# MINE SAFETY

by

James Westfield
Assistant Director- Coal Mine Safety
U. S. Bureau of Mines
Washington, D.C.

## ABSTRACT

During the last twenty years, we have witnessed changes in the mining industry that would have staggered the imagination of the past generation of miners. New mining complexes are being constructed throughout the country which are employing mining equipment, systems, and procedures that, at best, were just recently only a concept. Significant gains are being made in both the productivity rates and total mine production.

These improvements are certainly desirable and commendable, but it is evident from a study of mine safety records that a corresponding impressive improvement in mine safety has not been achieved. Although there has been an overall improvement in mine safety, the mining industry still has the highest injury rate when compared with the more than forty other major industries. The recent publicity associated with mine inundations, mine fires, mine explosions, and explosives accidents, along with the health hazards of mine atmospheres, has precipitated, and rightly so, demands from persons working in the mining industry and the general public for real and significant improvements in mine safety and health standards.

If the same type of desire, imagination, initiative, and effort that has produced the mining complexes that we have today is focused on mine safety, the desired improvements in mine safety can be accomplished.

Through safety orientated mine management, well directed company safety organizations, the use of properly designed and engineered mining equipment, systems, and procedures with safety as the primary consideration, the establishment of programs and systems that will insure full compliance with Federal and State mine laws at all times, and continued research in mine safety, we can make real and significant improvements in the industries' safety record. The mining industry can become a leader in the field of safety through our combined efforts.

During the last twenty years, we have witnessed changes in the mining industry that would have staggered the imagination of the past generation of miners. New mining complexes are being constructed and put into operation at an accelerated rate each year employing mining equipment, systems, and procedures that, at best, were just recently only a concept. Significant gains are being made in both the productivity rates and total mine production, and the mining industry is experiencing a steady increase in the demands for its products.

These improvements are certainly desirable and commendable, but it is evident from a study of mine safety records that a corresponding impressive improvement in mine safety has not been accomplished. Although there has not been an impressive improvement throughout the industry in mine safety, some mining companies and corporations do have an enviable safety record. Nonetheless, the mining industry, in general, has one of the worst fatal and nonfatal injury rates of the more than forty other major industries.

The recent publicity associated with mine inundations, mine fires, mine explosions, and explosives accidents along with pneumoconiosis and radiation hazards connected with mine atmospheres has precipitated, and rightly so, demands from within the mining industry and the general public for real and significant improvements in mine safety and health standards. Although disaster type accidents have been the catalyst which produced the present concern over mine safety, the mine safety record shows, as we in the industry well know, that accidents where only one or, at the most, two individuals are involved cause the vast majority of mine injuries. These injuries are usually the results of accidents involving falls of roof, face, and ribs, handling material, machinery, haulage, electricity, and falling material. Therefore, our concern has to be directed toward the prevention of all types of mining accidents in order to improve the overall mine safety record.

Our free enterprise system has developed to the point where excellence is expected in all fields which includes the field of safety. In our society, the safety and well being of the individual is the first consideration in any endeavor. The old time worn cliche "we cannot afford additional mine safety and health standards" is no longer acceptable. In fact, just the opposite is true. The mining industry can no longer afford to accept its own safety record. The mining industry must change the image that the public has concerning mine safety in order to fulfill its potential as a growth industry.

People are the basic requirements in any industry and with the demands now being placed on the labor market, the mining industry is finding it increasingly difficult to attract new and competent people to work in the mines, as people naturally migrate to what they consider to be the better areas of employment. This trend must be reversed or the mining industry can become stagnant or perhaps eventually die through attrition.

In order to improve the image of the mining industry, there must be a drastic improvement in our safety record. The logical foundation for establishing an outstanding safety program has to be a safety policy whereby safety takes precedence over all other considerations in practice as well as in fact. Reversing the public image of mine safety is, admittedly, a challenge, but this image can be radically changed through our concerted efforts. If the same type of desire, imagination, initiative, and effort that has produced the mining complexes that we have today is focused on mine safety, the desired improvements in our safety record can be accomplished.

Let us for a moment look at our mine safety record.

Injuries--frequency rates per million man-hours in coal, metal, and nonmental mines, 1948-1967, by kind of mine (excludes data for metal and nonmetal mills)

| Year | Coal | | | | | |
|---|---|---|---|---|---|---|
| | Deep mines 1/ | | Surface mines | | Grand Total | |
| | Fatal | Nonfatal | Fatal | Nonfatal | Fatal | Nonfatal |
| 1948 | 1.15 | 61.95 | 0.76 | 36.26 | 1.11 | 59.53 |
| 1949 | .97 | 57.69 | .39 | 31.55 | .91 | 55.11 |
| 1950 | .94 | 54.77 | .56 | 31.39 | .90 | 52.38 |
| 1951 | 1.19 | 52.77 | .51 | 34.25 | 1.13 | 50.99 |
| 1952 | .97 | 53.26 | .55 | 28.06 | .92 | 50.66 |
| 1953 | .96 | 49.38 | .38 | 29.48 | .90 | 47.23 |
| 1954 | 1.10 | 47.98 | .47 | 28.90 | 1.02 | 45.67 |
| 1955 | 1.06 | 48.10 | .56 | 23.07 | 1.00 | 45.03 |
| 1956 | 1.11 | 48.88 | .53 | 25.22 | 1.03 | 45.69 |
| 1957 | 1.30 | 49.23 | .45 | 26.68 | 1.17 | 46.04 |
| 1958 | 1.26 | 47.94 | .43 | 23.96 | 1.11 | 43.94 |
| 1959 | 1.11 | 44.90 | .42 | 22.52 | .99 | 41.09 |
| 1960 | 1.29 | 46.09 | .57 | 24.81 | 1.15 | 42.28 |
| 1961 | 1.34 | 48.19 | .39 | 24.66 | 1.15 | 43.86 |
| 1962 | 1.34 | 48.88 | .45 | 23.68 | 1.16 | 43.96 |
| 1963 | 1.28 | 48.62 | .53 | 24.87 | 1.12 | 43.97 |
| 1964 | 1.12 | 48.35 | .33 | 24.81 | .96 | 43.86 |
| 1965 | 1.21 | 49.09 | .39 | 26.39 | 1.04 | 44.73 |
| 1966 | 1.06 | 46.84 | .57 | 25.25 | .96 | 42.85 |
| 1967 2/ | .99 | 45.04 2/ | .52 | 24.64 | .89 | 41.23 |

1/ Includes data on bituminous coal preparation plants for all years, and for 1948-56, includes data on anthracite preparation plants

2/ Preliminary

Metal

| Year | Deep mines | | Surface mines | | Grand Total | |
|---|---|---|---|---|---|---|
| | Fatal | Nonfatal | Fatal | Nonfatal | Fatal | Nonfatal |
| 1948 | 0.72 | 56.45 | 0.39 | 15.57 | 0.64 | 47.25 |
| 1949 | .58 | 57.99 | .15 | 15.30 | .48 | 48.07 |
| 1950 | .70 | 56.07 | .21 | 12.66 | .57 | 44.74 |
| 1951 | .71 | 53.52 | .31 | 15.24 | .60 | 42.81 |
| 1952 | .94 | 52.61 | .21 | 14.57 | .74 | 42.13 |
| 1953 | .72 | 50.68 | .29 | 14.07 | .59 | 39.36 |
| 1954 | .74 | 48.45 | .46 | 12.36 | .66 | 38.27 |
| 1955 | .71 | 54.22 | .25 | 14.06 | .58 | 42.62 |
| 1956 | .82 | 50.15 | .18 | 11.06 | .62 | 37.91 |
| 1957 | .62 | 42.50 | .23 | 8.48 | .50 | 32.03 |
| 1958 | .86 | 41.19 | .19 | 13.21 | .64 | 31.95 |
| 1959 | .95 | 42.41 | .27 | 12.75 | .73 | 32.62 |
| 1960 | .96 | 45.40 | .31 | 11.14 | .70 | 31.71 |
| 1961 | .60 | 46.78 | .21 | 10.89 | .46 | 34.07 |
| 1962 | .78 | 44.26 | .26 | 9.65 | .59 | 31.42 |
| 1963 | .55 | 45.62 | .22 | 8.85 | .42 | 31.66 |
| 1964 | .69 | 44.34 | .26 | 9.35 | .53 | 31.34 |
| 1965 | .68 | 42.87 | .27 | 9.08 | .52 | 29.32 |
| 1966 | .98 | 43.64 | .22 | 11.70 | .67 | 30.71 |
| 1967 | .95 | 42.47 | .30 | 12.39 | .68 | 30.02 |

Nonmetal

| Year | Deep mines | | Surface mines | | Grand Total | |
|---|---|---|---|---|---|---|
| | Fatal | Nonfatal | Fatal | Nonfatal | Fatal | Nonfatal |
| 1948 | 0.52 | 45.66 | 0.57 | 36.93 | 0.54 | 42.33 |
| 1949 | .51 | 45.79 | .11 | 33.88 | .37 | 41.75 |
| 1950 | .59 | 50.46 | .82 | 30.16 | .67 | 43.51 |
| 1951 | .65 | 53.70 | .39 | 27.63 | .56 | 44.84 |
| 1952 | .37 | 48.11 | .70 | 25.90 | .48 | 40.44 |
| 1953 | .97 | 57.94 | .20 | 22.40 | .72 | 46.54 |
| 1954 | .26 | 39.23 | .39 | 19.58 | .30 | 32.34 |
| 1955 | .56 | 40.83 | .70 | 30.89 | .61 | 37.18 |
| 1956 | .30 | 37.38 | .80 | 20.48 | .50 | 30.50 |
| 1957 | .26 | 35.09 | .21 | 20.04 | .24 | 29.36 |
| 1958 | .74 | 43.52 | .27 | 18.89 | .43 | 27.56 |
| 1959 | .22 | 42.96 | .35 | 21.48 | .30 | 29.50 |
| 1960 | .63 | 46.60 | .46 | 19.16 | .52 | 28.69 |
| 1961 | .64 | 36.88 | .30 | 17.45 | .42 | 24.24 |
| 1962 | .73 | 42.64 | .25 | 20.80 | .43 | 29.06 |
| 1963 | 2.27 | 39.64 | .10 | 17.72 | .95 | 26.34 |
| 1964 | .58 | 37.96 | .45 | 17.33 | .50 | 25.18 |
| 1965 | .87 | 39.20 | .38 | 18.70 | .56 | 26.19 |
| 1966 | .74 | 37.49 | .22 | 20.05 | .39 | 25.80 |
| 1967 | .46 | 43.09 | .43 | 18.58 | .44 | 26.83 |

| | 1966 | 1967 |
|---|---|---|
| Manufacturing | 13.6 | 14.0 |
| Textile mill products | 10.6 | 9.8 |
| Lumber and wood products, except furniture | 36.1 | 39.2 |
| Primary metal industries | 15.0 | 15.1 |
| Contract construction | 27.9 | 26.0 |
| Transportation and Public Utilities | | |
| Local and interurban passenger transits | 23.5 | 23.9 |
| Electric, gas, and sanitary utilities | 5.5 | 5.6 |
| Wholesale and Retail Trade | 11.9 | 11.2 |

It is evident that there has been very little improvement in the fatal frequency rates for coal, metal, and nonmetal mines during the past twenty years. There has been a steady improvement in the nonfatal frequency rates, but our present frequency rate is still high when compared to the nonfatal frequency rates of other major industries.

As previously stated, humanitarian considerations have to be, and I am sure we will all agree, the first consideration in any endeavor. The avoidance of suffering, the destruction of health, and loss of life are the overriding factors that must be considered first by any responsible industry. Regardless of how we look at it, mine accidents are destructive. They are accompanied by human suffering and loss, and they will destroy efficiency and productivity. The needless destruction of life, health, and physical well being is morally unacceptable by the standards of values we deem important.

It may be states secondly that safety and efficiency are inseparable in the achievement of continued operating success. A good safety record will improve morale, promote better employee and public relations, reduce absenteeism, improve productivity, and in the final analysis improve the overall posture of the mining industry. It is obvious, we will all benefit by an improvement in mine safety, and to improve mine safety, we must provide conditions of employment that are creditable to mine employees, as well as to the mining industry.

Through safety orientated mine management, well directed company safety organizations, the use of properly designed mining equipment, systems, and procedures, the establishment of programs and systems to insure full compliance with Federal and State mining laws, and continued research in mine safety, we can make the desired improvements in working conditions and eventually mine safety.

In the final analysis, accountability and responsibility for mine safety rests in the hands of top mine managers. Although top mine managers operate and function through staffs, they have to establish goals, provide the facilities, materials, and personnel, and initiate policies. They must, for the sake of success, establish the overall intent of their policies. This is particularly true when establishing a mine safety policy.

It is sincerely felt that a mine safety policy based on the proposition that safety takes precedence over all other considerations is needed throughout the mining industry. This policy along with top management's demonstrated intent that the policy will be followed in actual practice is the basic foundation required in building an outstanding safety record. Top management can display its intent toward safety by providing adequate facilities, materials, and personnel, by directing and supporting all supervisors in their safety duties, by signed safety letters and messages to employees,

and through everyday conversations. When employees are convinced that safety is the first consideration, they will have a natural tendency to think and work safely.

A well organized and directed company safety department that is accountable only to top management is essential in the type of mining we have today. Mining equipment, systems, and procedures are more complicated and mining operations are geared to fast extraction and mass handling of large quantities of material. This type of mining requires the services of a full time mine safety department staffed by persons with knowledge, abilities, and interests in mine safety. Naturally, the size of the mining operation will dictate the size of the safety department. Some of the most important areas of responsibilities that should be assigned to a safety department are as follows:

1. Establish a systematic training program for potential supervisory personnel, and maintain a current and active training program for all levels of supervision.

2. Establish training programs for new employees and follow-up training programs for all mine personnel. Federal and State training courses in first-aid, mine rescue, and accident prevention should be used to supplement company presented courses and on the job training. An all out effort to obtain 100 percent participation should be made.

3. Establish a job safety analysis program and instruct all employees in the safe way to perform their work. When different types of equipment, systems, or procedures are put into operation, all employees involved should be instructed concerning the safety aspects that will be involved.

4. Establish and maintain emergency procedures and instruct all employees in emergency procedures.

5. Train and maintain mine first-aid and rescue teams.

6. Establish mine and plant inspection procedures and make formal reports concerning these inspections.

7. Establish accident investigation procedures, investigate accidents, and make recommendations to prevent similar accidents. A follow-up program should be initiated.

8. Establish and maintain accident records and applicable injury statistics.

9. Establish programs to recognize outstanding safety records of individuals and groups.

10. Participate in company, industry, and governmental safety meetings, and make an effort to be informed of new or improved safety devices or procedures.

11. Promote safety through safety literature, posters, and slogans.

Although a mine safety department should be accountable only to top management, the department should work with and through local mine management. The interest and cooperation of all levels of management is needed to obtain the desired results from a safety program.

The use of properly designed and engineered mining systems, equipment, and procedures with safety as the primary consideration is essential for an overall improvement in mine safety. In the design of a new mine or in the development of an existing mine, the system of mining should be compatible with seam conditions and the extent of the area to be mined.

Mining systems that are used without due consideration to seam conditions or the extent of the area to be mined can produce safety problems in areas, such as, ventilation, transportation, or roof control. It may become difficult to keep intake air, return air, and transportation entries open, and to ventilate face areas. In all cases, the system of mining should be developed on the basis of safety in relation to inherent seam conditions and the extent of the area to be mined.

The size and type of mining equipment employed should be based on the safe operation of the equipment in connection with the system of mining required. If seam conditions, such as a roof control problem, dictates a narrow entry system of mining, then the size and type of the mining equipment must be compatible with the narrow entries and safe operating procedures. Also, the size and type of mining equipment should not interfere with ventilation and roof control procedures.

All phases of mining are interconnected and the overall mine operation must be developed with safety as the first consideration. We cannot afford to consider mine safety a hit or miss proposition anymore than production can be considered a hit or miss proposition.

Programs and systems must also be developed for each mine which will keep the mine in a safe operating condition at all times. For these programs to be effective, they must be an integral part of every work cycle. Let us for a moment consider some examples:

1. Ventilation

A ventilation system that will insure positive ventilation throughout the mine must be used along with a system of active bleeder entries to prevent the accumulation of flammable or harmful gases within the mine. Auxillary fans, line curtains, or other approved devices must be used systematically to provide positive face ventilation at all times.

2. Loose coal and coal dust

A systematic program must be established along with the other

operating work cycles to keep loose coal and coal dust from accumulating in the mine.

A system of water infusion into the seam and/or water sprays, using a wetting agent, installed on all cutting machines, loading machines, continuous miners, conveyor installations, material transfer points, and along track haulage entries should be seriously considered to help control mine dust. Coal dust must be controlled to have an acceptable mine atmosphere and to prevent float coal dust from settling throughout the mine. Conveyor entries and material transfer points must be isolated from high velocity air currents.

3. Rock dusting

A system of keeping the mine adequately rock-dusted at all times must be initiated. Wet rock dusting in working areas and the use of continuous rock-dusting equipment in return air entries and along conveyor entries is a system that deserves consideration.

4. Mine equipment

A preventive maintenance program must be established to keep mine equipment in a safe operating condition at all times. A positive ground fault system for D.C. equipment and a continuously monitored ground system for A.C. equipment must be used. A lock-out program should be initiated when repairing electrical equipment. Methane monitors should be installed on equipment that operates in the immediate face areas of gassy mines.

Good programs and systems will also eliminate a considerable amount of wasted time, labor, and materials. Poor, inadequate, or unplanned work will almost always result in doing the same job a second or third time.

The mining industry has proven by past examples that programs and systems can be developed to effectively combat problems within the industry. Not too long ago, silicosis was a dreaded occupational disease in the matal mining industry, but through an intensive study, programs and systems were initiated and adopted to control the silica dust which produced this lung disease. The hazards of exposure to alpha radiation are now being brought under control in the uranium mining industry. Through better ventilating systems and mining methods, the standard that no employee shall be permitted to recieve an exposure of more than 6 working level months in any consecutive 3 month period and no more than 12 working level months in any consecutive 12 month period of radon daughter atmospheric concentrations is now being established.

When a new problem occurs or when a problem is first recognized in the mining industry, the industry, in many instances, is too quick to reply that a solution to the problem is impossible or impractical,

but in the fianl analysis, we can find ways and means to solve our problems.

It should also be mentioned that all mining organizations should encourage and support continued research in mine safety. There are many areas, such as, mine ventilation, dust control, roof support, and mining equipment where continued research from the standpoint of safety is needed.

As we all know, mine safety is a complete field of study within itself, and at best, we have only been able to briefly discuss the subject. An attempt has been made to stress the need for an improvement in mine safety and to present a few thoughts on some areas that need to be considered in order for us to improve our mine safety record. By making safety the first consideration in our overall concept of mining, we can make the needed and desired improvements in our mine safety record.

In conclusion, I would like to express my appreciation for the opportunity to participate with you in this mine environmental conference. Thank you.

## COMMENTS

QUESTION: I have a question for Mr. Cook. I wondered whether you have any statistics on just where accidents take place. I think I read a figure a few years ago that something like 70% of the accidents that take place were within 30 feet of the actual mining face. Is this still true?

ANSWER: That is still pretty much true - within 25 feet of the working face. I'm not giving it as a definite figure, but I feel sure it's within that range.

QUESTION: Mr. Cook, in regards to this concentration of accidents near the face, do we also have a concentration of workers near the face.

ANSWER: That's true.

QUESTION: You realize the roof is much more dangerous before you can get some control under it. Have they gone any further in this statistical examination of accidents in relation to the concentration of workers as to different types of accidents in relation to the nearness of the face? Accidents can only happen where people are.

ANSWER: This is true and to answer your question, I really don't know whether they have or not. But I do know that most accidents in coal mining which I'm more familiar with happen beyond roof support.