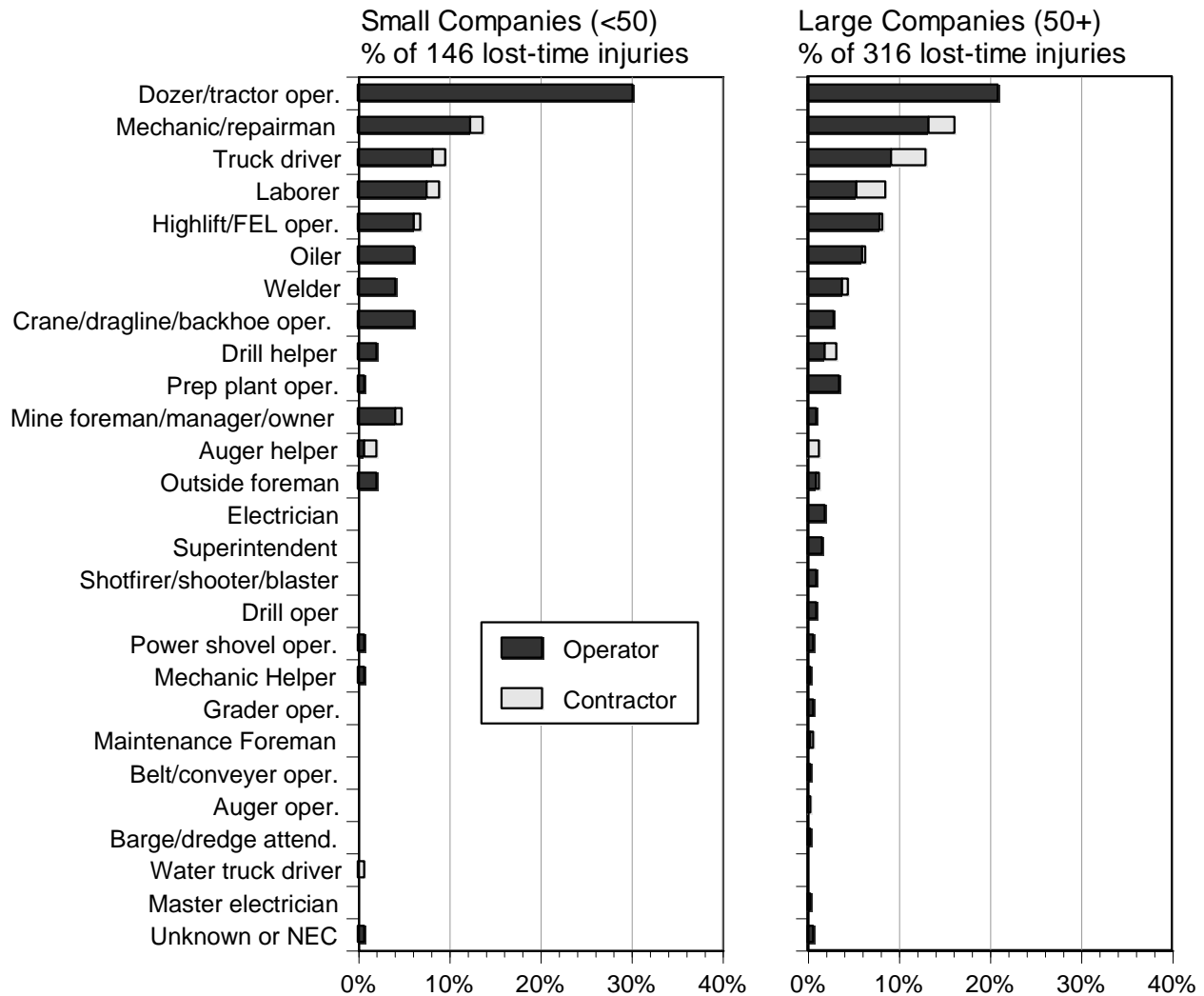
**Figure 5.** Lost-time injuries at Pennsylvania surface bituminous coal mines by MSHA classification and company size, 1993-1997.

most common MSHA injury classification since the two are often associated. For instance, of the 1465 materials handling lost-time injuries reported at U.S. surface bituminous operations during 1993-97, 594 (40.5%) were back injuries. No other body part accounted for more than 12% of these injuries. Small companies had relatively fewer back injuries than large companies (19.2% versus 23.4%), but they had higher proportions of finger, leg, and neck injuries.

### Discussion

Safety statistics at Pennsylvania surface bituminous coal mines have been improving over the past five years, and have kept pace with similar mines elsewhere in the U.S. The primary challenges that remain include incidents involving powered haulage, machinery, slips and falls, materials handling, machine maintenance, and dozer operation.

The differences between the small and large company mines tended to be subtle rather than obvious. The small company mines had relatively fewer independent contractor injuries than large mines, which may reflect lower employment of contractors in small operations. Small company mines had a slightly higher fatality rate than large company mines, but their lost-time rate was actually lower. The reported characteristics of injuries at small and large mines were



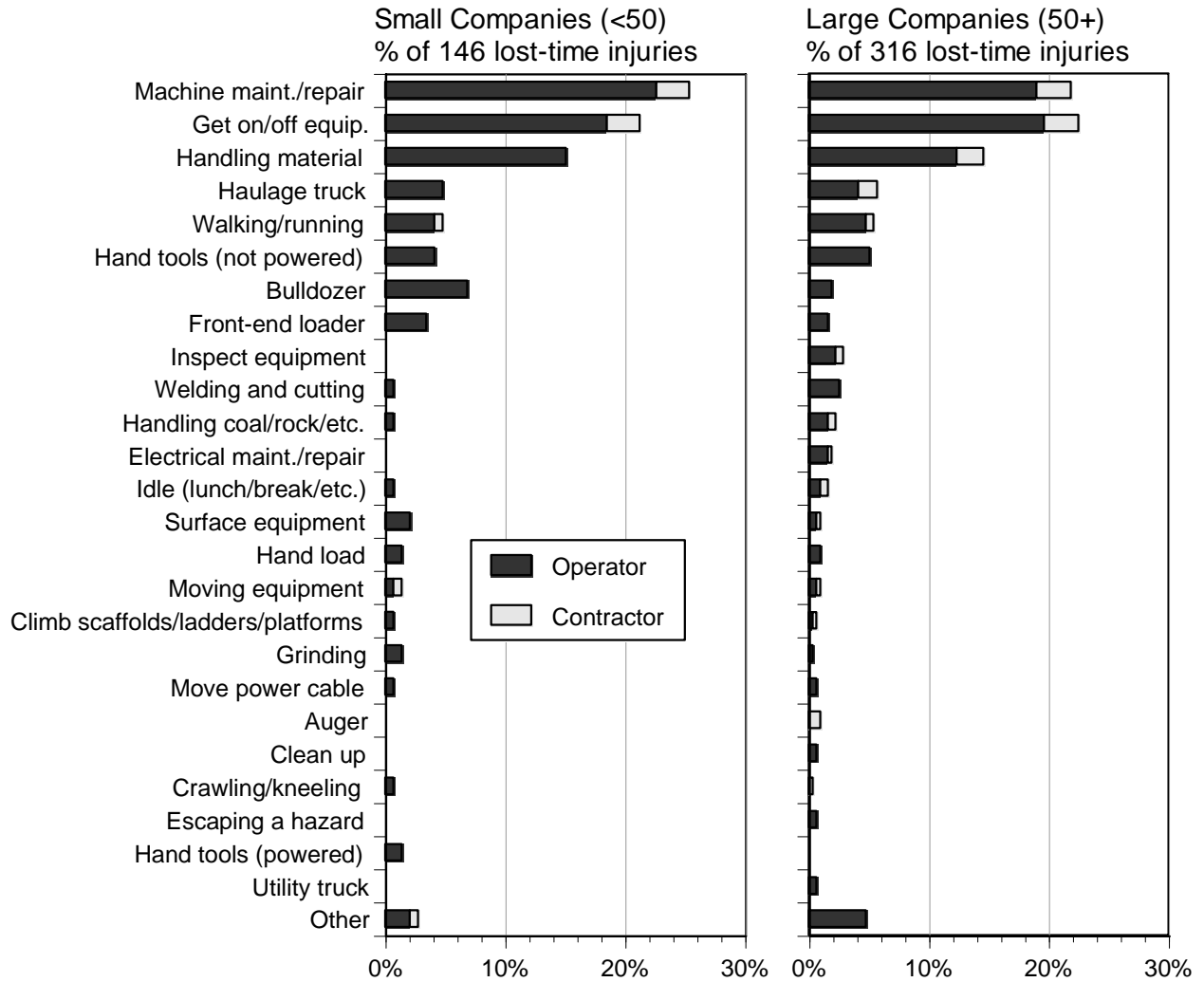
**Figure 6.** Fatalities at Pennsylvania surface bituminous coal mines by occupation and company size, 1993-1997.

similar, but with relatively higher reports of dozer operation, maintenance, and foreman injuries at small company mines. Differences in fatality patterns were more difficult to ascertain because of the small numbers involved. Of course the remarkable achievement of zero fatalities in Pennsylvania surface bituminous mines during 1996-1997 makes any analytical difficulties seem trivial. Using data from studies such as this one, health and safety professionals can focus their resources more intently on the remaining high-frequency incidents.

### References

- Peters, R. H. and Fotta, B. (1994) Statistical profile of accidents at small underground coal mines. In proceedings of Bureau of Mines Technology Transfer Seminar: Improving Safety at Small Underground Mines. BuMines SP 18-94, pp. 5-14.
- Randolph R. F. and Boldt C. M. K. (1997) Safety analysis of surface haulage accidents. Holmes Safety Association *Bulletin*, May-June 1997, pp. 1-7 (Part 1); July 1997, pp. 6-7 (Part 2).





**Figure 7.** Lost-time injuries at Pennsylvania surface bituminous coal mines by activity at time of incident and company size, 1993-1997.