CHALLENGES AND OPPORTUNITIES FACING THE MINING INDUSTRY IN THE QUEST FOR IMPROVED SAFETY

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INTRODUCTION

This paper begins by looking at the vision and mission of the National Institute for Occupational Safety and Health (NIOSH), particularly the mine safety and health research program. Next, current employment within the mining industries is examined. The paper then focuses on trends within the mining industries, with particular attention to workforce trends, workplace trends, and operational trends.

Next, health and safety issues within the mining industry are examined. Health and safety data on fatalities, injuries, and occupational illnesses within the mining industry are reviewed.

Published opinions of others with regard to directions or concerns for the mining industry in the future are explored. The paper concludes with the author's view of the challenges and opportunities facing the mining industry in the quest for improved safety.

NIOSH VISION AND MISSION

The vision of NIOSH is—Delivering on the Nation's Promise: safety and health at work for all people through research and prevention.

The Office for Mine Safety and Health Research within NIOSH undertakes its activities consistent with the following mission: to provide national and world leadership to prevent mining work-related illness, injury, and death by gathering information, conducting scientific research and demonstrations, and translating the knowledge gained into products and services. It is important to note that the work of NIOSH does not end with the conduct of research or the gathering of information. Rather, it must go beyond to translate that acquired knowledge into products and services that can make a real difference for industry in general and the mining industry in particular.

THE CURRENT MINING INDUSTRY

Table 1 shows the current number of employees in the U.S. coal industry; the metal/nonmetal industry; and the sand, gravel, and stone industries. These employment figures are broken out for both surface and underground. It is interesting to note that the three segments of the mining industry (coal; metal/nonmetal; and sand, gravel, and stone) all employ about 100,000 workers each. This reality causes NIOSH to consider all mining segments of equal importance as it plans and conducts its research programs.

Table 1. Employees in the Mining Industry

Current Industries
(Number of Employees)

	Coal	Metal and Nonmetal	Sand, Gravel and Stone
Surface	55,999	88,886	105,863
Underground	46,297	12,633	2,197
Total	102,296	101,519	108,060

INDUSTRY TRENDS

In looking for opportunities to conduct health and safety research, NIOSH looks at the coincidence of workforce trends, workplace trends, and operations trends. As shown in Figure 1, consideration of all three factors provides NIOSH planners with the correct focus for its mine health and safety research program.

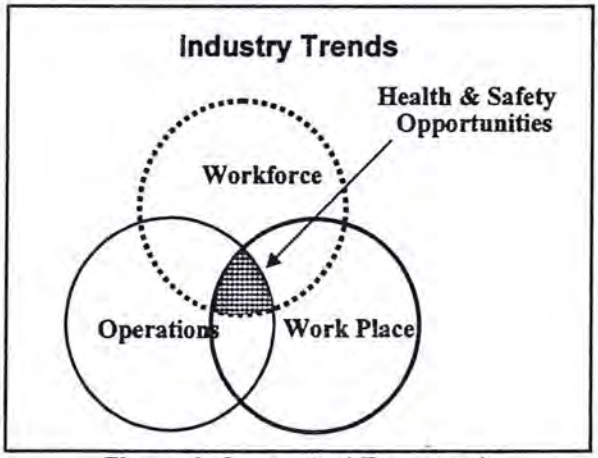

Figure 1. Conceptual Framework

Workforce Trends

The U.S. mining workforce is changing. U.S. miners are getting older. The average age of a coal miner in this county is approaching 50 years of age. Turnover among new miners is high. As many as 80% of new miners entering the workforce leave quickly.

Many new miners are Spanish-speaking. English as a second language is a growing concern in the U.S. mining industry. There are increasingly higher percentages of women in the mining workforce.

Figure 2 breaks down employment in surface mines by various categories. It is noteworthy that the largest single category of employment is within the stone industry (30%).

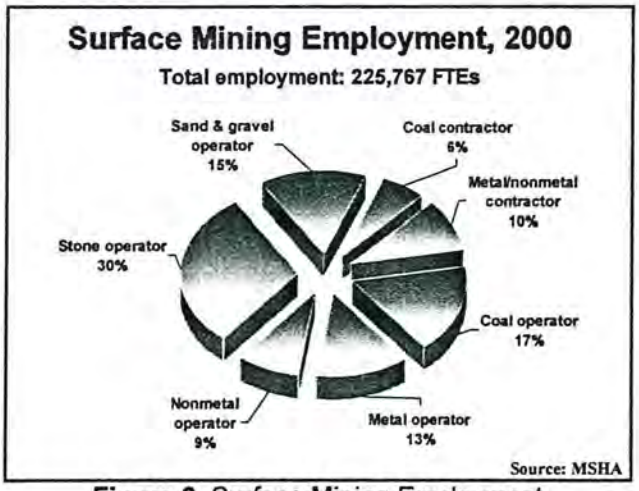

Figure 2. Surface Mining Employment

Figure 3 looks at underground mining employment. Coal operators at 69% are far and away the largest category of employees for the underground mining industry.

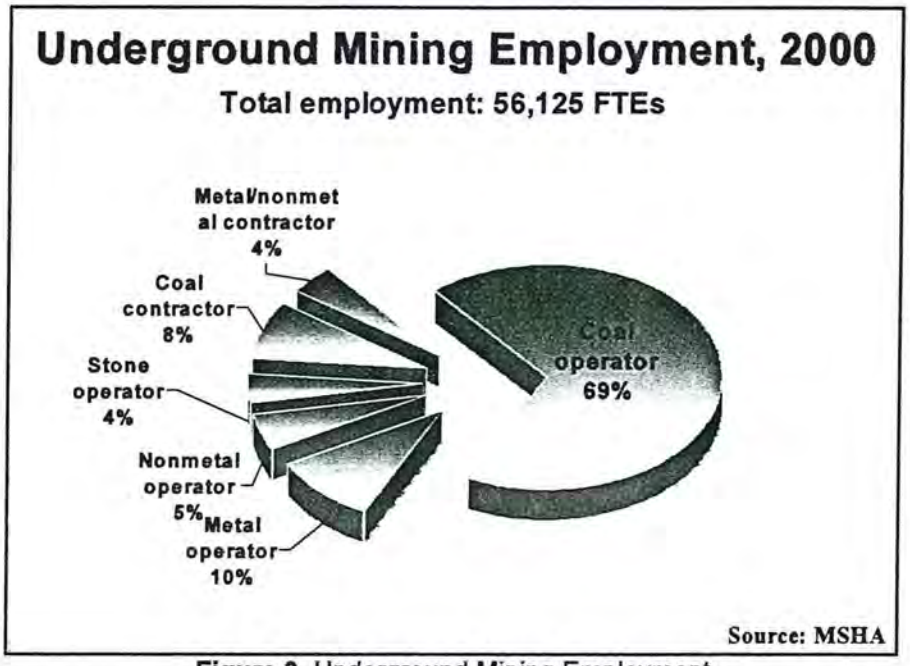

Figure 3. Underground Mining Employment

Figure 4 examines employment trends within the surface mining industry for the period 1991-2000. It is noteworthy that there are increases in all of the contractor categories from 1991 to 2000. The role of contractors in the mining industry is growing, which brings its own special issues and challenges.

Figure 4. Surface Mining Employment Trends

Figure 5 looks at employment trends from 1991 to 2000 for underground mining. There is a notable decrease in coal, metal, and nonmetal operators, whereas the number of contractors is increasing in underground mining.

Figure 5. Underground Mining Employment Trends

Workplace Trends

The number of mines and prep plants in the United States is decreasing. Figure 6 shows this declining trend over the past 20 years. Conversely, the dimensions of many of our mines are increasing. One need only look at the size of longwall panels used to mine underground coal as an example of this significant increase in size.

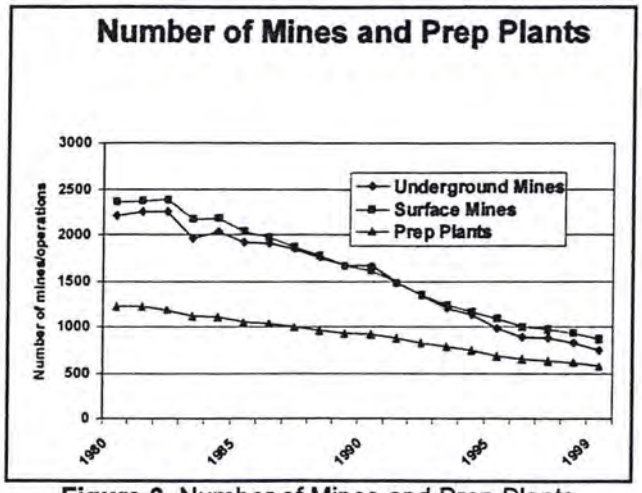

Figure 6. Number of Mines and Prep Plants

The conditions in which we must mine are becoming ever more difficult and challenging. Previously, we mined the reserves closer to the surface. Now we are continually going deeper, encountering the problems of higher stresses and more difficult geologic conditions.

In the United States, a number of stone operations are moving underground to be more environmentally acceptable and to maintain a "good neighbor" relationship to the local communities. This movement to underground operations creates increased health and safety challenges not faced during surface mining. It is also noteworthy that many sand and gravel operations are small. This brings particular concerns to those addressing health and safety problems in the stone industries.

Operational Trends

Production in underground coal mines has seen tremendous increases in recent years. Figure 7 shows the increases in longwall production from 1970 to 1999. In this case, there has been an almost tenfold increase in production.

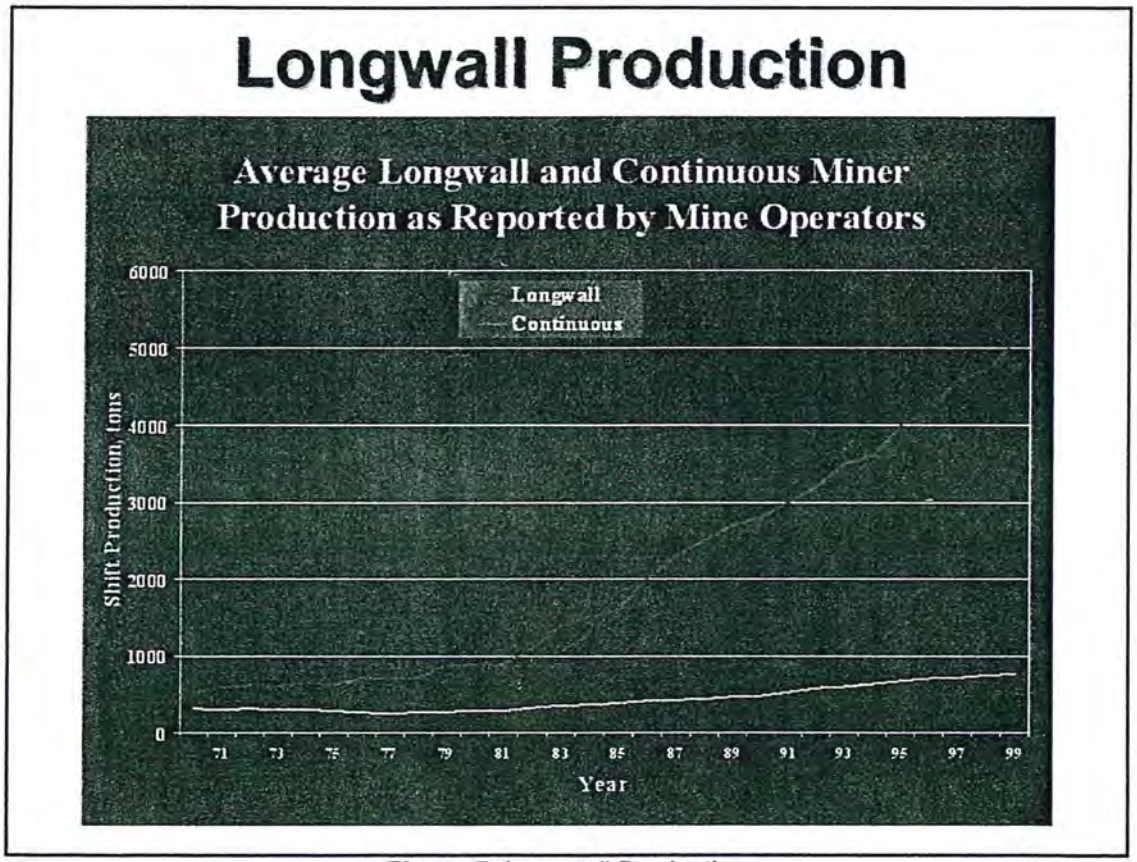

Figure 7. Longwall Production

Fewer workers produce more products in mines in the United States, a testimony to operational efficiency and worker accomplishments. Figures 8 and 9 show the

accomplishments by the mining community as the number of workers has decreased and the productivity per worker has increased dramatically.

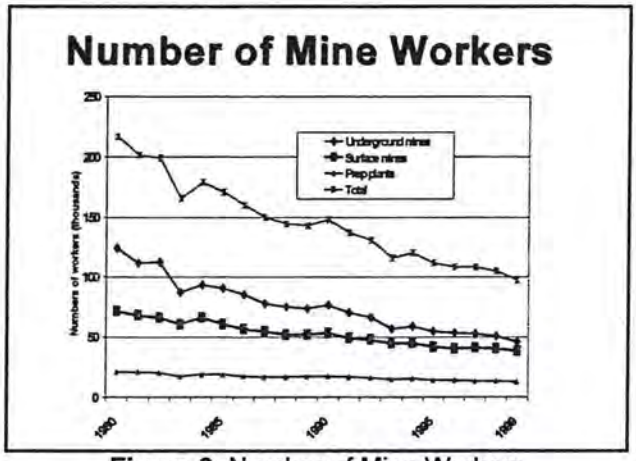

Figure 8. Number of Mine Workers

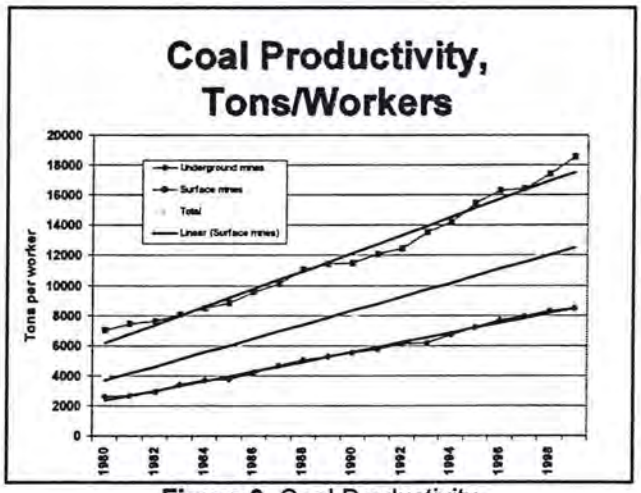

Figure 9. Coal Productivity

The equipment used in mining is getting ever larger. The average capacity of a haul truck has doubled in size over the last 15 years. It is currently projected that haul truck capacity could reach 1,000 tons by the year 2020, yet another doubling in size.

The use of diesels in underground mines is increasing. Although diesels are widely used in metal/nonmetal mines, they are now finding there way in increasing numbers into underground coal mines. Pennsylvania has recently allowed the use of diesel engines in underground coal mines. It is likely that West Virginia will follow suit.

Another operational trend is the increased use of extended work shifts. Shifts longer than 8 hours are becoming much more common within the mining industry. Some operations have gone exclusively to 12-hour shifts.

Selected Health and Safety Trends

In this section, we will examine certain trends in the health and safety performance of the mining industry.

Figure 10 looks at the average annual fatality rates for mining industries versus all private industry within the United States. It is alarming to note that for coal mining, for example, the average annual fatality rate is six times that of all other industries within the United States. For metal/nonmetal, the rate is five times as great.

Figure 10. Annual Average Fatality Rates

Figure 11 looks back over the last 35 years at the decline in the average number of fatalities in the mining industry. The mining industry has much to feel good about in terms of working on its health and safety issues and seeing tremendous improvements.

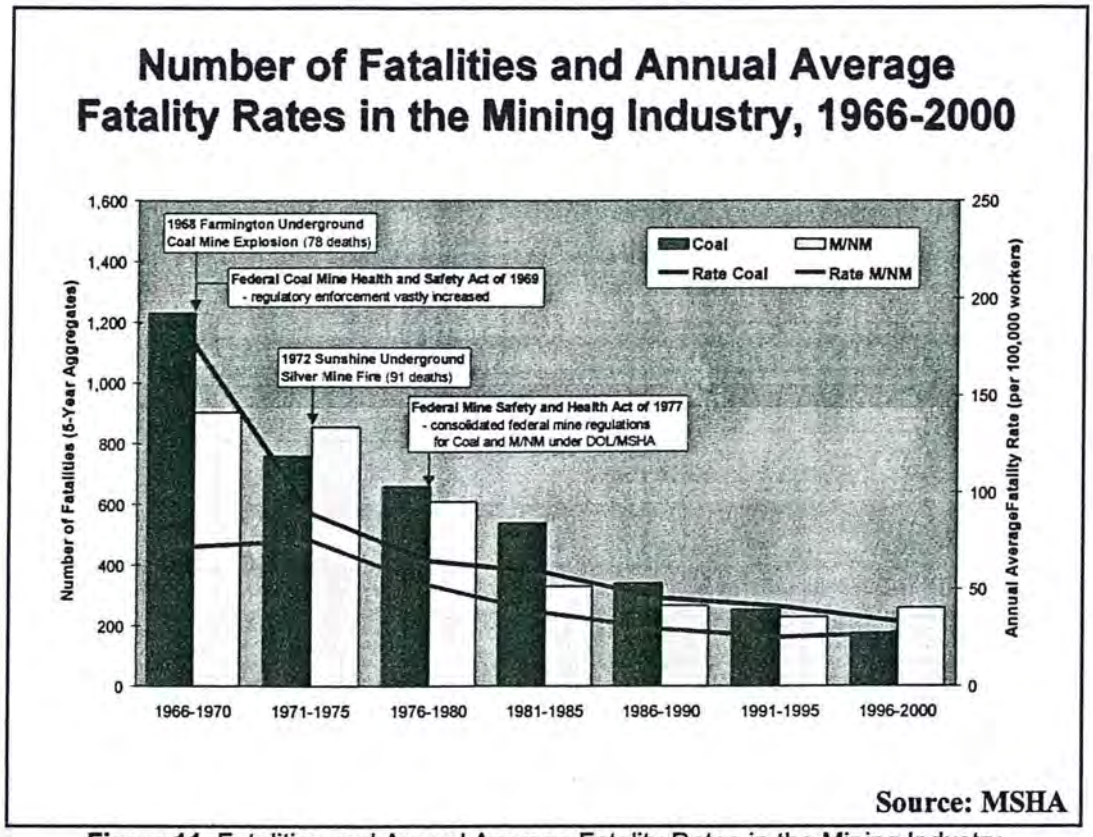

Figure 11. Fatalities and Annual Average Fatality Rates in the Mining Industry

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Figure 12 takes a more recent snapshot looking back to 1981. Here we see a leveling-off in the rate of decline of mining-related fatalities.

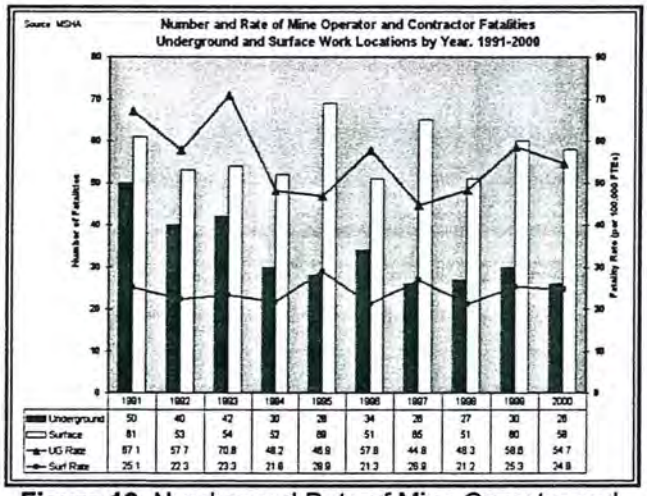

Figure 12. Number and Rate of Mine Operator and Contractor Fatalities, 1991-2000

Figure 13 examines the causes of accidents that have led to underground mining fatalities. Not surprisingly, in underground mining, falls of ground predominate with 50%. However, powered haulage at 23% is a major contributor as well.

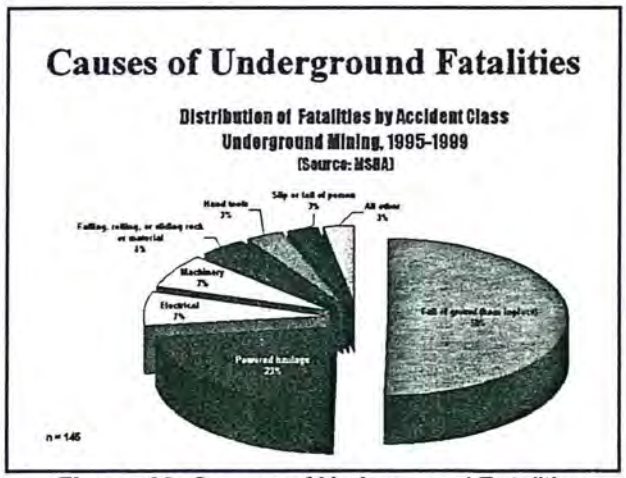

Figure 13. Causes of Underground Fatalities

Figure 14 looks at causes of surface fatalities in the mining industry. Powered haulage, machinery, and slips and falls are the largest three categories.

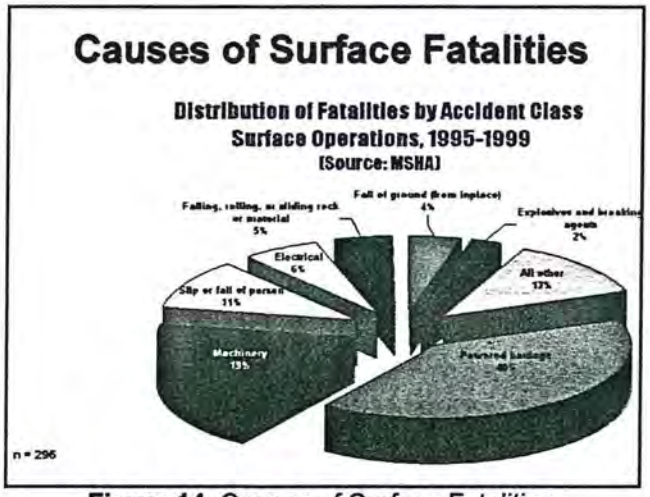

Figure 14. Causes of Surface Fatalities

Figure 15 looks at lost-time nonfatal injury and illness rates for coal mining and metal/ nonmetal mining versus all private industry within the United States. Coal mining, by a factor of 2.5, has higher injury and illness rates compared to all industry within the United States.

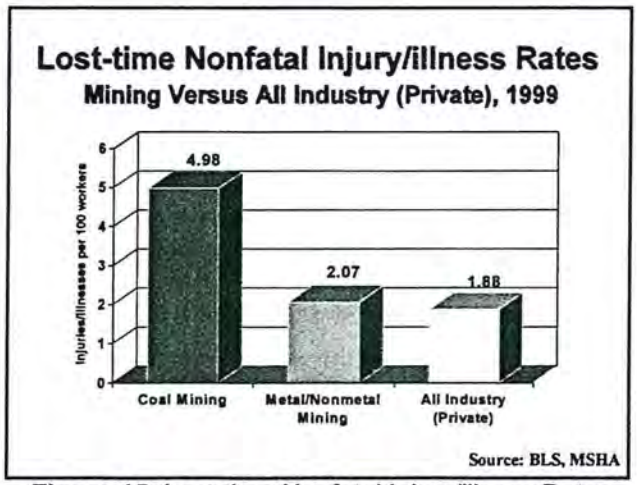

Figure 15. Lost-time Nonfatal Injury/illness Rates

Figure 16 shows that not only is there a greater frequency of lost-time injuries and illnesses in the mining industry, but the severity, measured by the median number of days lost for each injury and illness, is also much worse than for all other industries within the United States.

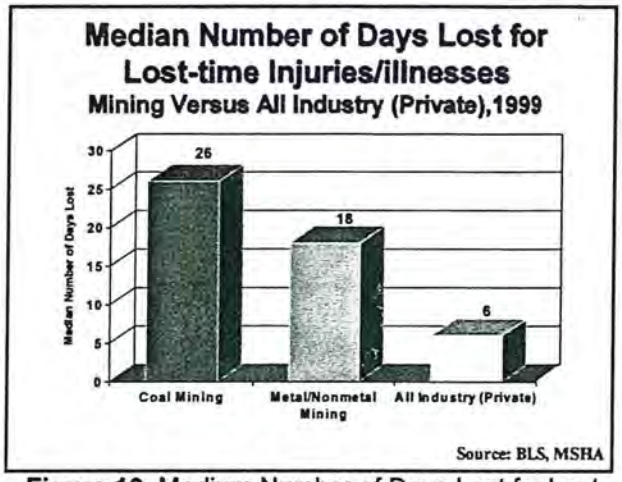

Figure 16. Medium Number of Days Lost for Lost-time Injuries/illnesses

Figure 17 looks back over the last 20 years at the number of lost-time injuries and illnesses, as well as the injury rates. Here again there is a leveling-off, particularly in the surface mining sector.

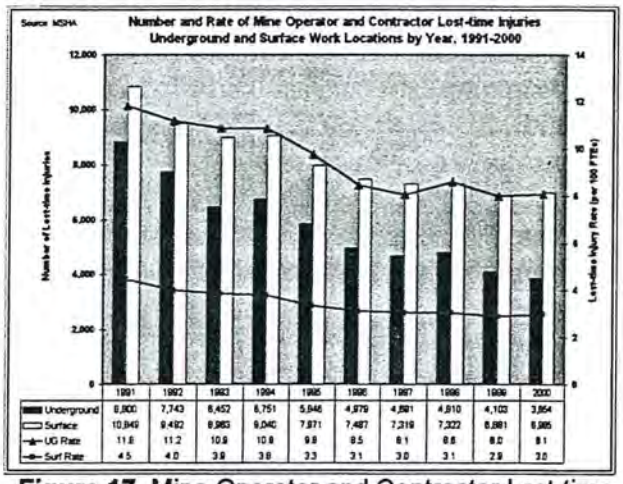

Figure 17. Mine Operator and Contractor Lost-time Injuries, Underground and Surface

Figure 18 examines causes of injuries in the underground mining industry. Materials handling, slips and falls, and falls of ground are the three principal causes.

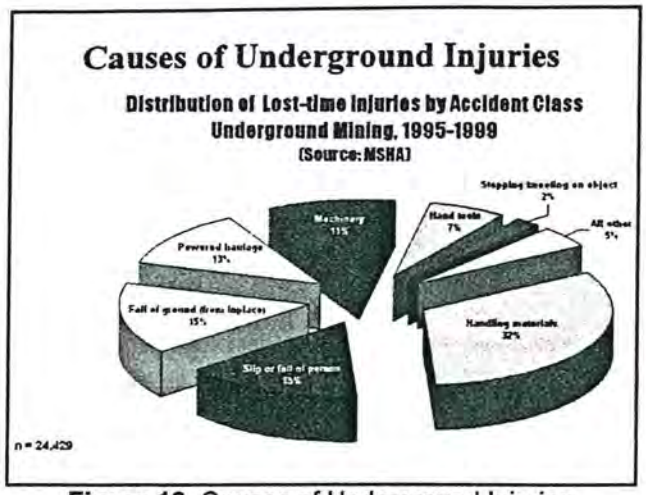

Figure 18. Causes of Underground Injuries

Figure 19 looks at causes of surface injuries. Here, materials handling and slips and falls of person dominate.

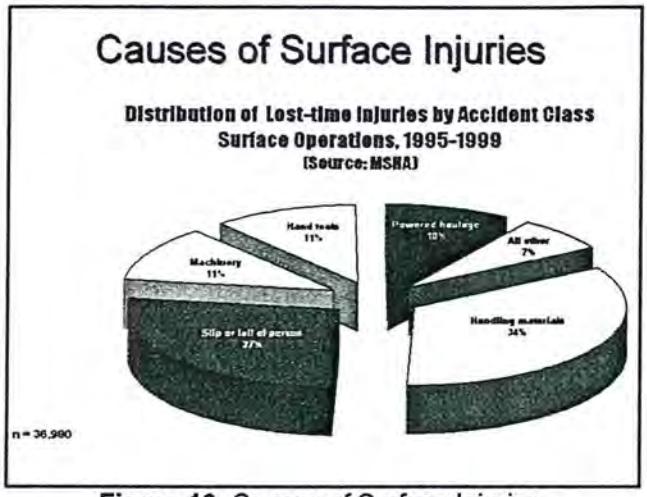

Figure 19. Causes of Surface Injuries

Figure 20 shows the number and rates of death for coal workers' pneumoconiosis (CWP) during 1968-99. Although there has been significant improvement, the problem still remains. We need to be ever vigilant in our effort to continue to stamp out CWP in the United States.

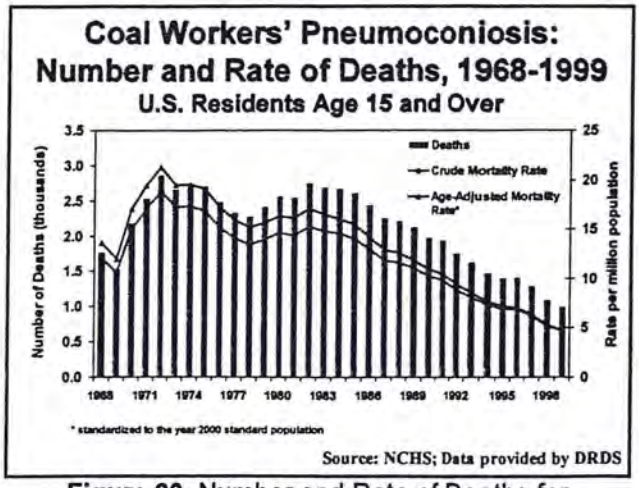

Figure 20. Number and Rate of Deaths for Pneumoconiosis

Figure 21 shows that 25% of people who have silicosis recorded as a cause of death on their death certificate work within the mining industry. The figure also shows that the coal, metal, and nonmetal sectors are fairly equal in silicosis-related deaths.

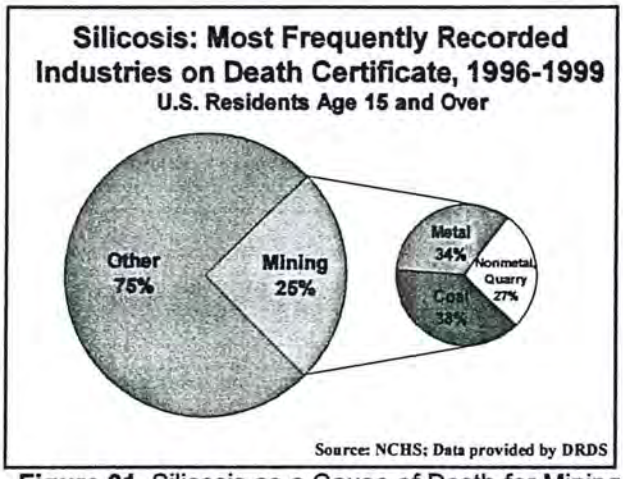

Figure 21. Silicosis as a Cause of Death for Mining Versus Other Industries

Figure 22 indicates that 30% of mining samples exceed the permissible exposure level for silica. This is based on MSHA inspector samples.

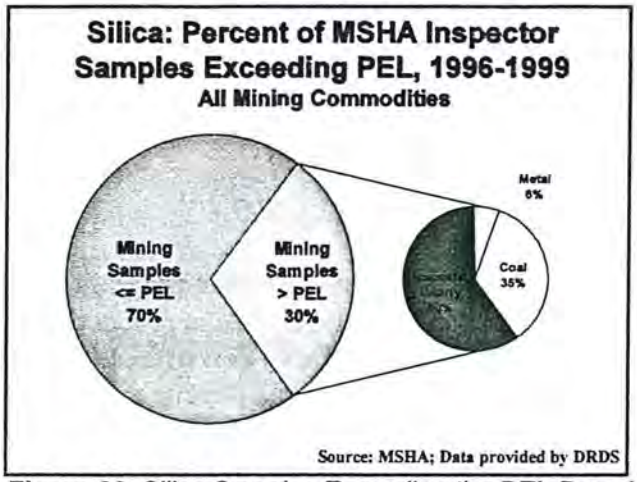

Figure 22. Silica Samples Exceeding the PEL Based on MSHA Inspector Results

Figure 23 contrasts the percentage of male hearing-impaired miners against age. The figure indicates that for miners approaching the latter years of their work life, there is a very good chance that they will suffer from a hearing impairment.

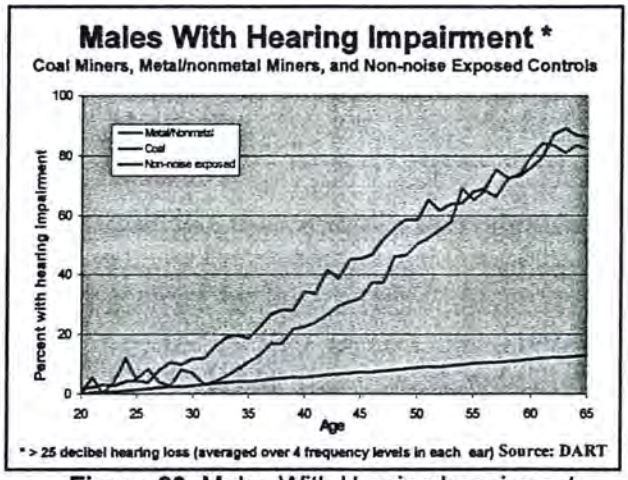

Figure 23. Males With Hearing Impairment

THE OPINION OF OTHERS AS TO FUTURE HEALTH AND SAFETY ISSUES

The First International Design for Extreme Environments Assembly met in Houston, Texas, in November 1991. It defined underground mining as one of the six extreme work environments, along with outer space, underwater, the Arctic, deserts, and mountains. The underground worksite was designated as a hazardous environment because it generally is in confined space and has poor visibility, the surrounding structure is unknown and unpredictable, and the atmosphere is dusty and potentially toxic or explosive.

RAND published a report in 2001 entitled "New Forces at Work in the Mining Industry: Industry Views of Critical Technologies." Of interest are the following two excerpts: "Mining equipment innovations not only litigate health and safety risk, but also address the need to create a more enjoyable, interesting, and productive work environment— critical to attract and retain highly qualified workers." "Despite the prospects of automation and other technology enhancements, people are becoming more critical to the success of the mining operation."

The National Research Council 2001 report on the evolution and revolutionary technologies for mining contain the following recommendations for research and development in health and safety: (1) technology to alert equipment operators of the existence and location of obstructions (such as equipment, berms, miners, etc.); (2) design specifications for automated operation in the mining environment that enhance robustness and reliability; (3) miner training programs to address special hazards that are created by the introduction of automated systems; (4) identification and elimination of workplace hazards introduced by new chemicals and bioagents; (5) identification of workplace risk factors that lead to muscular skeletal disorders (e.g., low back pain) and the design of equipment and training problems to eliminate them; (6) technology for assessing health and safety conditions in mine atmospheres; monitoring equipment that can distinguish the source of airborne pollutants (blasting, diesels, oxidation, cutting); an instrument that can reliably measure the amount of diesel particulate matter; instruments that can accurately measure real-time personal exposures, particularly exposures to airborne respirable coal mine dust; (7) determination of the health effects of mixed mode exposures in mine environments; (8) new materials and technologies to reduce noise in mining equipment and systems; (9) linking of computer-oriented monitoring of conditions in

mines with a safety information system and a rapid communication system to provide specific information in real time to each miner; and (10) virtual reality training modules for miners and mining equipment operators.

THE AUTHOR'S VIEW OF CHALLENGES AND OPPORTUNITIES FACING THE MINING INDUSTRY IN THE QUEST FOR IMPROVED WORKER SAFETY

The U.S. mining industry has come a long way in its health and safety performance. However, in the year 2001 there were 72 fatalities associated with mining, 160 permanent disabling injuries, 14,426 lost-time injuries, and 759 new cases of occupational illness. Clearly, we have a long way to go.

Based on the information presented above, the author presents the following concerns: (1) Increased production leads to increased dust and methane generations. Control technologies and strategies must keep pace. There is a need for real-time monitoring. (2) Increased mining depths and more complex geologic conditions require a more site-specific focus on ground stability designs. (3) The range and complexity of problems faced by the mining industry mandates that we approach these challenges in partnership. (4) For mining to get its due in terms of health and safety accomplishments and to get its fair share of the resources, we must ensure that the public is aware of the vital role that mining plays in the quality of everyday life. (5) The insidious problems that we face in mining (e.g., noise-induced hearing loss) need to get more focus. (6) Increased production and more difficult geologic conditions lead to a higher chance of the occurrence of mining disasters. (7) The rapidly changing demographics of the mining workforce is apparent by the influx of younger and inexperienced miners. There is a need to capture the experience and expertise of older workers. The growing prevalence of English as a second language requires that we focus on training—*training that works*.

CONCLUSION

If we are to continue to make progress in the area of health, safety, and mine productivity, it is important that all of us—Government, industry, labor, and academia—come together and work together in partnership. The problems that we face are too difficult for us not to use the full weight and talent of all involved. In those efforts, we must never forget one thing: that our efforts must be about the health and safety of the mine workers.

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