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Mining Sessions

MANAGEMENT'S ROLE IN MINE SAFETY LEADERSHIP

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The field of industrial safety may be in the throes of its first encounter with "future shock." Future shock has been defined as that condition in which the rate of change dazzles the mind, making weaker men long for a return to the sane and simple "good old days." That definition troubles me. It indicates that I entered shock at about the time of my fortieth birthday and have gone continuously deeper into shock ever since.

Whether or not we are in future shock, we are certainly passing through a period of more radical and more rapid change than we have ever experienced before, and it will probably get worse before it gets better. I would like to briefly review the development of this situation, and attempt to examine what it all means to mine managers and their role in job safety leadership.

Many late arrivals to the field of safety would have us believe that concern for industrial health and safety came to the mining industry through the recent efforts of socially-conscious outsiders. They would have us believe that management's role in safety leadership is a new and imposed one that is yet to be accepted by management. I believe we all know that nothing could be further from the truth. The American mining industry has a long and proud record of concern for safety and health in mines and their associated metallurgical plants. Major mining associations, including the American Mining Congress, have long maintained trained specialists to assist individual companies or managers with complex and unfamiliar problems. The work of the Bureau of Mines in the setting of standards and in the encouragement and support of job safety and health has long been of the highest order. But most important the majority of individual managers in the industry have long accepted the awesome responsibility for the job safety and health of their employees.

Despite a long history of continuing improvement in industrial safety, many outside industry, and some within it, felt that progress had been too slow, that some companies or managers were not keeping up or simply that legislation was required in order to effectuate what they saw as compelling social policy. Whatever the reasons, employee health and safety is now clearly a subject of major concern with the federal government.

In the short span of two years, 1969 and 1970, the Congress enacted three stringent safety laws: the Federal Coal Mine Health and Safety Act of 1969, the Occupational Safety and Health Act of 1970, and the Federal Railroad Safety Act of 1970. These laws, collectively, cover virtually all of the nation's industry. Amendments to modify and strengthen the administration of the Federal Metal-Nonmetallic Act of 1966 are still under consideration by Congress. Three federal agencies, the Departments of Labor, Interior, and Transportation, have been given broad regulatory power and substantial appropriations with which to implement these federal laws in health and safety.

From this formidable array of actions, one might logically conclude that the federal law-making process has about run its course on the subject of employee health and safety. Such may not be the case. The Congress is a political institution and, thus, one legislative effort which is successful by political standards creates incentives for other similar efforts. Consequently, we should not be surprised to see the federal employee health and safety laws continue to expand for the remainder of this decade.

This legislation is affecting nearly every aspect of the employment relationship and the federal government is now regulating such diverse matters as the height of railings, the amount of dust in the air, noise levels, and the type of equipment to be used in the performance of a particular task. Potentially, regulations could be adopted fixing the number of hours employees should work, the qualifications needed to perform certain jobs, and the size of crews thought necessary for safe work performance. The undefined "general duty" obligation imposed upon employers will remain a heated issue for many years to come.

It is also evident that collective bargaining concerning job health and safety has intensified, at least in part as a result of this new legislation. Contractual provisions concerning specific safety and health conditions have been more earnestly sought by labor organizations in recent negotiations. Some managers have been tempted to relieve themselves of some of their responsibility by sharing the safety effort with the bargaining agent. But this is neither possible nor desirable. Management's responsibility in this area cannot be delegated and no right-minded union is going to accept any of management's burdens, except in an advisory capacity, regardless of the individual human concern of its officers and members.

On the other side of the coin, employers are intensifying their efforts to provide sanctions to require employee compliance with the detailed provisions of new health and safety regulations. How much success may be gained in this area is yet to be seen.

Without question, the improvement of job safety and health programs is desired by all. It remains to be seen, however, whether legislation can be an effective or efficient method of providing safe working conditions for American workers, including miners.

Experience in the industry has long taught that it requires much more than regulation to achieve improved health and safety conditions, since less than one-third of accidents are caused by physical fault and less than 10 per cent of these are due to lack of mechanical protection —the only area that can be corrected by statute. Nine-tenths of all accidents, then, find their source in man's constitution and his behavior in the actual work environment. Carelessness, lack of foresight, inattention, awkwardness, of which we are all guilty, reduce the effectiveness of the best technical arrangements. We cannot standardize employees, as is implied by these various Acts, and still have them behave as free human beings. No two of us are alike, and for that reason standardizations tend to kill the very things we are striving to preserve—human initiative, desire to create, desire to produce, desire to excel. It has been and continues to be our contention that despite the efficacy of safety and health standards and regulations, the best safety device continues to be the safe worker; and the safe worker becomes a safe worker as a result of the leadership provided by a responsible and responsive management.

The human being, wherever and whoever he may be, is capable of far greater creative accomplishments than he ever has had the opportunity to show. No one has yet invented a machine to match the miraculous quality of the human mind. No one ever will. Competent management has for its purpose the release of this pent-up productivity and usefulness so that human resources may be fully employed toward ever increasing the well-being of us all. Management practices, when based on sound moral principles as well as on experience and scientific knowledge, are the most powerful and creative of social as well as economic forces with which to maintain and advance mankind's interests. And the safety and well-being of employees will always rate the highest place in the list of mankind's interests.

How then have these recent changes affected the manager's responsibility? In some ways they may make his job easier, in some ways they will make it more difficult, but management still has the ultimate responsibility for the safety and well-being of its employees. Given this unchanged and unchangeable responsibility, management must prepare itself to meet that responsibility under rapidly changing conditions.

Meeting this responsibility still requires much more than lip service or pious exhortations. It requires a dedication by management to the goals of safety

and a program involving all employees that recognizes the human factor in accidents and the individual differences in employees.

Top management must set definite safety objectives and policies in the first place. How top management chooses to support and implement its policies is crucial to the effectiveness of those policies. It is top management that decides, ultimately, even in the largest corporation, how extensive a safety organization to set up, the caliber of safety personnel that will be employed, and how much money, in total, it will invest in safety. The single most important element in the success or failure of any company-wide program, whether it be safety, training, research, or maintenance, is the emphasis given that program by top management.

Too often top managers with a multitude of other problems and pressures hope that with the appointment of that brilliant new safety director they can delegate all responsibility for safety and get on with the activities only they can perform. Nothing could be further from the truth. That brilliant new safety director cannot do it alone. The only way to achieve and maintain a safe mine or plant is for top management to place its own responsibility for safety on at least an equal status with its responsibility for production, cost control, quality, and profits. Whenever the responsibility for maintaining a safe mine or plant is relegated to a frill that can be attended to only after the more important objectives are achieved, then injury rates will be high and will remain high until line management at all levels devotes adequate attention to accident prevention. If certain foremen or workers are not released to attend safety meetings because they cannot be spared from production, then the safety effort will suffer. If requisitions to design and install machine guards are put aside because plant engineering has "more important" work to do, then the safety program will deteriorate. In short, the basic responsibility for injury prevention rests with line management. It starts with the company president and goes vertically downward through the entire hierarchy—vice president, plant manager, production superintendent, and foremen, to the actual worker.

The staff safety director plays a key role in mine safety but he rarely has line authority to order supervisors and workers to take a particular action in regard to safety. But if he is chosen well he will acquire considerable influence in the establishment of plant policies, procedures, and the development of engineering standards. He must work closely in those areas with other line and staff managers. Only if they recognize his proficiency and specialized competency will his views be given the proper weight.

In summary, we in the mining industry have witnessed an increasing growth and proliferation of federal safety and health laws and, by these, a broadening incursion by government into many areas of industrial life. We have no quarrel with the need for greater national interest in the health and well-being of industrial workers; in fact, we welcome it. We do not doubt that most of this legislation results from genuine humane concern. However, concern of itself does not generate wisdom, and much of the legislation appears to be of questionable value in reducing frequency and severity rates. Too often the direction of this legislation is punitive. No amount of standard setting, no amount of fines will of themselves reduce accidents. In the final analysis, management through the proper exercise of its prerogatives is the only effective agent in so developing each unique, individual employee that the entire potential of the company is directed consciously and subconsciously toward safe working in a healthy environment. The laws and fines approach is negative, and although high costs may make safety a preferred condition, costs cannot of themselves bring about safety goals. Achievement rests solely with management—knowledgeable and dedicated to safety as an integral function of management. Federal agencies may provide technical assistance and determine proper standards. Unions must remain unions and advise and question. But neither federal agencies nor unions can properly absorb any of management's primary role in safety leadership.

Our most serious risk is that workers and managers may feel that now that we have detailed laws on the subject their problems as to safety and health have been miraculously taken care of. Or that

in the proliferation of reports and inspections the efforts of management will be dissipated and diverted from the main business at hand—providing a safe and healthy workplace. Only a management dedicated to providing positive leadership can ensure us a safe and healthy future in our industry. We can do this by continuing a one-to-one safety relationship with each employee so that safety becomes a part of the fabric of the workplace and by questioning each new incursion by federal agencies into this area to be certain that what is proposed will accomplish the good promised without detracting from the good already achieved.

I would like to conclude with some personal thoughts on the basic incentives that have motivated management in the past or might motivate them in the future. I believe there are possibly only three basic, long-term incentives for management attention to safety. They are: financial, i.e., the cost of accidents; legal, i.e., personal liability of the manager; and humanitarian, i.e., concern for human suffering. A fourth, competition between managers, is usually a created incentive and hence neither basic nor necessarily long-term.

Although the most frequently discussed, I believe the financial incentive may be the least effective of the three, particularly at higher management levels. On a purely financial basis, the cost of accidents warrants the manager's time only to the extent of its relative importance in his over-all financial responsibility. On a purely financial basis, if the cost of accidents represents one per cent of a line supervisor's total costs, then safety warrants a full one per cent of his time. On a purely financial basis, if the cost of accidents represents one-tenth of one per cent of a top manager's total financial responsibility, then safety warrants one-tenth of one per cent of his time. This incentive seems inherently weak and is least effective at the top level where, any safety engineer will agree, strong incentives can have the most widespread effect.

Coercion, effected by making the manager personally liable for accidents, either civilly or criminally, has never to the best of my knowledge been tested in the English-speaking world as an incentive to reduce industrial accidents. Although there is a legal base for such liability in those countries whose legal systems are based on the Napoleonic Code, and in most communist countries, the penalties have seldom been applied, and then only in cases involving gross negligence or for political purpose. Such liability has been suggested by extremists during debate on recent legislation, but wisely rejected by the legislators. Any experimentation in this area must be approached with extreme caution. As with some drugs, the side effects of the curative can be more devastating than the disease.

The least discussed, the most underrated as to its current effect on managers, and I believe the potentially most effective of the three basic incentives, is a simple concern to prevent human suffering. This concern is both inherent in the species and an integral part of the American culture. This is why a serious accusation of lack of concern frequently brings forth a violent reaction. Nice people do not question one another's concern for fellow human beings. However, only the recognition that this is now a major and highly effective portion of our incentive mix, and should be sufficient incentive in and of itself for proper action, will allow us to exploit this natural concern to its fullest.

I believe the question we should be asking ourselves and one another is not, Do you know how much accidents are costing? or, Do you know you can go to jail or be fined for that? but, Do you have the proper concern for the health and well-being of those men and women who have entrusted themselves to your leadership?

75 912

AUTOMATIC FIRE PROTECTION FOR LARGE HAULAGE VEHICLES

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As mine haulage vehicles become larger, the danger to a driver during a fire emergency increases. This is because the cab is located higher above the ground and the access ladder is usually located next to the engine compartment, the area where most vehicle fires occur. This fact was illustrated, unfortunately, in January 1973 when a truck driver in Upper Michigan was seriously hurt when he was forced to jump from his truck during a flash fire in the engine compartment. The truck was a 75-ton capacity model, which is of only moderate size considering the 200-ton capacity models now available. The vehicle's cab was 8½ feet above the ground, and the driver fractured both heels and received first and second degree burns. The Bureau of Mines Health and Safety Report (No. 20-00424) on the accident stated: "An automatic fire extinguishing system may have prevented personnel injury and minimized property damage."

To help solve this health and safety problem and better protect a very expensive piece of equipment, the Bureau of Mines, through contract research, has developed an automatic fire protection system for large haulage vehicles. This work was accomplished through two contracts with FMC Corporation, San Jose, Calif. The first contract was awarded in June 1972 and ended on schedule in May 1973. The second contract was awarded in June 1973 and ended in April 1974. One objective of the first contract was to define the large mobile vehicle fire problem and develop design criteria to solve the problem. Another objective of the first contract was to find the most fire-prone class of large, mobile, open pit mining equipment. Once this vehicle was found, its fire problem was to be solved with a system flexible enough to be applicable (with modifications) to other large mobile equipment.

As a result of this study, a dual sensing, automatic with manual override, fire detection and suppression system was designed for use on haulage trucks of over 100-ton capacity. The system protects both the engine compartment and brake grid areas of the truck and suppresses the fire with pressurized B-C class powder. Both near-infrared and thermal wire sensors are used to detect the fire. The system also has a timing sequence to allow the driver to test the fire warning signal and use manual discharge, but if the driver does not activate the system, it automatically discharges the powder to extinguish the fire before it spreads. An automatic with manual override fire protection system was thought preferable over a manually activated system because of the panic situation usually prevalent during a fire emergency, as many times the driver's only thought is getting away from the truck. Automatic engine shutdown is currently not a part of the system, but such a design alternative could be easily built in if a user would think that such an option is desirable. Applications of the system or variations thereof to other mobile equipment can also be visualized.

The third objective of the first contract was the fabrication of a prototype system and mine site fire testing of the system. The system's novel hardware was successfully demonstrated in April 1973 on a 100-ton capacity truck at the Pima mine, Tucson, Ariz. The first contract's final report will be available through the National Technical Information Service in Springfield, Va.

The first objective of the second and current contract with FMC was to reinstall the automatic truck fire protection system prototype on a 100-ton capacity truck at the Pima mine for long-term, hot weather reliability testing. Such testing was very beneficial in pointing out weaknesses in the first system. As a result, a

modified system was developed and is currently undergoing long-term, cold weather testing at the Erie Mining Co., Hoyt Lakes, Minn., which fulfills the second objective of this contract.

It should be noted that both systems have been designed so they are easy to install and their cost is very reasonable (about $3,000 to $5,000) when compared to the $200,000 and higher cost of the truck. In addition to a final report, the second contract will also produce an "Automatic Truck Fire Protection Selection and Use Manual." The final report and user manual will also be available through the National Technical Information Service.

In conclusion, it should be noted that during the long-term testing of the system at Pima, an accidental fire occurred in the engine compartment of the test truck. This was a flash fire which occurred on October 7, 1973, while the truck was working in the pit. The driver did not manually discharge the system before he exited the truck. However, the system automatically sensed the fire and successfully extinguished it. There was no injury to the driver and very little damage to the truck. In fact, the truck was back on shift work within eight hours. Similar fires in the past have cost $15,000 to $40,000 and more in truck repairs. The Bureau of Mines and Pima Mining Co. are happy with the success of the system during the accidental but very convincing test of the system's effectiveness.

(There followed a slide presentation of the development, installation, and operation of the system.—Ed.)

75 913

UPDATE ON THE FEDERAL METAL AND NONMETALLIC MINE SAFETY ACT

By JAMES M. DAY
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In May 1973, the secretary of the interior created the Mining Enforcement and Safety Administration (MESA). The purpose of the secretary's action was to intensify federal mine health and safety efforts and to insure that MESA could perform its duties free from any real or apparent conflict of interest with the Bureau of Mines.

The reorganization involved the transfer of five basic functions from the Bureau of Mines to MESA: metal and nonmetal mine health and safety; coal mine health and safety; education and training; technical support; and Office of Assessments. Each of these functions relates directly to the singular purpose of the MESA organization—to safeguard the health and safety of our nation's miners.

Statutory Authority

Statutory authority for MESA metal and nonmetal mine health and safety activities is the Federal Metal and Nonmetallic Mine Safety Act, which was enacted in 1966. The Act provides for the development of federal health and safety standards and for their application and enforcement. It requires the inspection of metal and nonmetal mining and milling operations to insure compliance with mandatory standards. Public Law 89-577 also provides for programs for education and training, technical support research, and the collection of injury and employment information. The Act also authorizes coordination of federal and state mine health and safety activities through development of programs wherein states which meet certain criteria may submit plans for the approval of the secretary of the interior, so these states may conduct their own health and safety inspection programs under federal monitoring. There are now seven State Plan States.

Inspections

The Act does not specify the frequency at which these inspections are to be made, except that underground mines shall be inspected at least once each calendar year.

Three types of inspections are conducted by metal and nonmetal mine inspectors. "Regular" inspections consist of a complete health and safety audit into all aspects of an entire mine or plant, including careful observance of all working places, haulageways, escapeways, and associated surface and maintenance facilities. The first inspection of a mine during the year is generally a regular inspection.

"Limited mine area" inspections are made at mines too large for one inspector to conduct an effective regular inspection of the complete operation within a reasonable time. The content of the inspection is the same as a regular inspection but is limited in area, such as one level of a multi-level mine. The total of several LMA inspections constitutes one regular inspection.

Finally, MESA inspectors make "spot" inspections, generally as a follow-up to the regular or limited mine area inspections, for such purposes as checking on action by mine operators to abate violations of mandatory standards and, where appropriate, to terminate notices, extend time for abatement, or issue orders. Spot inspections may also be made for other special purposes relating to health and safety.

Inspection Force

The law requires that persons selected for the job of metal and nonmetal mine inspector have the basic qualification of at least five years of practical mining

experience, and in addition these persons must meet rigorous physical qualifications.

MESA's metal and nonmetal inspection force has grown in numbers, from 150 as of July 1973 to 225 as of July 1974, and we hope to increase this to 300 by July of 1975. Persons selected for metal and nonmetal inspection positions receive classroom and on-the-job training.

So far this year, three six-week courses of study at the National Mine Health and Safety Academy at Beckly, West Virginia, starting January 28, February 25, and May 6, were completed by recently employed metal and nonmetal inspector trainees in classes of about 30 each. A fourth class began on September 24, 1974. Each class will receive intensive training in a broad range of subjects pertinent to inspection and investigation activities.

When an inspector in training is considered qualified to conduct inspections and investigations under the Act, he is designated a duly authorized representative (DAR) of the secretary.

Conducting Inspections

There is no advance notice given to either the mine operator or workers of a pending inspection. Upon arrival at a mine, the metal and nonmetal inspector advises both management and union representatives, if any, that he is there to conduct an inspection. Under the law, union participation in the actual inspection is at the discretion of the mine operator; however, to achieve a complete safety program, cooperation between labor and management is essential. Therefore, our inspectors are advised to encourage mine operators to invite participation in the inspection by employee representatives. Ideally, the representative should be a member of the employee safety committee.

It is highly desirable that a responsible management official accompany the inspector. Hazards are discussed with appropriate officials as soon as they are observed, and management is urged to correct dangerous conditions immediately when possible. The inspector makes a point to talk to the mine workers; however, all notices and orders are issued to mine management during the inspection as necessary.

Upon completion of an inspection, the inspector holds a post-inspection conference with management to discuss findings and recommendations. Notices and orders issued during the inspection are also discussed. If a labor representative did not participate in the inspection or post-inspection conference with management, the inspector offers to hold separate discussions with a workers' representative after the meeting with management. Post-inspection conferences are very important.

A formal report is prepared after each inspection. Copies of the report are distributed to interested persons, including company officials, state inspection agencies, and all unions which represent employees at the operation.

Enforcement

Under enforcement provisions of Public Law 89-577, when an inspector finds a violation of a mandatory standard, he is authorized to issue a "Notice" citing the violation and specify a reasonable time for total abatement of the hazard. If the mine operator fails to correct the condition within the time specified, the inspector may either extend the time for abatement or he may issue an order withdrawing men from the mine or the affected area for failure to comply with the notice. The inspector is also empowered to issue an order requiring the immediate withdrawal of all men from the affected area, except those necessary to eliminate the danger, when he finds an imminent danger condition which would reasonably be expected to cause death or serious physical harm.

Penalties provided by the law include restraining orders, injunctions, fines, or imprisonment when an operator fails to heed certain requirements of the law.

Scope of Metal and Nonmetal Inspection Responsibility

There are approximately 14,300 active mining operations in the United States that come under the jurisdiction of the Federal Metal and Nonmetallic Mine Safety Act. This includes 700 underground mines; 5,200 open pit mines and crushed stone operations; 7,600 sand gravel operations; and about 800 mills.

During 1973, metal and nonmetal mine

inspectors conducted a total of nearly 17,000 inspections. This inspection activity was an increase of 27 per cent over the 13,000 inspections made in 1972. Establishment of additional field offices resulted in a reduction of inspector travel time.

The 17,000 inspections conducted during 1973 included 3,000 at underground mines, 2,400 at open pit mines, 4,700 at crushed stone quarries, 6,000 at sand and gravel operations, and 400 at mills. During the first seven months of 1974, total inspections of 11,300 indicate a continued increase of 18 per cent over a corresponding period of 1973.

Notices of Violations

A total of 63,000 notices were issued for violations of mandatory standards noted during the course of all inspections conducted in 1973 compared with 55,000 notices issued in 1972. Notices issued during the first seven months of 1974 totaled 47,600. This was an increase of 30 per cent over the same period in 1973.

Mandatory Standards Most Frequently Cited In Notices Issued

A detailed breakdown of more than 60,000 notices issued during the 12-month period of July 1973 thru June 1974 reveals that 10 standards accounted for nearly 55 per cent of all notices. Mandatory Standard .14-1, requiring guards on moving machine parts, was by far the most frequently cited. Nearly 15,000 notices, one-fourth of all notices issued, cited this standard. The second most frequently cited standard was .11-2, requiring handrails along elevated walkways; more than 4,000 notices were issued on this standard. More than 2,700 notices were issued citing Standard .4-2, requiring no smoking signs, making it the third most frequently cited standard.

Following, in order of ranking, were Standard .11-12, requiring that openings be guarded to prevent fall of person or falling object accidents (2,700 notices); Standard .11-1, requiring safe access to working places (2,600 notices); Standard .9-22, requiring berms along elevated roadways (2,400 notices); Standard .9-7, requiring emergency stop cords along conveyor belts (2,000 notices); Standard .12-25, requiring grounding of electrical equipment (1,500 notices); Standard .16-5, requiring compressed and liquid gas cylinders be secured safety (1,500 notices); and Standard .9-11, requiring mobile equipment windows to be in good condition and kept clean (1,300 notices).

Withdrawal Orders

MESA inspectors found it necessary to issue 965 withdrawal orders nationwide at metal and nonmetal mines during 1973, as compared to 210 orders issued in 1972. Approximately half of the withdrawal orders issued in 1973 were for imminent danger conditions; the balance were issued for noncompliance with previously issued notices. Of the 965 orders issued in 1973, 771 were terminated following satisfactory abatement of the unsafe conditions. Through July 1974, the number of orders issued was 1,012—an increase of 80 per cent over the same period of 1973.

Mandatory Standards Most Frequently Cited In Withdrawal Orders Issued

A ranking of specific standards cited which resulted in issuance of withdrawal orders during the 12-month period July 1973 thru June 1974 is revealing. Ten standards accounted for 60 per cent of 1,282 orders issued. Standard .14-1, moving machine parts not guarded, was most frequently cited, accounting for 143 withdrawal orders. The next most frequently cited standard was .3-5, men working under unsafe banks, for which 113 withdrawal orders were issued. This was followed by standard .3-22, unsafe ground control practices, for which 102 orders were issued; followed closely by Standard .9-3, brakes on mobile equipment, with 75 orders issued during the 12-month period.

Following in order of ranking of standards most frequently cited for which withdrawal orders were issued was Standard .11-1, safe access to working places (56 orders); Standard .3-20, unsafe ground support (52 orders); Standard .5-1, exposure to airborne contaminants (48 orders); Standard .11-2, handrails along elevated walkways (43 orders); Standard .9-2, unsafe equipment (42 orders); and Standard .9-22, berms along elevated roadways (40 orders).

From this very brief and incomplete discussion of most frequently violated federal mandatory standards, as measured by notices and orders issued, it is readily apparent what conditions and practices must receive much more attention from both the mine supervisor and the mine worker.

Suffice it to say the entire mining community, including the mine operator, the mine workers, and the various state and federal enforcement agencies should take a long hard look at the conditions and practices which these standards are designed to correct. These are the same conditions and practices that contribute to the occurrence of injuries and deaths.

Metal and Nonmetal Mining Fatalities

MESA investigates all known accidents involving fatal injuries in metal and nonmetal mines and mills. Formal reports are prepared and distributed on all fatalities determined to be chargeable to the mineral industries. The reports include general information about the operation, detailed description of the accident, and discussion of causes of the accident. The report also lists any orders and notices resulting from the investigation and includes recommendations to prevent recurrence.

Fatal injuries totaled 171 for 1973, compared with 234 for 1972 and 164 for 1971. Of the 1973 deaths, 47 were at underground mines, 94 were at surface mines—an increase from 70 of the previous year—and 30 at mills. Nationwide, the fatal frequency rate per million man hours worked was an estimated 0.38 for 1973, compared with 0.64 for 1972 and 0.32 for 1971. The loss of 91 men in the Sunshine mine fire disaster contributed to the higher total in 1972. Through September 30, 1974, fatalities totaled 112, compared to 137 on this date in 1973, a decrease of 18 per cent.

Machinery accidents accounted for 51 deaths in 1973, making it the leading cause of accidents in metal and nonmetal mining operations. Thirty-seven of the machinery-related deaths occurred at surface mining operations. The second leading cause of fatalities in 1973 was haulage accidents, which accounted for a total of 37 deaths at all mining operations, of which 23 were at surface mines. Taken together, these two causes contributed to more than half of all fatalities and nearly ⅔ of all surface mining fatalities during the year. It is certainly obvious where we must concentrate our efforts if we expect to reduce fatalities at metal and nonmetal mines and mills. Leading causes of fatalities so far in 1974 are similarly distributed.

Fall-of-ground accidents resulted in 22 deaths, 14 at underground mines and eight at surface mines, making it the leading cause of fatalities at underground mines and the third leading cause overall.

Slips and falls of persons accounted for 20 deaths, making it the fourth leading cause of fatalities. Nine of these were at surface mines.

Particularly disturbing was the occurrence of 16 deaths caused by electricity-related accidents; this was an increase from only five deaths from this cause in 1972, and four deaths in 1971.

Much remains to be accomplished: catastrophic occurrences must be eliminated; campaigns to combat fall-of-ground accidents at underground mines must be intensified; and much more attention must be directed toward the elimination of machinery and haulage accidents at surface mines, especially with regard to the ever increasing use of larger mobile loading and hauling equipment.

Memorandum of Understanding between OSHA and MESA

On April 22, 1974, MESA and OSHA entered into an agreement which clarifies the authority of each agency regarding areas of employee safety and health and provides a procedure to coordinate and adopt safety standards promulgated by the secretary of labor under the Occupational Safety and Health Act of 1970 (P.L. 91-596) which have significant application to working conditions in mines subject to the Federal Metal and Nonmetallic Mine Safety Act (P.L. 89-577). The purpose of this agreement was to strengthen the effective enforcement of health and safety standards by MESA under the Metal Act and OSHA under the Occupational Act.

This agreement provides that within six months after April 22, 1974, the secretary of the interior, after consultation with the secretary of labor, shall determine which standards promulgated under the Occupational Act may have significant application to working conditions in mines subject to the Metal Act and are not covered by mandatory standards promulgated under the Metal Act. The secretary of the interior shall then propose the adoption, modification, or revision of such standards in accordance with section 6 of the Metal Act. Also, the secretary of labor shall consult with the secretary of the interior prior to proposing future safety standards under the Occupational Act which may have significant application to working conditions in mines subject to the Metal Act. After such standards are promulgated by the secretary of labor, the secretary of the interior shall propose the adoption, modification, or revision of such standards under the Metal Act. MESA has made an initial determination of the standards involved, and we are looking forward to the promulgation of more new comprehensive standards as a result of this cooperative effort.

New Metal and Nonmetal Legislation

In my judgment there are basic legislative changes needed in the Federal Metal and Nonmetallic Mine Safety Act in order to improve administration and enforcement of this most important law. We are in the process of preparing draft suggestions in this area and, hopefully, they will be reviewed by appropriate departments for submission to the new Congress sometime early next year.

Expansion of the Federal Metal and Nonmetallic Mine Health and Safety Advisory Committee

On July 12, 1974, Secretary Morton announced the appointment of twelve persons to serve on the Federal Metal and Nonmetallic Mine Health and Safety Advisory Committee, (a thirteenth person was added in August 1974). In announcing the new appointments, Secretary Morton pointed out that the Committee was being expanded because a threefold increase of work was anticipated during 1974 as a result of increased emphasis placed by the Department on metal and nonmetal mine health and safety. The terms of the former nine-person committee expired May 31, 1974.

Conclusion

A major objective of a safety program is to achieve full cooperation of management, unions, employees, and enforcement agencies. Safety standards, company rules, and inspections cannot be totally effective unless all persons actively support the safety programs. Miners must be made to understand that their own actions are just as much a part of a safety program as the physical plant and equipment. Mining companies must realize that a total safety program not only results in fewer accidents but also in increased productivity.

As stated at the outset, the goal of MESA is to safeguard the health and safety of our nation's miners. MESA intends to continue to increase the number and improve the quality of inspections of all types of metal and nonmetal mining operations. Special attention will be directed toward those mines presenting special health and safety problems. Development of new or revised health and safety standards will continue as a major effort, with particular emphasis placed on upgrading good advisory standards to mandatory status.

MESA technical support functions and education and training programs will be directed at the major causes of accidents involving bodily injury or loss of life. Your cooperation in these efforts is essential if we are to expect a significant reduction in the occurrence of injuries and deaths at metal and nonmetal mines.

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SAFETY WITH WATER GEL EXPLOSIVES

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When nitroglycerine was discovered by the Italian scientist, Ascanio Sobrero, in 1846, he found its behavior so unpredictable and frightening that he actually warned against its use.

But the power unleashed by nitroglycerine was needed by a rapidly developing world. Nitroglycerine could do five times the work of black powder, and do it better. Man wanted the power of nitroglycerine to relieve him of his most back-breaking labor. Moreover, he needed that power to mine his minerals, build his highways and railroads, and dig the foundations for his buildings and bridges.

As a result, in 1866, when the Swedish inventor, Alfred Nobel, found that he could control the unstable power of nitroglycerine within "safe" limits by mixing it with kieselguhr, an absorbent diatomaceous earth, the world quickly grabbed at the new product, which Nobel called "dynamite."

However, nitroglycerine, which provided the desired energy needed by man, had two basic shortcomings: (1) it was relatively easy to detonate by accidental means, and (2) it produced headaches in handling and/or breathing post detonation fumes. Consequently, from the day dynamite was discovered, both the manufacturer and consumer have searched for a replacement product that would be safer to manufacture, transport, store, and use without headaches. Not until the late 1940's did non-cap sensitive blasting agents make a significant replacement impact on dynamite usage in large diameter blast holes — a significant breakthrough in safety.

In the mid-1950's, ammonium nitrate-fuel mixtures (NCNs), in packaged and bulk form, were developed and rapidly replaced dynamite; again, only in larger diameter blast holes. By the early 1960's, NCNs had essentially replaced all dynamite in all diameters where dry conditions prevailed. However, NCNs not only lacked water resistance but also lacked the density necessary to replace dynamite in tough shooting areas.

The introduction of water gels or slurried explosives in the 1960's was the answer for replacing dynamite in large diameters where tough shooting and wet conditions prevailed. This resulted in essentially the end of dynamite in sizes over four inches diameter. However, technology for small diameter water gels was slower in coming. Only in the last few years have technological breakthroughs resulted to now attack the small diameter dynamite replacement.

Yes, the introduction of water gels was really the beginning of the end for dynamite, because it not only offers advantages in safety, but also has the energy, density, and water resistance, as well as lending itself to handling systems in both bulk and cartridged products much more readily than dynamite.

Water gel explosives generally consist of a gelled ammonium nitrate-sodium nitrate solution with a sensitizer of TNT, flaked AL, smokeless powder, etc. These solid sensitizers were satisfactory for large diameter products; however, in small diameter the problems are more difficult, and more sophisticated sensitizers were required.

Recent technology has resulted in water soluble or water miscible liquid sensitizers that lend themselves to reliable sensitizing small diameter water gels. Such liquid sensitizers provide a continuous explosive medium, bringing all ingredients into more intimate contact than can be done with solid sensitizers.

While small diameter sensitivity requirements are greater than large diameter formulations, they still retain the safety advantages over dynamite as well as producing no headaches when handling.

Du Pont monomethylamine nitrate, commonly referred to as MMAN, is now being used to sensitize water gels down to one inch diameter. Du Pont markets their water gels under the trade name "Tovex" and feel that dynamite is now obsolete. Consequently, they have publicly announced that they intend to phase out dynamite and replace it 100 per cent with the "Tovex" by the end of 1976. Field consumption to date of approximately 60 million lbs. of small diameter "Tovex" shows it has performance characteristics at least equal to dynamite with an order of magnitude greater safety.

(There followed a series of slides to show safety tests conducted with water gels, as well as specially developed primer that is used with non-cap sensitive water gels.—Ed.)

Tests run to demonstrate resistance of water gels to accidental detonation do not imply that water gels or any other explosive are "safe." All explosive products are designed to detonate, and under the right conditions, they will.

However, the future of water gels must be considered excellent because of their improved safety, performance, and adaptability to unique handling devices. They will undoubtedly replace dynamite as the predominant product for breaking rock.

MAGIC OF FIRE

By JAY RODRIQUES
MESA, Tucson, AZ

Fire, as we all know, is a great help to mankind. Very little we have has come to us without being treated somehow with heat. Yet with all our vast technical knowledge and developments, almost 12,000 people in the United States died because of fires and burns and another 300,000 were hospitalized. What we hope to do here is show you what fire is, how it starts, and how to put it out, so that you can have this basic knowledge about fire and you can spread it to your family, friends, and fellow workers.

First of all, let us look at what makes up a fire. It takes three elements to have a fire start, much like a triangle.

1. Fuel: we must have some element that will burn. If we look around the room we will see that almost everything in the room will burn, so just about anything could be classified as a fuel.

2. Air: normal air consists of about 79 per cent nitrogen and 21 per cent oxygen. What we are concerned with is the 21 per cent oxygen; this is the level at which all fuels' flammability levels are based. If you have over 21 per cent oxygen, the fuel needs less heat to ignite than at the normal level. Also, most fuels will not ignite below 16.25 per cent oxygen.

3. Heat: the third leg of the triangle. As you can see, fuel and air are always mixed, so that leaves heat as the variable leg, the one that is usually controlled. But when the three of these are mixed in the right proportions, you are going to have a fire.

Let us look at the fuel leg a little closer. Here is a block of wood, and we all know wood is a fuel. Yet I can pass it through a flame and it does not readily ignite, does it? So we can say wood in solid form is not a fuel.

Here is a pan of solvent. We know that kerosene-based solvents burn, yet I can put this match out in it. So we can say that this solvent, in liquid form, is not a fuel.

But we know that both of these items are fuels and will burn. What we are trying to show you is that most items we call fuels will not ignite in a solid state. If we hold the wood in the fire, the heat will release the wood tar and turpentine vapors, and it is these items that ignite, not the solid part. The same applies to the solvent, which is a safe fuel at normal temperatures, but when you heat it, and its temperature reaches its flash point or above, it then gives off enough vapors to form a flammable mixture with air. All flammable liquids have a flash point.

Let us now look at a very common fuel we all work with almost every day, and that is gasoline. First of all, remember that I could put a match out in solvent at room temperature. Let us try it with gasoline. It ignites just as you get to the lip of the jar. The flash point of gasoline is —55° F, which means that anytime you have an open container of gasoline, you have an explosive mixture of vapors and air above it.

Another factor about gasoline is that its vapors are heavier than air, and whenever you have an open container of gasoline, the vapors flow over the top of it and down to the floor or work bench. This is how many gasoline fires are ignited, by the vapors flowing along the ground or floor to an ignition source such as a pilot light, open flame, etc.

One other characteristic of gasoline, and in fact all liquid and vapor fuels, is that they have an explosive range. That is, there is a minimum and a maximum amount of fuel needed to have an ignition. For example, gasoline has an explosive range of 1.4-7.6 per cent by volume; kerosene, 0.7-5 per cent; methane, 5.3-14 per cent; carbon monoxide, 12.5-74 per cent. You can see this as I ignite a spark down near the surface of this gasoline; it does not ignite because the vapors are above the upper limits of its range, but as I bring the spark up the vapors ignite as the spark reaches the explosive range.

The source of heat for the majority of building and other fires in the United States today is electrical. The causes vary from overloading circuits to old and worn parts; from deterioration of insulation to static electricity.

There are many safety measures today for electrical devices. One is overloading circuits. As electricity enters into a circuit, it passes through a safety device called a fuse or circuit breaker. This device allows a specific maximum amount of electricity into a circuit. If you ask for more electricity than the fuse will allow, the fuse will blow or the breaker will trip and stop any further flow of electricity into the circuit. This is a safety device as well as a warning device that you are calling for too much electricity to go through the circuit.

Many people bypass the system or put larger fuses in. When this is done, the wires heat up and sometimes start to burn. Use of electricity is something we all take for granted, but we should always respect it and its capabilities and inspect all the devices that use it.

One other area that is a hazard in the surface areas of mines is that of liquid petroleum gas, or LPG. A common LPG is butane, which has an explosive range of 1.9-8.5 per cent and is heavier than air. When a valve is left open, the vapors collect and move on the floor or ground.

Another source of flammable vapors that is very common at work and in the home comes from pressurized containers containing things such as hair spray, penetrating solvent, spray paint, etc.

So far I have dealt with how fires start; now I would like to go into how to extinguish fires. First, let us look at the types of fire. I have shown you three of the four classifications. Class A is fire with wood, cloth, paper, or rubber as a fuel. Class B is a fire of flammable liquid or gases. Class C is a fire of energized electrical equipment. Class D are fires which have combustible metals as a fuel.

To extinguish any of the above fires you must break any one leg of the fire triangle or a fourth leg which begins after the fire is started, and that is the chemical reaction leg. Once a fire has started, it chemically feeds itself. To break one of these legs, you can use many different methods: (1) heat leg—cool it; (2) fuel leg—remove it; (3) air leg—smother it; (4) chemical leg—inhibit it.

The type of extinguishing agent depends greatly upon the type of fire you have. Water, as an agent, works good only on Class A fires. Carbon dioxide works good on Class B and C fires. Dry chemicals work on Class B and C fires, with some special chemicals for Class A-B-C or just Class D fires.

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